

# Vision Science

Degree Offered:	PhD, MS, OD/MS
Program Director:	Michael Twa, OD, PhD
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## Program Information

Vision Science is a multidisciplinary field where basic scientists and clinicians focus on the discovery of new knowledge that will further our understanding of the eye and vision. This discovery includes virtually every scientific discipline where advances come from biologists, neuroscientists, optical engineers, epidemiologists, psychologists, optometrists, physicians and others.

The Vision Science Graduate Program at the University of Alabama at Birmingham provides comprehensive training for the next generation of leaders in vision science. Your decision to pursue graduate training in this program will place you at the center of one of the nation's top biomedical research institutions and will immerse you in collaborative multidisciplinary research environment that is today's model for biomedical research leadership. Moreover, our training environment will present opportunities for creative career paths such as dual degree programs with business, law and public health that will allow you to position yourself for a career as unique as your individual talents and interests.

## Admission and Financial Aid

Applications for admission to the graduate program in vision science are reviewed by the Vision Science Graduate Program Admissions Committee. Qualified students admitted to the program may receive financial assistance in the form of annual stipends, tuition support, scholarships, and student health insurance.

## Master of Science Degree

Two calendar years are generally required to complete the Master of Science degree (MS) in the Vision Science Graduate Program. Each candidate must complete a minimum of 30 hours of credit: 24 credit hours in vision science and 6 credit hours in related graduate courses. In addition, the candidate must successfully complete and defend a research thesis.

### Admission Requirements:

- GRE Required (subject tests are optional)
- TOEFL or IETLS tests required for international students (see program website for minimum scores)
- Undergraduate GPA of 3.0 on a 4.0 scale (B average)
- Strong background in the biological, physical or health sciences
- Three letters of recommendation

## Doctor of Optometry / Master of Science —Dual Degree

Selected students in the UAB optometry professional program are encouraged to combine the clinical doctorate degree with additional

research training in Vision Science. Financial assistance is available for qualified students. Potential candidates should have completed an undergraduate degree in a biological, physical, or health science field.

### Admission Requirements:

- See Master Degree Requirements
- OAT scores can be used in lieu of GRE requirement

## Doctor of Philosophy Degree

Doctoral research training leading to the PhD degree in vision science is based upon completion of graduate course work, a qualifying examination, research accomplishments, and successful defense of a dissertation. There is considerable flexibility in the coursework for the PhD in vision science. Each student is required to take the first-year core curriculum for their respective track, as well as courses in statistics and the ethical conduct of research. Students then take three additional courses, selected by the student in consultation with their academic advisor, which can include a wide range of interdisciplinary topics. Other graduate level courses can be substituted so that students can take maximum advantage of offerings in other programs at UAB. Individuals with previous clinical training will have opportunities for further clinical development and research integration. Students are also required to gain teaching experience.

### Admission Requirements:

- GRE Required (subject tests are optional)
- TOEFL and/or IETLS tests required for international students (see program website for minimum scores)
- Undergraduate GPA of 3.0 on a 4.0 scale (B average)
- Strong background in the biological, physical or health sciences
- Three letters of recommendation

## Additional Information

Deadline for Entry Term(s):	Summer and Fall (No Spring admission)
Deadline for All Application Materials to be in the Graduate School Office:	January 15th
Number of Evaluation Forms Required:	Three
Entrance Tests:	GRE (TOEFL and TWE also required for international applicants whose native language is not English.) OAT is considered for combined degree programs, e.g. OD/ MS.
Web site:	<a href="http://www.uab.edu/vsgp/">http://www.uab.edu/vsgp/</a>

For detailed information, contact the graduate program manager, Dr. Stefanie Varghese, UAB School of Optometry Vision Science Graduate Program, HPB 516, 1720 2nd Ave S., Birmingham, AL 35294-4390 (office location: Henry Peters Building, Room 516, 1720 University Blvd.).

Telephone 205-934-6743

E-mail [sbvarghese@uab.edu](mailto:sbvarghese@uab.edu)

Web <http://www.uab.edu/vsgp/>

## Courses

### **VIS 600. Clinical Vision Science Literature Review. 1 Hour.**

Review, critical analysis and discussion of foundational literature and current topics in clinical vision science and evidence-based practice.

### **VIS 601. Fundamentals of Clinical Research. 2 Hours.**

Introduction to fundamental principles of clinical research including: framing research questions, structured literature reviews, study design, sources of bias and their control, presentation and publication of research findings.

### **VIS 610. Ocular Anatomy and Biology. 4 Hours.**

Anatomy, biochemistry, physiology, cellular and molecular biology of ocular tissues.

### **VIS 611. Biology and Pathology of Ocular Disease. 4 Hours.**

Overview of ocular disease and pathology of the visual system including disease mechanisms and treatments.

### **VIS 612. Optics for Vision Science. 4 Hours.**

Advanced topics in optics related to the eye and vision including paraxial, wave, and quantum optics, light safety, refraction, reflection, aberrations, interference, diffraction, polarization, Fourier optics, lasers, and fluorescence. The course will include applications for optical system design, biomedical imaging, microscopy, and clinical assessment of the eye and visual system.

### **VIS 613. Visual Neuroscience. 4 Hours.**

Vision begins with photons and ends in the brain. How does it all work? This course introduces the student to the anatomical and physiological underpinnings of visual perception, stepping from single photoreceptors in the retina on through the cortical neural circuits devoted to capturing every facet of seeing the world. Lectures are supplemented with hands-on sessions where students can test their own vision.

### **VIS 615. The Body Electric: Electronics for Biologists. 3 Hours.**

This course provides an overview of the fundamental concepts of electronics that are relevant to a biologist. The material is aimed at non-engineers who require a background in the circuit concepts needed for studying ion channels, electrophysiology, proper use of amplifiers and filters, and the use of computers to acquire and analyze data. There will be a mix of formal lectures and problem sets with practical hands-on experience.

### **VIS 670. Intermediate Orientation and Mobility Skills. 3 Hours.**

Development of teaching skills in orientation and mobility in semi-independent settings with multihandicapped and blind students.

### **VIS 671. Intermediate Orientation and Mobility Seminar. 3 Hours.**

Recent research practices and problem areas in special education. Focus on intermediate orientation and mobility for multihandicapped and blind students.

### **VIS 672. Advanced Orientation and Mobility Skills. 3 Hours.**

Advanced orientation and mobility teaching techniques for travel in independent settings for multihandicapped and blind students.

### **VIS 673. Advanced Orientation and Mobility Seminar. 3 Hours.**

Recent research practices and problem areas in special education. Focus on advanced orientation and mobility for people with multiple handicaps and blindness.

### **VIS 674. Orientation and Mobility Internship. 3-6 Hours.**

Demonstrate skills in applying principles of special methods of teaching, designing instruction, conducting skills assessments, and in preparing written reports, and consulting and collaborating with professionals and parents to assure orientation and mobility programming for students with visual impairments.

### **VIS 698. Master's Level Non-Thesis Research. 1-15 Hour.**

Lab/research hours for master's students who have not entered into candidacy.

### **VIS 699. Master's Level Thesis Research. 1-15 Hour.**

Lab/research hours for master's students who have entered into candidacy.

**Prerequisites:** GAC M

### **VIS 700. Vision Research Literature Review. 1 Hour.**

Review, analysis, and discussion of foundational literature and current topics in basic and translational vision science.

### **VIS 701. Principles of Research. 2 Hours.**

Principles and fundamentals of scientific thinking and practice including: framing the research question, critical thinking, literature review, use of modern information resources, experimental design, sources of bias and their control, reproducibility, presentation and publication of research findings, and case studies in failures of the scientific method.

### **VIS 702. Fundamental Techniques in Vision Science. 4 Hours.**

This course is designed to provide graduate students with an overview of common laboratory techniques, both basic science techniques and clinical techniques, used in vision research.

### **VIS 703. Matlab: Imaging and Image Processing. 3 Hours.**

This course is designed to provide graduate students with an introduction to the use of Matlab and its capabilities for analysis and quantification of image data. Students will learn the fundamentals of Matlab and the unique challenges of working with image data types.

### **VIS 704. Visual Communication for the Sciences. 3 Hours.**

A workshop to develop visual communication skills using commonly encountered data in the quantitative sciences. Emphasis will be on the creation of clear figures that aim to appear in the professional literature.

### **VIS 705. Microscopic Anatomy of the Retina and Central Visu. 3 Hours.**

### **VIS 710. Ocular Biochemistry and Molecular Biology. 3 Hours.**

Ocular Biochemistry.

### **VIS 714. Ocular Biomechanics. 3 Hours.**

This interdisciplinary course provides upper-division graduate students exposure to scientific principles and practices related to the biomechanics of soft-tissues and the eye. Knowledge of basic histology and ocular anatomy is assumed. The course will include lecture and laboratory exercises.

### **VIS 717. Research Ethics for the Clinician Scientists. 3 Hours.**

Training in the principles of scientific integrity and research ethics with specific emphasis on issues encountered by clinician scientists engaged in clinical research (e.g. human subjects research, clinical trials, data safety monitoring, etc.).

### **VIS 729. Introduction to Neurobiology/Marine Biology. 4 Hours.**

### **VIS 743. Optics and Imaging. 3 Hours.**

Optical properties of the eye. Transparency, aberrations, modulation transfer functions of the eye. Use of coherent optics (lasers) in vision research. MRI in vision research.

### **VIS 744. Ocular Anatomy, Physiology and Biochemistry of Anterior Serment. 3 Hours.**

Anatomy of the eye. Biochemistry and physiology of ocular tissues, including tears, cornea, aqueous humor, lens, vitreous and sclera.

### **VIS 745. Ocular Anatomy-Physiology and Biochemistry II. 3 Hours.**

Continued examination of ocular anatomy, biochemistry and physiology.

**VIS 755. Electronic for Biologists. 3 Hours.**

This course provides an overview of the fundamental concepts of electronics that are relevance to a biologist. The material is aimed at non-engineers who need a background in the circuit concepts needed for studying ion channels, electrophysiology, the basics of the proper use of amplifier and filter, and the use of computers to acquire and analyze data. There will be a mix of formal lectures and problem set with practical hands-on experience.

**VIS 756. Visual Neuroscience. 4 Hours.**

Vision begins with photons and ends in the brain. How does it all work? This course introduces the student to the anatomical and physiological underpinnings of visual perception, stepping from single photoreceptors in the retina on through the cortical neural circuits devoted to capturing every facet of seeing the world. Lectures are supplemented with hands-on sessions where students can test their own vision.

**VIS 757. Functional MRI. 3 Hours.**

In this course, we will explore the history of fMRI, design of fMRI experiments, and the analysis of fMRI data. We will also discuss several related techniques that are used in neuroimaging research. When designing fMRI experiments, it is important to know what techniques and statistical methods are available. It is also important to understand the kinds of hypotheses that can be tested with fMRI. By the end of this class, students will understand what led to the development of fMRI, when to use fMRI or related methods, limitations of experiments involving this technology, and different techniques for analyzing fMRI data. This class will be 'hands-on'; each student will be required to design and execute an fMRI experiment.

**VIS 760. Sensory Impairment Lit Review. 1 Hour.**

Sensory Impairment and Deafblind literature review and presentation.

**VIS 770. Advanced Graduate Seminar in Ocular Biology. 1-3 Hour.**

Advanced graduate seminar in biology of the eye and visual system that will include critical review analysis, and discussion of fundamental literature and current topics.

**VIS 771. Advanced Graduate Seminar in Ocular Surface. 1-3 Hour.**

Review, analysis and discussion of current literature topics of ocular surface physiology and disease.

**VIS 772. Advanced Graduate Seminar in Cornea and Anterior Segment. 1-3 Hour.**

Advanced graduate seminar on topics related to the cornea and anterior segment that will include critical review and discussion of fundamental literature and current topics.

**VIS 773. Advanced Graduate Seminar in Retinal Research. 1-3 Hour.**

Advanced graduate seminar on topics related to retinal research that will include critical review, and discussion of fundamental literature and current topics.

**VIS 774. Advanced Graduate Seminar in Visual Neurobiology. 1-3 Hour.**

Advanced graduate seminar in visual neurobiology that will include critical review and discussion of fundamental literature and current topics.

**VIS 775. Advanced Graduate Seminar in Ocular Motor Systems. 1-3 Hour.**

Advanced graduate seminar in ocular motor systems that will include critical review analysis, and discussion of fundamental literature and current topics.

**VIS 776. Advanced Graduate Seminar on Refractive Error. 1-3 Hour.**

Advanced graduate seminar on topics related to refractive error, ocular growth, and development that will include critical review, and discussion of fundamental literature and current topics.

**VIS 777. Advanced Graduate Seminar in Public Health and Vision. 1-3 Hour.**

Advanced graduate seminar on topics in public health issues with a focus on visual disorders that will include critical review and discussion of fundamental literature and current topics.

**VIS 778. Advanced Graduate Seminar on Vision Rehabilitation. 1-3 Hour.**

Advanced graduate seminar on topics in visual rehabilitation, orientation and mobility that will include critical review and discussion of fundamental literature and current topics.

**VIS 779. Advanced Graduate Seminar in Interdisciplinary Sciences. 1-3 Hour.**

Advanced graduate seminar on topics related to research that spans faculty and student interests across traditional academic disciplines or boundaries. The course will include critical review, and discussion of fundamental literature and current topics relevant to the participants.

**VIS 790. Individual Topics and Advanced Topics. 1-3 Hour.****VIS 798. Doctoral Level Non-Dissertation Research. 1-15 Hour.**

Lab/research hours for doctoral students who have not entered into candidacy.

**VIS 799. Doctoral Level Dissertation Research. 1-15 Hour.**

Lab/research hours for doctoral students who have entered into candidacy.

**Prerequisites:** GAC Z