INDIANA UNIVERSITY

University Graduate School
2009-2010
Academic Bulletin

Vision Science

School of Optometry
Bloomington

Director
Professor William H. Swanson*

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Graduate Faculty

(An asterisk [*] denotes membership in the University Graduate School faculty with the endorsement to direct doctoral dissertations.)

Professors
Carolyn B. Begley*, Joseph A. Bonanno*, Arthur Bradley*, Stephen A. Burns*, Robert DeVoe* (Emeritus), Ann E. Elsner*, David A. Goss*, S. Lee Guth* (Emeritus), Gary S. Hafner* (Emeritus), Gerald Eugene Lowther* (Emeritus), Victor E. Malinovsky, Edwin C. Marshall*, Paul Pietsch* (Emeritus), P. Sarita Soni*, William H. Swanson*, Larry Thibos*, Graeme Wilson*

Associate Professors
Clifford W. Brooks, T. Rowan Candy*, Ronald Everson* (Emeritus), Daniel R. Gerstman (Emeritus), Sally Hegeman (Emerita), Douglas G. Horner*, Don W. Lyon, Richard E. Meetz, Donald T. Miller*, S. P. Srinivas*, Suresh Viswanathan*

Assistant Professors
Shirin Hassan, Pete Kollbaum, Nicholas Port*

Academic Advisor
Professor William H. Swanson*, Optometry Building 504, (812) 856-4681

Degrees Offered

Master of Science and Doctor of Philosophy

Program Information and Requirements

The Vision Science Program is designed primarily for students wishing to prepare themselves for teaching and research in the sciences that relate to vision.

University Graduate School
Kirkwood Hall 111
Indiana University
Bloomington, IN 47405
(812) 855-8853
Contact: grdschl@indiana.edu

Admission Requirements
Course requirements are flexible to accommodate students with interests in vision science but with varying backgrounds. A bachelor's degree (or equivalent) is required. Course work with appropriate laboratories in the following areas is strongly recommended: optics, computing and engineering, physics, biology, mathematics through differential and integral calculus, statistics, and psychology of sensation and perception.

Degree Requirements
Students must demonstrate breadth of knowledge in vision science. This requirement is normally fulfilled by completion of V700 and V701 with a minimum grade of B in each course. Each semester, students are required to register for and participate in the weekly vision science seminar (V765) known as "Oxyopia." Participation implies that the seminar will be taken for credit and that the student will make a presentation. Students must complete ethics training, usually fulfilled by completion of V792.

Students commence their research training by joining an ongoing research project directed by a faculty member chosen by the student. The research topic will be formulated in consultation with the faculty member and an advisory committee. The topic may or may not be in the same field in which the student expects to do dissertation research.

Master of Science Degree

Course Requirements
A total of 30 credit hours is required, of which 15 credit hours must be didactic hours in vision science (or approved substitutes), generally excluding seminars. Students holding the O.D. degree or enrolled concurrently in the O.D. and M.S. programs may accelerate progress by receiving up to 4 graduate credit hours completed in the optometry curriculum. Students must complete courses that satisfy knowledge base in statistics, research design and vision science.

Research Requirements
Candidates must submit a written research report by the end of the first year in residence. Students enroll in a minimum of 3 hours of research credit per semester. A thesis research proposal must be submitted and approved by the end of the first year of study.

Thesis
Required.

Doctor of Philosophy Degree

Course Requirements
A total of 90 credit hours is required, of which 30 must come from didactic courses with grades of B or higher. Students holding the O.D. degree, or enrolled in the O.D. program, may apply up to 6 credit hours to this requirement of 30 didactic credit hours. When the grade point average of a student falls below 3.0, the student is placed on academic probation.

During the first year students will complete two Vision Science survey courses (V700 and V701).

Students will select at least one minor subject in any relevant field of study, subject to approval by their advisory committee. The requirements for the minor are determined by the department or program offering the minor. A specialized inter-departmental minor is also possible, if approved by the University Graduate School before classes are taken.

Vision Science Ph.D. Degree requirements:
In order to ensure adequate progress toward the Ph.D. degree, all students must achieve the following milestones at the end of years 1, 2, and 3 of the program.

Advancement to Second Year exam: At the end of the first year in the program each student must pass a written examination covering a wide selection of vision science topics in order to advance to the second year of the program. By this time, students should also have demonstrated an appropriate command of spoken and written English.

Advancement to Third Year: By the end of the second year all students should have identified the area of study and the specific experiments that will eventually constitute their Ph.D. thesis. This requirement will be met by submitting a formal abstract describing the proposed experiments to the Graduate Program coordinator. This abstract must be accompanied by written approval of the Ph.D. advisor.

Advancement to Candidacy: By the end of the third year, each student must complete a written and oral qualifying examination. These examinations are administered by the student's advisory committee. The written component is the dissertation proposal, and can be in the form of a grant application. The requirement of 30 credit hours of didactic course work must be fulfilled before the qualifying examination. After successful completion of the qualifying exam, each student will be advanced to candidacy for the Ph.D. degree. Participation in the Ph.D. program will be terminated if a student fails the qualifying examination twice.

The final milestone is completion of the dissertation.

Completion of Dissertation: After completion of the written dissertation, it is presented and defended at a scheduled seminar meeting. The dissertation must be approved by the student's research committee. The student is responsible for submitting the final approved dissertation to the University Graduate School.

IU Office of Research and University Graduate School (RUGS) provides a guide to the preparation of theses and dissertations. Related forms may be acquired from the IU School of Optometry Office of Student Administration.

Teaching: All doctoral students are required to participate in teaching, usually in the second or third year of their program.

Ph.D. Minor in Vision Science

Students from other departments who wish to minor in vision science should complete V700 and V701, Introduction to Vision Science I and II, and at least one other course from the following group: V705, V723, V754, V783, and V791.

Courses

General
V595 First-Year Research (1-5 cr.)**
V695 Second-Year Research (1-5 cr.)**

V700 Introduction to Vision Science I (4 cr.) The first of a two-semester sequence of courses that provides a comprehensive introduction to vision science. The course is designed for graduate students enrolled in the Vision Science Program, but is also suitable for students from other disciplines who are interested in the eye and vision.

V701 Introduction to Vision Science II (4 cr.) The second of a two-semester sequence of courses on vision science. V700 and this course constitute a breadth requirement for Ph.D. students in vision science.

V703 Refractive Anomalies I (3 cr.) Optics and epidemiology of refractive anomalies of the human eye.

V704 Refractive Anomalies II (3 cr.) Development, progression, and management of myopia.

V705 Ocular Surface I: Basic Biology and Physiology (4 cr.) Basic biology and physiology of the ocular surface, including the cornea, conjunctiva, and tear film.

V706 Ocular Surface II: Current Issues (4 cr.) Current issues affecting the ocular surface, including contact lenses, disease, and surgery.

V707 Retinal Imaging (2-3 cr.) The fundamental methods used in imaging the human retina will be examined, including types of illumination and delivery methods, optical techniques for detection, interaction of light and tissues, systems integration, and selection of imaging modalities based on scientific goals.

V716 The Visual Pathways (4 cr.) P: permission of the instructor. For students in the visual sciences, comprehensive study of the human optic pathways.

V717 Noninvasive Assessment of Visual Function (3 cr.) Focuses on the clinical application of psychophysical techniques for the detection and diagnosis of visual anomalies and ocular disease.

V718 Visual Functions in Low Vision (3 cr.) Studying behavioral aspects of visual function measurements in the low-vision population.

V723 The Eye as an Optical Instrument (4 cr.) P: V663 or equivalent.

V754 The Motility of the Eye (4 cr.) P: V665 or equivalent. Quantitative and qualitative study of eye movements and myologic reflexes, monocular and binocular, and related phenomena.

V764 Cellular and Molecular Aspects of Ocular Disease and Injury (4 cr.) Study of selected reports dealing with corneal-wound healing, the cataractous lens, and retinal degenerations.

V765 Vision Sciences Seminar (1 cr.) Students in the Ph.D. program in vision science are required to take this seminar and make a presentation annually.

V767 Electrophysiology of Vision (3 cr.) Review of techniques of recording neural events, development of a neural hypothesis, experimental testing of hypothesis, writing and presenting of data and conclusions.

V768 Special Topics in Vision Science (1-4 cr.) Covers topics not offered on a regular basis. Possible topics include cell and molecular biology as it relates to the eye and vision, comparative studies of the vertebrate eye, current research, experimental design, optical and ophthalmic instruments, pathology, and pharmacology. May be taken more than once when different topics are covered.

V773 Classics in Physiological Optics (1 cr.) Study of selected scientific articles of early contributors to our understanding of ocular motility, monocular and binocular functions, the optics of the eye, and ocular physiology.

V783 Monocular Sensory Aspects of Vision (4 cr.) P: V664 or equivalent. Analysis of visual stimulus and its perception in color, form, brightness, motion, etc.

V784 Binocular Sensory Aspects of Vision (4 cr.) P: V666 or equivalent. A study of perceptual phenomena and responses facilitated by binocular vision.

V785 The Vertebrate Eye (3 cr.) Comparative anatomy of the vertebrate retina. Primate retina used as a model. Accommodative mechanisms discussed. Laboratory exercises required.

V791 Quantitative Methods for Vision Research (3 cr.) Introduction to communication theory approach to problems in vision. Topics include the sensory nerve code, representation of nerve messages by orthogonal functions, sampling theorem, linear filters, Fourier analysis in one and two dimensions, analysis of directional data, stochastic processes, and signal detection theory.

V792 Ethical Issues in Scientific Research (1 cr.) This course explores the ethical issues and dilemmas raised by research in the biological sciences.

V793 Critical Evaluation of Peer Reviewed Publications in Vision Science (1 cr.) This course will provide experience to students to critically evaluate literature in the area of vision research. Students will meet for two hours each week for an eight week period. Evaluation will be based on attendance, reading assignments and class participation.

V795 Third-Year Research (3 cr.)**
V799 M.S. Thesis Research (1-10 cr.)

V801 Basic Experimental Design and Methods in Vision Science (3 cr.) An introduction to basic research skills in vision science.

V899 Ph.D. Dissertation Research (1-12 cr.)**

Doctor of Optometry Curriculum Courses

V501 Integrative Optometry I (2 cr.) Overall goal is to provide an integrated perspective of optometry in the paradigm of problem-based learning (PBL). The problems will be clinical cases that relate to the contents of courses taught contemporaneously in optics, biomedical, and ocular biology modules.

V502 Integrated Optometry II (2 cr.) Overall goal is to provide an integrated perspective of optometry in the paradigm of problem-based learning (PBL). The problems will be clinical cases that relate to the contents of courses taught contemporaneously in optics, biomedical, and ocular biology modules.

V512 Ocular Anatomy (2 cr.) P: V511 Human Gross Anatomy, or equivalent. A detailed study of the normal anatomy and embryology of the eye and its adnexa. The organization of various components of the eye is studied at the light and electron microscopic level and this organization is related to the molecular structure where it is known.

V514 Neuroanatomy (1.5 cr.) P: V511 Human Gross Anatomy, or equivalent. Functional anatomy of the human brain, with emphasis on the visual system.

V516 Ocular Physiology (2.5 cr.) C: V512 or equivalent. Vegetative physiology of the eye, with attention to the chemical constitution, intermediary metabolism, regulation of hydration and intraocular pressure, transparency of the ocular components, and retinal physiology.

V521 Geometric and Visual Optics I (4 cr.) Fundamentals of geometric and physical optics. Optical analysis of myopia, hyperopia and astigmatism. Components of the eyes and their optical properties. Clinical instrumentation for optical measurement and diagnosis of eyes.

V523 Geometric and Visual Optics II (4 cr.) P: V521 or permission of instructor. Continuation of application of the principles of geometric and physical optics to the optical description

and correction of the eye. Schematic optical models of the eye. Measurement of light. Higher-order aberrations and their impact on vision.

V540 Ocular Biology I (4.5 cr.) Head and neck neuroanatomy related to the normal functioning of the eye and visual system. Detailed anatomy/histology and physiology of the eye and adnexa. Maintenance of optical transparency and intraocular pressure. Phototransduction, retinal physiology, and the basis for the electroretinogram and electro-oculugram.

V542 Systems Approach to Biomedical Sciences I (4.5 cr.) First of a three semester sequence that presents basic science information organized into specific organ systems. The first module will cover common processes: basic biochemistry, cell and molecular biology, fundamentals of physiology, pharmacology, immunology/infection and oncology.

V543 Systems Approach to Biomedical Science II (4 cr.) Second of a three semester sequence which presents basic science information organized into specific organ systems. This module will discuss the structure, function, pathology and therapy for each organ system.

V550 Clinical Sciences I (3 cr.) Introduction to clinical history and interview techniques, health history content, and medical record documentation as applied to the optometric setting; optometric and medical terminology, interview techniques for special populations, legal aspects of medical records, differential diagnosis of visual symptoms, introduction to physical assessment, slit lamp biomicroscopy and ophthalmoscopy.

V551 Clinical Sciences II (4 cr.) Vision examination techniques, ocular diagnostic techniques, and theory and application of vision testing instrumentation, with emphasis on preliminary tests, refractive tests, and the ocular health exam; study of the principles involved in the measurement, epidemiology and treatment of ametropia, oculomotor imbalances and associated conditions.

V560 Vision Science I (3.5 cr.) This course provides an understanding of how visual performance is determined by the underlying biology of the eye and the brain. Topics include visual pathway neuroanatomy and physiology with special emphasis on the roles of receptive fields and neural sampling.

V601 Integrated Optometry 3 (2 cr.) Overall goal is to provide an integrated perspective of optometry in the paradigm of problem-based learning (PBL). The problems will be clinical cases that relate to the contents of courses taught contemporaneously in optics, biomedical, and ocular biology modules.

V602 Integrated Optometry 4 (2 cr.) Overall goal is to provide an integrated perspective of optometry in the paradigm of problem-based learning (PBL). The problems will be clinical cases that relate to the contents of courses taught contemporaneously in optics, biomedical, and ocular biology modules.

V648 Neurophysiology of Vision (1 cr.) Introduction to the functional organization of the visual system and the physiological basis of vision. This course treats the visual system as a biological image processor to reveal how the structure and function of the retina and brain determine visual performance and constrain the quality of vision.

V663 Physiological Optics I: Visual Optics (3.5 cr.) P: V522 Geometric Optics II, or equivalent. The eye as an optical instrument.

V664 Physiological Optics II: Visual Function (2.5 cr.) The basic aspects of monocular vision, including light and dark adaptation, color vision, and both spatial and temporal resolution. The science of measuring visual performance and its application to clinical optometry.

V665 Vision Science II: Ocular Motility (3.5 cr.) Characteristics, control, and deficits of the five somatic eye-movement systems (convergence, saccadic version, pursuit version, fixation maintenance, vestibular reflex) and the autonomic systems subserving accommodation and pupillary diameter reflexes.

V666 Physiological Optics IV: Binocular Function (2.5 cr.) Binocular sensory mechanisms of vision. Summary of the geometry of three-dimensional space and stereo vision, underlying neuroanatomy and physiology of binocular vision, prerequisites for normal stereopsis, and commonly encountered anomalies of binocular vision.

Relevant Courses

Biology
L586 Cell Biology (4.5 cr.)

Statistics
S501 Statistical Methods I: Introduction to Statistics (3 cr.)
S503 Statistical Methods IIb: Generalized Linear Models and Categorical Data (3 cr.)