

**GRADUATE
PROGRAM
HANDBOOK**

VISION
SCIENCE

**COLLEGE OF OPTOMETRY
THE OHIO STATE UNIVERSITY**

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1. Purpose of the Handbook

The purpose of this handbook is to describe the policies, rules and procedures of the graduate program in Vision Science, and particularly to define distinctions between the information relating to this program and the general information already described in the *Graduate School Handbook*. This version applies to students who will graduate beginning in autumn 2011 and beyond.

2. Goals of the Program

The goals of the graduate program in Vision Science are:

- a) To train researchers in the latest and most effective approaches for solving vision science problems;
- b) To train educators for professional programs that train eye care providers; and
- c) To produce scientists for the conduct of vision science in military, government, industrial and other professional settings.

3. Relationship between the Graduate School and the Research and Graduate Studies Committee

- a) The Graduate School of The Ohio State University includes faculty members authorized to provide graduate instruction, the graduate faculty, the Graduate Council, and the administration. The Graduate Council is the principal legislative body of the Graduate School and initiates policies and rules governing Graduate Programs. The policies, rules, procedures and general information concerning graduate education and research at The Ohio State University are embodied in the *Graduate School Handbook*.
- b) The Research and Graduate Studies Committee administers the Graduate Program in Vision Science. This committee oversees and administers the Graduate Program and serves as the liaison between the Graduate School and the graduate faculty members. The responsibilities of the Research and Graduate Studies Committee are described in detail in the *Graduate School Handbook* (<http://www.gradsch.ohio-state.edu/graduate-school-handbook1.html>). They include but are not limited to: monitoring courses proposed for graduate credit; establishing procedures for assigning advisors; appointing graduate faculty; reviewing graduate faculty membership; making recommendations on student admissions; monitoring student progress; and establishing rules and procedures for the conduct of Master's Examinations, Candidacy Examinations, and Final Oral Examinations. The Research and Graduate Studies Committee is appointed by the College of Optometry Dean from the Category P, tenured graduate faculty in Vision Science.
- c) The Committee publishes this *Graduate Program Handbook* embodying the policies, rules, and procedures of the program.

4. Admission, Registration and Scheduling

- a) The admission criteria that are outlined in the *Graduate School Handbook* apply to the graduate program in Vision Science. The Research and Graduate Studies Committee evaluates the applicant's credentials and admits graduate students to the Graduate Program in Vision Science by a simple majority vote of the Committee.
- b) The admission procedure is a competitive process that examines the applicant's overall undergraduate/professional grade point average (GPA), Graduate Record Examination (GRE) results (required of all applicants), and other qualifications. Admissions assessments may also include publications, scores on the National Board of Optometry examinations, and professional and research experience.
- c) The Research and Graduate Studies Committee may elect to conduct an interview with the applicant.
- d) A limited number of Graduate Teaching Associate (GTA) positions are available in the College of Optometry. Students will be notified at the time of the offer of admission whether he/she will receive a GTA position and for what period of time. The conditions of the GTA position are described in Section 10 of this manual.
- e) Likewise, Graduate Research Associate (GRA) positions are sometimes available on the College of Optometry, typically funded through individual faculty members' extramural funding. Students will be notified at the time of the offer of admission whether he/she will receive a GRA position and for what period of time. The conditions of the GRA position are described in Section 10 of this manual.
- f) Applicants are normally expected to have completed an appropriate baccalaureate degree or a Doctor of Optometry degree at an institution accredited by the Association of Schools and Colleges of Optometry to be considered for the program. Other potential applicants should make inquiry directly to the chair of the Research and Graduate Studies Committee to determine their eligibility.
- f) Registration and scheduling requirements, including course loads for Graduate Associates, are commensurate with the conditions outlined in section II.2 of the *Graduate School Handbook*. Procedures for determination of course credit and the general setting of academic standards comply fully with the descriptions in the respective sections of the *Graduate School Handbook*.

5. Advisors and Committees

- a) Advisors are selected by the graduate student with consent of the selected advisor. The Research and Graduate Studies Committee Chair serves as the interim advisor for all graduate students prior to selection of a regular advisor. The advisor must be selected prior to beginning thesis/dissertation research or undertaking any VS 999 coursework.

- b) The student and advisor are responsible for selecting the student's schedule. The advisor is responsible for proposing the composition of examination committees and chairs all such committees.
- c) A student is expected to participate actively in the ongoing research program of the laboratory of his or her selected advisor.
- d) The student is expected to monitor his or her own progress and adherence with all Graduate School and Graduate Program in Vision Science requirements and timelines for admission, course enrollment, course requirements, credit hour requirements, examinations, and graduation.
- e) A student enrolled in any degree-seeking capacity in the Graduate Program in Vision Science may, without prejudice, request a change of advisor by writing to the Research and Graduate Studies Committee. The Research and Graduate Studies Committee and the student must concur on the particular choice of the new advisor. A change of advisor does not reset time limits defining adequate "academic progress" except at the discretion of the Research and Graduate Studies Committee.

6. Description of Fields of Study

Vision Science is the science concerned with the study of all aspects of the eye or the visual system. Among the active research programs within The Ohio State University's graduate program in Vision Science are:

- (1) geometrical and physical optics (e.g., the study of ophthalmic and ocular optics);
- (2) ocular development (e.g. etiology of refractive error and growth of the ocular components);
- (3) visual psychophysics (e.g., color vision and monocular sensory processes);
- (4) infant vision (e.g. development of visual acuity and stereopsis);
- (5) binocular vision and space perception (e.g., correspondence, fixation disparity and spatial localization);
- (6) ocular motility (e.g., accommodative - convergence interactions, sports vision, eye movements);
- (7) ocular physiology and pathophysiology (e.g., corneal metabolism and chemistry of the tears);
- (8) environmental vision (e.g., vision standards and quality of life issues);
- (9) epidemiology of vision (e.g., progression of keratoconus, natural history of eye growth);

(10) pediatric vision (e.g., amblyopia, vision screening, convergence insufficiency, management of refractive error);

(11) contact lenses;

(12) dry eye;

(13) neurobiology of vision (e.g., the neuroanatomy and functional neurophysiology of the retina and the ascending visual pathway);

(14) pathology of vision (diseases and disorders of the eye and the visual system); and

(15) vision rehabilitation (e.g. assessment and rehabilitation of visual performance in individuals with impaired vision).

7. Master's Degree Programs

- a) The degree offered is a Master's (MS) in Vision Science.
- b) A minimum of 30 graduate credit hours is required to earn a Master's degree. No more than 8 credit hours of 8999 coursework may count toward this minimum. The student must complete at least two 8000 level courses in Vision Science, with at least one being one of the four-credit 80X0 core courses. Two other courses are required: Vision Science 7960 (Ethics in Biomedical Research) and Vision Science 7980 (Statistics in Clinical Research). The remaining coursework is selected according to the student's interests, as recommended by the student's advisor.
- c) The MS degree normally is completed in two years. A student may be considered lacking in academic progress after this period.
- d) Part-time students are permitted, but first priority is given to full-time students. If permitted, the time limit for part-time attendance is determined by the Research and Graduate Studies Committee prior to the admission of the student. If a full-time student wishes to change to part-time status, he or she must petition the Research and Graduate Studies Committee who will provide written terms for continuation on part-time status.
- e) Only the Plan A (thesis) program is offered.
- f) Where human subjects, animals, or chemical or biological agents are involved in the thesis research, it is the responsibility of the student to assure that the appropriate institutional review is obtained prior to commencing this research.
- g) The Master's thesis examination committee consists of three graduate faculty (M or P category).

- h) Examination of the thesis occurs in two steps including an oral examination and approval of the written thesis document. The thesis oral examination is a two-hour examination with emphasis on the thesis material. The first hour of the examination consists of the student presenting his or her thesis work, followed by one hour of questioning on the work and related topics. The examination is scheduled by the student in close consultation with his or her advisor. The written thesis is approved by the thesis examination committee after successful completion of the oral examination.
- i) A combined program OD/MS (OPT 7) is available to outstanding students wishing to simultaneously pursue the OD degree offered by the College of Optometry and the Master's degree in Vision Science program offered by the Graduate School. Optometry students typically apply for this program to begin enrollment in autumn semester of their second year in the optometry program; in exceptional circumstances (an undergraduate overall grade point average higher than 3.50), a student may apply for admission sometime during the first year of optometry school. Admission of the applicant and based on the student's academic performance and the Research and Graduate Studies Committee's assessment of his or her motivation and capability to complete a program of independent research in combination with the regular optometry curriculum. A minimum GPA of 3.0 in the optometry program is required. This program also requires the completion of 30 graduate credit hours as specified in item 7b above. Vision Science courses 6300, 6320 and 7620 may contribute to these 30 graduate credit hours, up to a limit of 10 credit hours.
- j) The College of Optometry offers an MS degree in conjunction with a Post-Graduate Advanced Practice Fellowship in: 1) Cornea and Contact Lenses; 2) Pediatrics and Binocular Vision; 3) Vision Rehabilitation; 4) Family Practice; and (5) Ocular Disease. Applicants to this program must be eligible for licensure to practice optometry in the state of Ohio. This is a two-year program that provides the opportunity to obtain a MS degree in Vision Science combined with clinical experience. Students in this program must meet all requirements for the MS degree outlined in this document and proscribed coursework and clinical assignments that are specified in the College document, *Post-Graduate Advanced Practice Fellowship in: Cornea and Contact Lenses, Pediatrics and Binocular Vision, Vision Rehabilitation, Family Practice, and Ocular Disease* (Appendix A).
- k) The current policies of the Graduate School apply with regard to academic performance requirements, transfer of credit, residence, and time limits, except as specified in this document.

8. Doctoral Degree Program

- a) The Doctoral degree offered is a PhD in Vision Science. Special departmental requirements include:
 - (1) All students who do not have a Master's or Doctoral degree will matriculate into the Master's in Vision Science program. After one year in the Master's program, if a

student wishes to enter the PhD program without completing the Master's degree, in consultation with his or her advisor, he or she petitions to the Research and Graduate Studies Committee for admission to the PhD program. The Research and Graduate Studies Committee admits by a simple majority vote.

(2) A student who completes the MS degree in the graduate program in Vision Science at The Ohio State University then petitions the Research and Graduate Studies Committee for approval to enter the PhD program. The Research and Graduate Studies Committee admits by a simple majority vote. Surplus MS hours may be transferred to the Doctoral program if approved by the Research and Graduate Studies Committee, subject to limits established by the Graduate School. If the student wishes to change academic advisors at this time, they may do so per rule 5.e.

(3) Upon admission to the PhD program, every PhD student will be assigned a Progress Committee, a three-person panel of P-level faculty, one of whom is the student's advisor, who serves as the Progress Committee's chair. The Progress Committee will be expected to follow the student's progress throughout his or her training and to help mentor the student in his or her research. It is expected that the Progress Committee will meet with the student at least annually as a group.

(4) A minimum of two semesters of teaching experience is required as part of the Doctoral program, although it can be on a part-time basis. At least one of these semesters must encompass teaching in a laboratory course. In the event that the student is funded through a source outside the College (e.g., a training grant) such that the student cannot receive compensation for teaching, then the student's participation to fulfill this requirement would be participation as an "extra" alongside another student who is being compensated.

- b) Each PhD student is required to present a research symposium talk based on his or her research interests annually, beginning 12 months after matriculation into the PhD program, culminating with his or her open dissertation defense as described below. Students enroll for 1.0 unit of Vision Science 7940 (Oral Presentation of Scientific Research) during the semester in which they will present. The talk will be given in the Vision Science 7950 seminar series. Failure to do so could provide evidence of insufficient academic progress.
- c) A minimum of 80 graduate credit hours (or 50 graduate credit hours beyond the Master's degree) is required to earn the Doctoral degree. No more than 40 hours of Vision Science 8999 (research) may count toward the total. The minimum program of study consists of four Vision Science 80X0 courses (16 semester hours) and three required other courses: Vision Science 7960 (Ethics in Biomedical Research), Vision Science 7970 (Grantsmanship), and Vision Science 7980 (Statistics in Clinical Research). Beyond this minimum, each program of study is designed according to the student's interests in consultation with his or her advisor.

- d) Candidacy (General) Examinations are arranged by the graduate student's advisor. The Candidacy Examination has both written and oral portions. The Candidacy Examination Committee will consist of the student's advisor (who will serve as the Candidacy Examination Committee Chair), at least one of the other two Progress Committee members, plus at least two additional members of the graduate faculty of the Graduate Program in Vision Science. The two additional members may include the third Progress Committee member and may include one M-level faculty member. The advisor and candidate will work together to select the Candidacy Examination Committee.

The written portion of the Candidacy Examination consists of a 13-page NIH-R01 type application (one page specific aims plus 12-page application) plus a critical review article on the same topic (20 double-spaced pages, suitable for publication). These page limits do not include references. The written portion timeline will be no fewer than two and no more than three months after the approval of the Candidacy Examination topic. The oral examination then has to be scheduled within the next month but no sooner than two weeks after the completion of the written examination.

The topic of the Candidacy Examination proposal must be distinct from the candidate's proposed dissertation topic but may be in a related area. The grant proposal cannot be one that has been created *for any other* purpose previously. Writing on the grant proposal cannot begin until the topic has been approved by unanimous vote of the Candidacy Examination Committee. After the topic has been finalized and approved by the Candidacy Examination Committee, candidates are not permitted to seek advice regarding the proposal from anyone other than the Candidacy Examination Committee. The entire proposal will be evaluated by the Candidacy Examination Committee.

The oral examination is two hours in length. Each Candidacy Examination Committee member is expected to participate fully in the oral questioning of the student. Questions must relate to the written materials but can draw from related areas in vision science and other related disciplines. Questions at the oral examination will require the candidate to understand important and classic papers in vision science. The candidate should also be prepared to discuss strengths and limitations of various study designs and methods, potential threats to validity, and other pitfalls in the area of research interest.

Satisfactory completion of the Candidacy Examination is achieved by unanimous affirmative vote of the Candidacy Examination Committee. If the examination is judged unsatisfactory, a second examination may be permitted on the recommendation of the Candidacy Examination Committee, according to the guidelines in the *Graduate School Handbook*. Satisfactory completion of the Candidacy Examination admits the student to Candidacy for the Doctoral degree.

The Candidacy Examination Committee can unanimously designate an "Honors" (non-transcript) level for exceptional performance on the Candidacy Examination. It is expected that the Honors designation will be used rarely.

- The entire Candidacy Examination should be scheduled to occur within no more than one 10-week period, beginning with the Candidacy Examination Committee's approval of the Candidacy Examination topic. Extensions must be approved by simple majority vote of the Research and Graduate Studies Committee.
- e) The PhD student, in consultation with his or her advisor, selects the dissertation topic. Within one semester of successful completion of his or her Candidacy Examination, the student must prepare a comprehensive research plan of the research for the Dissertation Committee. This plan should include proposed methodologies, analyses and expected outcomes and must be approved by each internal member of the Dissertation Committee.
 - f) The Dissertation Committee will consist of three graduate studies faculty members, at least two of whom are members of the Progress Committee, plus one faculty member outside the College of Optometry who is not a member of the Graduate Faculty in Vision Science, either from Ohio State or from another academic institution. In either case, this external person has to be approved by the Graduate School of The Ohio State University. A change in committee membership subsequent to approval of the research plan must be approved by the Research and Graduate Studies Committee per rule 5.e.
 - g) Where human subjects, animals, or chemical or biological agents are involved in the dissertation research it is the responsibility of the student to assure that the appropriate institutional review is obtained.
 - h) The oral portion of the Dissertation Examination takes the form of verbal questioning by the Dissertation Committee and a graduate school representative. The presentation (first) hour of the defense will be open to the public and will include questions from any audience member. The hour will include a 45-minute presentation followed by a 15-minute question and answer session, moderated by the PhD advisor. One hour of questioning by the Dissertation Committee will take place after the public presentation, and only the student and Dissertation Committee will attend that portion of the Dissertation Examination. Questioning is focused on the dissertation material, although it also may be comprehensive of the major field. The examination is scheduled by the student and his or her advisor. The written dissertation is subsequently approved by the entire Dissertation Committee following successful completion of the oral portion of the Dissertation Examination.

9. Departmental Research Facilities

In addition to providing access to clinical and basic facilities for research, the graduate faculty members in Vision Science maintain specialized laboratories that offer a varied research environment for graduate students in the Graduate Program in Vision Science. All applicable University and College policies should be reviewed and adhered to prior to commencing use of these facilities.

10. Departmental Graduate Associate Policies

- a) The rules and procedures relating to Graduate Associate (GA: both Graduate Teaching Associates [GTA] and Graduate Research Associate [GRA]) responsibilities, appointments, and benefits, as described in the *Graduate School Handbook*, apply to the Graduate Program in Vision Science.
- b) Graduate Associate positions are normally awarded by the Chair of the Research and Graduate Studies Committee on an annual or academic year basis and may be terminated by providing a one-semester notice. GA appointments may be terminated on the basis of unsatisfactory evaluations or failure to make adequate academic progress.
- c) Graduate Teaching Associates are normally evaluated annually on the basis of their teaching performance; however, evaluations may be conducted each semester if deemed warranted by the Research and Graduate Studies Committee. Evaluations are conducted by the Chairman of the Research and Graduate Studies Committee and are based on information provided by the instructors of the courses in which the GTA has had involvement, research job performance, faculty reviews, and/or teaching evaluations.
- d) Graduate Associates should only undertake employment outside the College after consultation with their advisor.

11. Academic Progress

- a) Graduate students who fail to make adequate academic progress may be dismissed from the Graduate Program in Vision Science by unanimous vote of the Research and Graduate Studies Committee.
- b) Doctoral students who fail to schedule and take his or her Candidacy Examination within two semesters after completion of 40 credit hours (exclusive of Vision Science 8999) and all required coursework may be considered failing to make adequate academic progress.
- c) Doctoral students who fail their Candidacy Examinations and are permitted to retake the examination may be considered failing to make adequate academic progress if they fail to retake the Candidacy Examinations within two semesters of their initial failure.
- d) Doctoral candidates who do not complete their dissertation within two years of being admitted to candidacy may be considered to be failing to make adequate academic progress.
- e) Master's students who do not complete the program in two years may be considered to be failing to make adequate academic progress.

- f) To be considered in good standing, a student must maintain a graduate cumulative grade point average of 3.0 or better in all graduate credit courses. Note that for optometry students enrolled in the OPT 7 program, all Vision Science credit hours count toward this graduate cumulative grade point average, even those in excess of the 10 credit hours maximum from the professional optometric curriculum that also count toward the Master's degree.

12. Special Features

- a) The graduate program in Vision Science participates in the combined program (OPT7) for concurrent enrollment in the College of Optometry and in the Graduate School for the MS degree offered by the Vision Science program.
- b) There may be training grant support options for PhD students.

Appendix A

Post-Graduate and Advanced Practice Fellowships in: Cornea and Contact Lenses Binocular Vision and Pediatrics Vision Rehabilitation Family Practice

The Advanced Practice Fellowship program is a two-year program involving work toward a Master's degree in Vision Science combined with clinical experience. Its purpose is to provide advanced optometric and research training with particular emphasis on the chosen specialty (cornea and contact lenses, binocular vision and pediatrics, vision rehabilitation, or family practice).

The program consists of course work in Vision Science, statistics, and general issues related to research plus elective courses specific to the student's areas of interest. A total of 30 credit hours, including independent research credits, must be completed for the Master's degree. The remaining time is devoted to clinical teaching, serving as a teaching assistant in appropriate laboratories, patient care from the routine to the most complex phases of optometric practice, and completion of a research project and Master's thesis.

The Advanced Practice Fellowship program requires that a successful trainee complete an initial summer semester of direct patient care experience followed by seven semesters of graduate teaching experience as a Graduate Associate at 50% full-time equivalent (FTE). He or she does not enroll as a graduate student until autumn semester. Any student with the option of serving as a Graduate Research Associate (rather than Graduate Teaching Associate) for all or part of that 50% FTE will need to petition the Research and Graduate Studies Committee at least one semester prior to the change (i.e., such a petition for spring semester would have to be filed the previous autumn semester). The Research and Graduate Studies Committee, in conjunction with the Associate Dean for Clinical Services and Professional Program, would then make a decision based on simple majority vote on a case-by-case basis as to whether to approve the proposed research appointment because it would enhance the fellow's clinical education and would serve the trainee and the College well.

There are specific training and experience aspects to the various specialties as follows:

Cornea and Contact Lenses: The first summer semester of the program is typically spent full-time in contact lens clinic and possibly other clinical settings, providing direct patient care to sharpen clinical skills before the academic program formally begins in autumn semester.

Binocular Vision and Pediatrics: The first summer semester of the program is typically spent full-time in binocular vision/pediatrics clinic and possibly other clinical settings,

providing direct patient care to sharpen clinical skills before the academic program formally begins in autumn semester.

Vision Rehabilitation: In addition to examining patients within the Vision Rehabilitation Service at the College of Optometry, the resident may work at a multidisciplinary blind rehabilitation center that provides vocational, homemaking, and mobility training. The initial semester in the program will be spent in full-time direct patient care in Vision Rehabilitation and other clinical settings, e.g., Primary Vision Care and Ocular Disease.

Family Practice: The first summer semester of the program is typically spent full-time in primary vision care clinic and possibly other clinical settings, providing direct patient care to sharpen clinical skills before the academic program formally begins in autumn semester.

Required coursework specific to the specialty:

Cornea and Contact Lenses:

- Vision Science 8040

Binocular Vision and Pediatrics:

- Vision Science 8020

Vision Rehabilitation

- Vision Science 8010

Family Practice: •Public Health 7620

Clinical Curriculum

The graduate optometrist will instruct students and/or provide direct patient care in his or her chosen area of specialization, and (in order to maintain scope and skill levels) some additional clinical services, e.g., Primary Vision Care, Binocular Vision and Pediatrics, Vision Rehabilitation, and Contact Lenses.

Individual sequences will be established by consultation among the graduate optometrist, his or her advisor, his or her clinical mentor, the Assistant Dean for Clinical Services, and the individual Clinic Chief, and may be influenced by thesis project requirements.

Teaching Experience

(1) General and Specialty Clinic Services

The graduate optometrist has the opportunity to work with optometry students in providing care to patients seen in The Ohio State University College of Optometry.

(2) Optometry and Vision Science Course Laboratories

The graduate optometrist will instruct optometry students in selected laboratories.

(3) Lecture Experience

The graduate optometrist will have the opportunity to present lectures in selected courses within the optometry curriculum and at continuing education conferences presented by the College of Optometry.

Appendix B

Graduate Curriculum in Vision Science

1. Courses in Vision Science primarily intended for graduate students

VIS SCI 7940 Oral Presentation of Scientific Research G 1

The student gives a talk based on his/her research or scholarship and improves his/her speaking skills.

VIS SCI 7950 Seminar in Vision Science G 1

Series of seminars dealing with new developments in the various areas of vision science.

VIS SCI 7960 Ethics in Biomedical Research G 2

Provides a general understanding of the issues surrounding the ethical conduct of science including issues related to research involving human subjects, scientific misconduct, and authorship of scientific papers. Real-life case studies will be used.

VIS SCI 7970 Grantsmanship G 2

The structure of the National Institutes of Health, the principles of good grantsmanship, and description of the grant review process. Emphasis focused on Mentored Clinical Scientist Development Award (K23) and Research Project Grant (R01).

VIS SCI 7980 Statistics in Clinical Research G 2

Introduction to the basic concepts and methods of statistical analysis of clinical research data. Statistical software packages will be demonstrated along with interpretation of output.

VIS SCI 7990 Assessing the Literature G 1

Provides a framework to develop skills to critically evaluate the literature, improve data presentation skills, summarize information efficiently, and improve statistical knowledge by critically reviewing published literature.

2. Core Courses in Vision Science G 4

Core courses present a comprehensive background in vision science and are not intended as introductory. The listed prerequisites refer to Vision Science courses taught in the College of Optometry at the Ohio State University. Graduates of other institutions should have the graduate program evaluate the suitability of similar courses at their institution as substitutions. Open to graduate students only.

VIS SCI 8010 Optics of the eye and specification of the visual stimulus G4

Ocular image-forming mechanisms of the eye and optics of ophthalmic instrumentation, specification of light, calibration and control of intensity and spectral composition of light.

VIS SCI 8020 Ocular Motility and Binocular Vision G4

Advanced topics on eye movements, ocular motility, and sensorimotor aspects of visual perception and binocular vision.

VIS SCI 8030 Visual Neurophysiology, Biophysics, and Psychophysics G4

Neurophysiology of the retina, the ascending visual pathway, and the brain, and their functional significance.

VIS SCI 8040 Anatomy and Physiology of the Eye G4

Advanced gross anatomy and vegetative physiology and molecular biology of the eye.

3. Advanced Seminars in Vision Science G 0.5-2

Advanced seminars present current and recent advances. Seminar format may require student presentations and participation. Courses are repeatable at the discretion of the instructor.

VIS SCI 8100 Advanced Seminars in Vision Science G 1-3

Advanced studies on special problems in vision science.

VIS SCI 8110 Advanced Laboratory Studies in Vision Science G 1-3

Laboratory techniques in vision science, for example, behavioral measurement of psychophysical responses, cell culture, imaging, immunocytochemistry, electrophysiological recordings. Course must not be used when 8999 is more appropriate.

VIS SCI 8910 Interdisciplinary seminar G 0.5-2

Graduate seminar for graduate interdisciplinary studies. Cross-listed in Biomedical Engineering, Biomedical Informatics, Biophysics, Computer Science and Engineering, Electrical and Computer Engineering, Integrated Biomedical Science, Pathology, Radiology, and Statistics.

VIS SCI 8911 Graduate Interdisciplinary Seminar on Biomedical Imaging G 0.5-2

Graduate seminar for Graduate Interdisciplinary Specialization in Comprehensive Engineering and Science of Medical Images.