

# M.S. IN VISION SCIENCE AND INVESTIGATIVE OPHTHALMOLOGY

## Overview

The **Master of Science in Vision Science and Investigative Ophthalmology (MVSIO)** at the University of Miami is an innovative program, the first of its kind in the world, which offers comprehensive training in ophthalmic translational research, problem-based learning, management, and a skill set available only at Bascom Palmer Eye Institute.

The MVSIO program focuses on science and laboratory research, including the disciplines of electrophysiology, biochemistry and molecular biology, as well as exposure to ocular clinical details and ocular pathology. It will prepare students with furtherance of their careers in vision science and investigative ophthalmology.

In addition, the multidisciplinary program builds management, administrative and entrepreneurial skills for professionals desiring a vision science-oriented career in medical practice, startup companies, management of non-profit organizations, academic practices, government regulatory agencies, and medical device and pharmaceutical companies. Led by Bascom Palmer Eye Institute's world-class faculty and supported by leading-edge technology, the MVSIO program opens the door to new career opportunities for medical school graduates, clinicians and other professionals.

For five decades, many of the most important innovations that have revolutionized global ophthalmology have come from Bascom Palmer Eye Institute. Bascom Palmer is recognized as one of ophthalmology's foremost resources providing advanced patient care, vision research and education. As the Department of Ophthalmology at the University of Miami Leonard M. Miller School of Medicine, it is committed to the protection and preservation of the treasured gift of sight.

## Admission Requirements

All individuals with strong background education in biology, biochemical, or biological sciences are eligible to submit an application; having taken courses in anatomy and physiology is advantageous. We strongly encourage the following to apply:

- Candidates with medical degrees (M.D.) from U.S. or foreign institutions.
- Candidates who have a bachelor's degree in experimental sciences encompassing any area of biological or biochemical sciences, provided they have the equivalent of a 3.5 or higher grade point average.
- Students with a cumulative grade point average of 3.5 and above (or U.S. equivalent) in their undergraduate degree, provided they have relevant work experience.
- Medical degree students: Step 1 United States Medical Licensing Examination (USMLE) - score greater than 245 is preferred.

## Curriculum Requirements

Code	Title	Credit Hours
Core Courses		
OPH 610	Anatomy and Physiology of the Eye	1
OPH 615	Pathology of Eye Diseases	1
OPH 620	Ocular Pharmacology, Epidemiology, and Biostatistics	1
OPH 625	Microbiology and Immunology of the Eye	1
OPH 630	Ophthalmic Genetics	1
OPH 635	Electrophysiology of the eye	1
OPH 640	Vision and Optics	2
OPH 645	Biochemistry, Cellular and Molecular Ophthalmology	2
Laboratory Courses		
OPH 661	LAB: Basic Biochemistry, Microbiology, and Pathology	3
OPH 662	Lab: Basic and Applied Optics and Statistics	1
OPH 663	Lab: Electrophysiology, Clinical Testing and Applications	1
Problem-Based Learning		
OPH 771	PBL: Advanced and High Throughput Approaches in Science	2
OPH 772	PBL: Management skills and Tools for Academia and Enterprises	2
OPH 773	PBL: Animal Models, Regulatory issues, and Research Methods	2
Electives		
OPH 691	Clinical Ophthalmology Update	2
Thesis		

OPH 810	Ophthalmology Research Thesis	7
<b>Total Credit Hours</b>		<b>30</b>

## Suggested Plan of Study

Year One		Credit Hours
<b>Fall</b>		
OPH 610	Anatomy and Physiology of the Eye	1
OPH 615	Pathology of Eye Diseases	1
OPH 620	Ocular Pharmacology, Epidemiology, and Biostatistics	1
OPH 625	Microbiology and Immunology of the Eye	1
OPH 630	Ophthalmic Genetics	1
OPH 645	Biochemistry, Cellular and Molecular Ophthalmology	2
OPH 661	LAB: Basic Biochemistry, Microbiology, and Pathology	3
OPH 771	PBL: Advanced and High Throughput Approaches in Science	2
<b>Credit Hours</b>		<b>12</b>
<b>Spring</b>		
OPH 635	Electrophysiology of the eye	1
OPH 640	Vision and Optics	2
OPH 662	Lab: Basic and Applied Optics and Statistics	1
OPH 663	Lab: Electrophysiology, Clinical Testing and Applications	1
OPH 772	PBL: Management skills and Tools for Academia and Enterprises	2
OPH 773	PBL: Animal Models, Regulatory issues, and Research Methods	2
<b>Credit Hours</b>		<b>9</b>
<b>Year Two</b>		
<b>Fall</b>		
OPH 691	Clinical Ophthalmology Update	2
OPH 810	Ophthalmology Research Thesis	4
<b>Credit Hours</b>		<b>6</b>
<b>Spring</b>		
OPH 810	Ophthalmology Research Thesis	3
<b>Credit Hours</b>		<b>3</b>
<b>Total Credit Hours</b>		<b>30</b>

## Mission

By training graduate students in research, research management skills and enterprise management, the goal of the MVSIO degree is to educate the next generation of leaders in vision science.

## Goals

Consistent with the university's strategic vision, the goals of the programs are:

- Train Master's students in research and research management skills; and
- Prepare students for a future PhD-level program in Vision Science and investigative Ophthalmology.

## Student Learning Outcomes

- **By training graduate students in research, research management skills and enterprise management, the goal of the MVSIO degree is to educate the next generation of leaders in vision science, including:**
- **Science graduates who want to extend their intellectual horizons**
- **College graduates who intend to improve their medical education prior to entering medical school**
- **Professionals in industry, academic research settings, regulatory bodies and philanthropic organizations**
- **Prospective entrepreneurs in the growing field of vision care**

- Medical school graduates interested in joining an ophthalmology residency program
- Clinician and non-clinician graduates with medical degrees from foreign countries

**OPH 610. Anatomy and Physiology of the Eye. 1 Credit Hour.**

This course introduces the major anatomical and physiological regions of the eye, including cornea, lens, retina, optic nerve, cranial nerves and extraocular tissues. Emphasis is placed on the relationship between the eye and others systems. Demonstrations include eye dissection, visual testing and visual perception experimentation.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Fall.

**OPH 615. Pathology of Eye Diseases. 1 Credit Hour.**

This course covers in detail the major pathologies of the eye, including congenital diseases and syndromes, infectious diseases, tumors and adult-onset degenerations. Emphasis is placed on pathophysiological mechanisms contributing to pathology, and also covers examination of the eye, diagnostic features, and management of major eye diseases. Demonstrations include histological sections, OCT, visual field and angiogram, and associated diagnostic criteria.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Fall.

**OPH 620. Ocular Pharmacology, Epidemiology, and Biostatistics. 1 Credit Hour.**

Course will teach local anesthetics, anti-infectious, anti-allergic agents, control of ocular pain, adverse ocular and systemic reactions caused by therapeutic agents will be part of the course. Ocular therapeutic principles (pharmacokinetics and pharmacodynamics, toxicity), sources of drug information, new drug development, drug regulations as applicable to different areas of operation including prescription writing will be discussed. An introductory course in epidemiologic and biostatistics methodology covering study design for investigation of both infectious and chronic diseases of the eye; screening programs and health services research will also be discussed. Outbreak investigation, natural history of infectious diseases, validity of clinical tests, survival analysis, and clinical trial and etiologic studies will be discussed. Methods of biostatistician evaluation of experiment design and analyses of data to decipher significant from non-significant results and general tools for statistical analyses will be reviewed.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Fall.

**OPH 625. Microbiology and Immunology of the Eye. 1 Credit Hour.**

Students will learn concepts and terminologies of immunology, bacteriology, virology, parasitology and mycology with an emphasis on mechanisms of microbial disease transmission and host defense mechanisms. Students become familiar with the types of organisms responsible for human disease, the mechanisms by which they produce disease, and the application of this knowledge to the treatment of patients. This course integrates the biomedical disciplines of immunology and medical microbiology. Infectious and immunological diseases with relevance to the clinical setting and pharmacological approaches will be presented. A basic understanding of the classification and characteristics of infectious microorganisms, the mechanisms by which infectious agents cause disease, and methods of both prevention and treatment are highlighted. Causes and treatment of immune diseases will also be presented. Concepts of inflammation, sepsis, cell injury, tissue repair, hemodynamic disorders, genetic disorders, environmental and nutritional pathology, immunodeficiency diseases, autoimmune and metabolic diseases will be presented. Throughout the course, small group tutorials and interactive clinical correlations based on clinical cases linking basic science concepts to clinical medicine will be presented. Tutorials, clinico-pathological correlations and laboratories emphasize problem-solving skills, integration of knowledge and independent learning.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Fall.

**OPH 630. Ophthalmic Genetics. 1 Credit Hour.**

This course provides an overview of the influence of genetics in ophthalmology with respect to understanding pathogenic mechanisms of eye diseases, and the development of novel therapeutic strategies. The course will provide an introduction to complex and Mendelian genetics, and research strategies involved in identifying disease-associated genetic changes. Specific topics include hereditary retinal diseases, genetic associations in age related macular degeneration and glaucoma, genetics of myopia and optic nerve diseases, and mitochondrial disorders affecting the eye. Additional discussions include current gene therapy clinical trials.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Spring.

**OPH 635. Electrophysiology of the eye. 1 Credit Hour.**

This course will introduce the basic principles of electrophysiology of the eye, identify neural signals, neurotransmitters, molecular signaling within neurons. Additionally, the sensation and sensory systems. Emphasis is placed on the relationship between the eye and other signals and senses.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Spring.

**OPH 640. Vision and Optics. 2 Credit Hours.**

This course will provide an introduction to the principles of geometrical optics and its application to the study and assessment of the visual system. Topic covered will include fundamental of geometrical optics, principles of optical system components (lenses, mirrors, prisms, light sources), optics of the eye and vision correction, basic principles of visual optical instruments (loupe, microscopes, telescopes), and principles and applications of ophthalmic diagnostic and imaging systems, including ophthalmoscopes, retinoscopes, slit-lamp, keratometers, corneal topography systems, aberrometers and optical coherence tomography.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Spring.

**OPH 645. Biochemistry, Cellular and Molecular Ophthalmology. 2 Credit Hours.**

An introduction to biochemistry with emphasis on ocular clinical applications. Topics will include nutrition, cellular biology, biochemistry of tears, conjunctiva, and cornea. The structure and functions of proteins and enzymes as well as metabolism of carbohydrates and lipids will be discussed. Case studies and journal articles will be used to demonstrate the useful applications of these principles to ocular health-related issues.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Fall.

**OPH 661. LAB: Basic Biochemistry, Microbiology, and Pathology. 3 Credit Hours.**

Experiments related to molecular biology (includes PCR, DNA cloning, hybridization analysis, restriction mapping, and DNA sequence analysis), protein purification and analysis (salt fractionation, ion exchange chromatography, affinity chromatography, SDS-PAGE, and immuno-blotting), and determination of enzyme kinetic parameters.

**Components:** LAB.

**Grading:** GRD.

**Typically Offered:** Fall.

**OPH 662. Lab: Basic and Applied Optics and Statistics. 1 Credit Hour.**

This laboratory course serves as a companion to the Vision and Optics course. It will include practical hands-on examples of the application of geometrical optical theory to the design and calculation of optical systems, provide an initial hands-on experience with basic optical system setup on an optical bench, and provide basic hand-on training or demonstration of ophthalmic diagnostic techniques and instruments, including refraction, ophthalmoscopy, retinoscopy, slit-lamp examination, aberrometry, corneal topography and optical coherence tomography.

**Components:** LAB.

**Grading:** GRD.

**Typically Offered:** Spring.

**OPH 663. Lab: Electrophysiology, Clinical Testing and Applications. 1 Credit Hour.**

This laboratory work will introduce the students to novel clinical recording techniques, electrophysiologic tests, and clinical applications of ERG, EOG, and VEP. Emphasis is placed on novel and specialized clinical applications and recordings. The course will be divided in two sections. Section one ends with focus on the effects of maturation, aging, and testing in infants. Section two will conclude with electrophysiologic findings of many clinical conditions and clinical applications of ERG, EOG, and VEP of various eye disorders/diseases.

**Components:** LAB.

**Grading:** GRD.

**Typically Offered:** Spring.

**OPH 691. Clinical Ophthalmology Update. 2 Credit Hours.**

Society, Science and Medicine. History and evolution of medicine, Seminars on different aspects of medicine including a broad spectrum view of career options. The emphasis will be how medicine has been developed historically, its efficacy, and the future outlook. For example, antibiotic resistant bacteria was discovered in 12,000 year old underground caves that makes us realize that antibiotic resistance is an old problem and we need to have an outlook bearing that in mind. .

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Fall.

**OPH 771. PBL: Advanced and High Throughput Approaches in Science. 2 Credit Hours.**

The Problem-Based Learning Method (PBL) was designed to teach students in small groups to identify specific techniques that will yield the answers to the problems. Content will include the underlying norms and principles that shaped these concepts. The courses also include plenary session presentations by experts on relevant topics and their use in preparing manuscripts and grant applications and policies regarding conduct of experiments using these techniques.

**Components:** ENS.

**Grading:** GRD.

**Typically Offered:** Fall.

**OPH 772. PBL: Management skills and Tools for Academia and Enterprises. 2 Credit Hours.**

This Problem-Based learning course will introduce grant writing, pre-award preparation, post-award management and will be taught using problem-based modules. Federal and non-federal extramural grants will be used as modules specific aspects of different segmental grants will be presented. Major research grant, training and fellowships, grants-in-aid will be taught. In addition, small business innovation research (SBIR) or STTR will be covered. Students will learn techniques to analyze markets, identify optimal opportunities, develop plans to sell their vision in order to attract talent and stakeholders. A series of problem-based lectures integrates modern business concepts from an entrepreneurial approach.

**Components:** ENS.

**Grading:** GRD.

**Typically Offered:** Spring.

**OPH 773. PBL: Animal Models, Regulatory issues, and Research Methods. 2 Credit Hours.**

Part I: The aim of this Problem-Based learning course is to provide students the basic understanding and expertise pertaining to generation and implementation of preclinical research IACUC protocol. This course consists of a problem based learning module with a focus on developing students' understanding of various animal models in preclinical research and how to refine animal research models that meet the requirement of IACUC regulation. Part II: The purpose of this course is to provide clinical research regulatory expertise with an aim to create future leaders in the drug development industry. This regulatory science course uses a multidisciplinary approach and encompasses course work in regulatory writing techniques, quality systems, and medical device and pharmaceutical regulation. The concentration is designed to develop the student's understanding of how to meet regulatory oversight requirements as they relate to the conduct of clinical studies. This course will prepare students to play critical roles throughout the lifecycle of pharmaceuticals, medical devices, and biologics. They provide strategic, tactical and operational direction, and support for working within regulations to expedite the development and delivery of safe and effective healthcare products to individuals around the world. The regulatory professional's services can be utilized in research and development, clinical trials, extension of premarket approvals, manufacturing, labeling and advertising, and post-market surveillance. Knowledge of clinical research conduct and management which involves the design, execution and management of clinical trials as well as quality assurance and compliance principles are important to regulatory professionals. Course also provides highlight on how to effectively partner with experts such as writers drafting pre- and post- approval regulatory FDA submission documentation (INDs, NDAs, PMAs etc.) for product clearance or licensure, IRB reviewers and investigational Pharmacists to enhance the development of healthcare products.

**Components:** ENS.

**Grading:** GRD.

**Typically Offered:** Spring.

**OPH 810. Ophthalmology Research Thesis. 1-7 Credit Hours.**

The course allows the student to work full-time on a research project of interest under the supervision of research/clinical faculty or a team of faculty members.

**Components:** THE.

**Grading:** SUS.

**Typically Offered:** Fall.