## DEPARTMENT OF NEUROSCIENCE, CELL BIOLOGY AND PHYSIOLOGY

### Eric Bennett, Ph.D.
Chair, Department of Neuroscience, Cell Biology and Physiology

### Kathrin Engisch, Ph.D.
Director, NCBP Graduate Programs

## Graduate Faculty

<table>
<thead>
<tr>
<th>Faculty Name</th>
<th>Department Address</th>
<th>Office Phone</th>
<th>Email Address</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eric Bennett, Ph.D.</td>
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</tr>
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</tbody>
</table>
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Master’s Graduate Programs in the Department of Neuroscience, Cell Biology, and Physiology (NCBP)

Master’s Degree in Anatomy
Graduate study in anatomy provides advanced professional education in the essentials of human anatomy, including gross anatomy, developmental anatomy (embryology), microanatomy (cell biology/histology), and neurobiology. The Master’s Degree in Anatomy offers two programs of study—a thesis option and a non-thesis, course option. The Master’s Degree in Anatomy is designed primarily for students who expect to continue on to more advanced degrees (such as Ph.D., M.D., D.O., D.D.S., P.A. or the equivalent) or for students who want to teach anatomy.

Certificate in Anatomy
The NCBP Department also offers a Certificate Program in Anatomy. This program is for students who have an interest in anatomy but do not want to pursue, or who do not need, a Master's Degree. The program of study consists of three of the core graduate anatomy courses.

Master’s Degree in Physiology and Neuroscience
Programs of graduate study leading to a Master of Science Degree in Physiology and Neuroscience provide students with both a broad knowledge of physiology and neuroscience as well as concentrated experience in one specific area of specialization. The first two semesters involve 17 credit hours, which include required departmental courses, and other courses as determined in consultation with the student’s research advisor. Research activities begin in the spring of the first year. The second program year involves 13 credit hours with emphasis on research. Completed research is presented in written thesis form at the end of the second year, with a public oral defense.

Goal Statements
The goals of the NCBP graduate programs are to provide the opportunity for graduate students to apply their knowledge of the biomedical sciences to solve an original problem and to achieve a high level of professional competence. All graduates of the Department’s Master of Science Programs develop a depth of understanding of human anatomy or human physiology/neuroscience and are afforded the opportunity to prepare for a career in the biomedical sciences or to prepare for further professional study following graduation.
Master of Science Degree in Anatomy

The Master's degree, *Course Option*, allows the student to plan a program of study that satisfies educational needs and career objectives as well as meeting degree requirements. The student's program of study includes a comprehensive oral examination of the material presented in the core anatomy courses and a written scholarly project focusing on a contemporary issue falling under the various subdisciplines of anatomy. The course option also includes the opportunity to learn fundamental laboratory techniques used in anatomical research, and to help teach in one or more of the department's graduate or undergraduate courses.

*The Course Option — 33 credits.* The Course Option requires successfully completing a minimum of 33 credits of graduate-level course work offered by the College of Science and Mathematics and passing a comprehensive examination. This option is designed primarily for those who plan to go on for further graduate or professional training. The pace of the curriculum is designed to permit adequate time to achieve excellence in the course work. Full-time students generally complete the Course Option program in five semesters. Below is a suggested course of study for this option.

<table>
<thead>
<tr>
<th>Semester</th>
<th>Course Number</th>
<th>Course Title</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fall</td>
<td>ANT 7210</td>
<td>Human Microanatomy</td>
<td>5</td>
</tr>
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<td></td>
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<td>Human Neurobiology</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>ANT 8000</td>
<td>Anatomy Seminar I</td>
<td>1</td>
</tr>
<tr>
<td>Spring</td>
<td>ANT 7110</td>
<td>Human Gross Anatomy</td>
<td>6</td>
</tr>
<tr>
<td></td>
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<td>Year Two</td>
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<tr>
<td></td>
<td>ANT 7020</td>
<td>Topics of Instruction*</td>
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<td></td>
<td>ANT 8510</td>
<td>Anatomical Techniques</td>
<td>1-3</td>
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<tr>
<td></td>
<td></td>
<td>Scholarly Project</td>
<td>3</td>
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</table>

*Students holding GTA positions are required to enroll in Topics of Instruction (ANT 7000) during the semesters in which they teach. For students not holding a GTA position, the requirement to serve as a Teaching Assistant for one semester can be scheduled in any of the semesters of the second year. Therefore, the sequence of courses for the second year will vary according to the teaching assignment.*
Master of Science Degree in Anatomy — Teacher Education

The Master's degree, *Course Option – Teacher Education*, allows the student to plan a program of study that satisfies educational needs and career objectives as well as meeting degree requirements. The student's program of study includes a comprehensive oral examination of the material presented in the core anatomy courses and a written scholarly project focusing on a contemporary issue dealing with the teaching of anatomy at the college level. A methods course and a measurement course, offered by the College of Education and Human Services, are required. The course option also includes a supervised practicum, and the opportunity to help teach in one or more of the department's graduate or undergraduate courses.

*The Course Option-Teacher Education — 34 credits.* This variation of the Course Option requires successfully completing a minimum of 34 credits of graduate-level course work offered by the College of Science and Mathematics and the College of Education and Human Services, and passing a comprehensive anatomy examination. This option is designed primarily for those who plan to teach anatomy at the college level. The pace of the curriculum is designed to permit adequate time to achieve excellence in the course work. Full-time students generally complete this Course Option program in five semesters. Below is a suggested course of study for this option.

<table>
<thead>
<tr>
<th>Semester</th>
<th>Course Number</th>
<th>Course Title</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fall</td>
<td>ANT 7210</td>
<td>Human Microanatomy</td>
<td>5</td>
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<tr>
<td></td>
<td>ANT 7310</td>
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<td>Spring</td>
<td>ANT 7110</td>
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<td>ANT 8000</td>
<td>Anatomy Seminar II</td>
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Master of Science Degree in Anatomy

The Master's degree, Thesis Option, is intended for those students who need or desire the full range of professional experience including intensive research and writing. This option assures training in research techniques and in the preparation of scholarly papers, and culminates in the preparation and defense of a thesis based on original research. The student's program of study is an initiation into methods of intense study and research in some selected area of anatomy.

The Thesis Option — 30 Credits. The purpose of the Thesis Option is to provide the student with a strong research-oriented background in one of several areas of anatomy. A program of study is designed for each student by the student's faculty advisor and an advisory committee. Course work for the first three quarters is essentially the same as that of the Course Option described above. The second year is devoted almost exclusively to research and culminates in the writing and oral defense of a thesis based upon original research performed while enrolled as a graduate student at the university. The Thesis Option requires successfully completing a minimum of 30 credits of graduate-level course work offered by the College of Science and Mathematics and defending a research thesis.

The number of students selected for the Thesis Option is limited and depends on the availability of research topics and advisors, as well as the student's research and educational interests. Two years in residence are normally required to complete the Thesis Option, although this length of time may vary depending on the background and goals of the student. Below is a suggested course of study for this option.

<table>
<thead>
<tr>
<th>Semester</th>
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<td></td>
<td>ANT 8000</td>
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<td>Spring</td>
<td>ANT 7110</td>
<td>Human Gross Anatomy</td>
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<td>Advanced Human Embryology</td>
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<td>Fall and</td>
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<td>Research</td>
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Certificate Program in Anatomy

Program description. The Anatomy Certificate Program is a two-semester program that provides graduate level education in three of the four human anatomy core courses—microanatomy, gross anatomy, embryology, and neurobiology. These courses cover basic cell biology and the microscopic survey of human tissues, dissection of the human body, development of the human body, and structure and function of the human nervous system. The program is applicable to physical therapists, occupational therapists, physician assistants, athletic trainers, health and physical education majors, and others in allied health disciplines. The intensive coursework requires a full-time commitment.

Note: The Certificate Program in Anatomy is not recommended for students who intend to pursue advanced degrees (e.g., Ph.D., M.D. or the equivalent).

Objective. To provide the essentials of human anatomy for students who have an interest in anatomy but do not want to pursue, or who do not need, a Master's Degree.

Admission requirements. Applicants for admission are expected to meet the general requirements for admission to the School of Graduate Studies with regular or nondegree status. Although there are no required prerequisite courses, it is recommended that applicants have completed at least one year of biology and two years of chemistry, including organic chemistry.

Program requirements. Students must complete microanatomy, gross anatomy, embryology or neurobiology with a cumulative grade point average of at least 3.0 to earn a certificate. Total credit hours must not exceed 14 hours. Written permission to enroll in each anatomy course must be obtained from the appropriate course director.

<table>
<thead>
<tr>
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</table>
General Descriptions of Anatomy Courses

ANT 6990  Special Problems in Anatomy
Topics vary. **Maximum of 4 credit hours applicable to degree requirements.** Letter graded; 1-4 credit hours. **Staff**

ANT 7000  Topics of Instruction
Topics of Instruction is required of all students who are appointed as an anatomy Graduate Teaching Assistant (GTA) (a paid position) and of all students who select the Course Option (a non-paid position). **GTAs are required to enroll in Topics of Instruction during the semesters of their employment.** Students either assist in the teaching of the department’s undergraduate anatomy and physiology course (ANT 3100 and 3120) or in the teaching of three of the anatomy graduate core courses (microanatomy, gross anatomy, and neurobiology). In preparation for this responsibility, students receive instruction on course content and methods of presentation from the course director. Graded pass/fail; 1 credit hour. **Staff**

ANT 7010  Selected Anatomy Topics
Selected topics in anatomy. Letter graded; 1-4 credit hours. **Staff**

ANT 7020  Anatomical Techniques
Anatomical Techniques is a laboratory rotation, and is required of all students who select the Course Option. Students spend a minimum of one semester in a research laboratory learning one or more research techniques, or assisting in the general operation of the laboratory. Other opportunities may be available to fulfill the requirements of this course. This includes, for example, doing special cadaver prosections for use in the anatomy courses. **May be repeated twice for credit.** Letter graded; 1-3 credit hours. **Staff**

ANT 7110  Human Gross Anatomy
Although three 1-hour lectures are given each week, the focus and concentration of the course is dissection of the human body. Three 3-hour laboratories are scheduled per week for a total of 12 class hours per week. Substantial unscheduled time is required to complete the scheduled work. Additionally, students are expected to explore human cross sectional and radiographic anatomy using computer-based technology. A team of four students assigned to a single donor typically accomplishes the dissection. Students are required to purchase appropriate textbooks and atlases, laboratory coats, and dissection instruments. Lockers are provided for the storage of clothing, books, and instruments. Letter graded; 6 credit hours. **Barbara Kraszpulska, Ph.D., Course Director**
ANT 7150  Advanced Human Embryology
The course addresses the development of the human body, including gametogenesis and early
development, development of all major organ systems, and the function of the placenta. A
major portion of the course is comprised of descriptive embryology. Mechanisms and clinical
relevance of developmental abnormalities are also incorporated into the course. In addition,
the experimental techniques of modern developmental biology are discussed. The course is
structured for students with a solid background in both gross anatomy and microanatomy.
The class usually meets for 4 hours each week in a lecture format; there is no laboratory.
Letter graded; 3 credit hours.  Gary Nieder, Ph.D., Course Director

ANT 7210  Human Microanatomy
Microanatomy is concerned with the functional morphology of cells, the chemical composition
of cellular components, the origin of specific cell types, and the histological and ultrastructural
survey of the tissues and organs that comprise the human body. Approximately 4 weeks are
devoted to cell biology; the remaining 10 weeks focus on the histology of tissues and organs.
The cell biology portion is entirely a lecture format, while the histology portion includes
laboratory sessions with the lectures. Students rent a microscope and set of histology slides
($25 fee) from the university; a storage locker is provided in the classroom. A laboratory
manual, written by the course director, helps guide students through the course content.
Classes typically meet 3 days per week for about 3 hours each day. Letter graded; 5 credit
hours.  Larry Ream, Ph.D., Course Director

ANT 7310  Human Neurobiology
The purpose of the course is to provide an introduction to the structure and function of the
human nervous system. Neuroanatomical and neurophysiological principles are presented
within the framework of current research strategies aimed at investigating common clinical
neurological disorders. Students are exposed to diverse learning experiences that include
neuroscience laboratories and case problem-solving sessions in addition to traditional lectures
and conferences. The course usually meets 2 hours per day, 3 days per week. Letter graded; 4
credit hours.  Michal Kraszpulski, Ph.D. and David Ladle, Ph.D., Co-Course Directors

ANT 8000  Anatomy Seminar
Two seminars (Anatomy Seminars I and II) run concurrent with the Department of
Neuroscience, Cell Biology and Physiology Seminar Series. The seminars are graded pass/fail;
1 credit hour.
**ANT 8110 Comprehensive Anatomy**
Comprehensive Anatomy is required of all students who select the *Course Option*. The student stands before a faculty committee, and answers questions on content of the four core anatomy courses—microanatomy, gross anatomy, embryology, and neurobiology. The faculty committee is composed of the course directors of the core anatomy courses. In anticipation of this important oral examination, students should spend a minimum of a month prior to the exam reviewing the course work previously taken. Students should frequently seek guidance from the four professors as to specific areas of course content to review. The examination is graded and open to the public. Graded pass/fail; 4 credit hours. **Staff**

**ANT 8510 Scholarly Project**
The Scholarly Project is required of all students who select the *Course option*, and is designed to provide some of the experiences required of those students who select the Thesis Option. One of the differences, however, is that students who choose the Course Option are not required to collect data from their own original laboratory research, but rather gather data from published scientific papers on a designated topic and write a review paper. Students select a faculty advisor for this project; specific instructions for writing the paper come from the advisor. The paper is presented to a committee consisting of the advisor and two other faculty members—one of which can be from outside the NCBP Department. Letter graded; 3 credit hours. **Staff**

**ANT 8600 Principles of Biomedical Research**
Principles of Biomedical Research is appropriate for students who will be involved in biomedical research. PBR provides the basic principles of biomedical research and covers topics that include the scientific method, productivity, experimental design, critical analysis of manuscripts, and biomedical ethics. Letter graded; 1 credit hour per semester. **Tom Brown, Ph.D., Course Director.**

**ANT 8990 Graduate Research**
Supervised thesis research. Letter graded; 1-14 credit hours per quarter. **Staff**

**Elective Courses**
Graduate course work should be selected after consultation with the student's faculty advisor. For the *Course Option*, a minimum of 33-34 credits of graduate courses is necessary to obtain the Master's degree. In addition to the required courses and seminars, one or more elective courses are taken in the Department of Neuroscience, Cell Biology and Physiology or in another science department in the College of Science and Mathematics. Courses taken outside the department include, for example, cell biology, biochemistry, pharmacology, and immunology. Courses selected should enhance the student's probability of achieving long-term goals.

Listed below are courses commonly selected by anatomy graduate students as elective courses.

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<thead>
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<th>Course Code</th>
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<th>Credits</th>
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<tr>
<td>BMB 7500</td>
<td>Molecular Biochemistry I</td>
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<td>BIO 7300</td>
<td>Cell Biology</td>
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<td>M&amp;I 7260</td>
<td>Immunology</td>
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<td>M&amp;I 7270</td>
<td>Pathogenic Microbiology</td>
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</tr>
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<td>Basic Virology</td>
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<td>Human Physiology</td>
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<td>P&amp;N 7760</td>
<td>Intercell. Communication</td>
<td>3 cr</td>
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ANT 8110 — Comprehensive Anatomy, Overview

The Course Option program of study of the Master's Degree in Anatomy includes Comprehensive Anatomy; students register for Comprehensive Anatomy as soon as they have completed the core anatomy courses. Comprehensive Anatomy consists of a two-hour oral examination over the four core anatomy courses—microanatomy, gross anatomy, neurobiology, and embryology. The exam consists of three rounds of questioning by a panel of four faculty members—each faculty member (usually the course director) representing one of the core courses. A fifth faculty member may act as moderator and timekeeper. Testing may include questions using projection slides, photographs or models. Students are often required to illustrate their answers. The exam is graded pass/fail (4 credit hours); students must pass at least three of the four subject areas to pass the exam. Each panel member votes according to the performance of the student in his/her area of expertise within the four core courses. The exam is open to the public.

Round 1 15 minutes of questioning by each course director
10 minute BREAK
Round 2 10 minutes of questioning by each course director
Round 3 5 minutes of questioning by each course director

In anticipation of this important exam, students should spend adequate time prior to the exam reviewing the content of the course work previously taken. Students meet with each course director to determine the specific areas of content to review. Each course director approaches the exam differently. Some offer more guidance and, therefore, expect more detailed answers. Other offer less guidance and are, therefore, satisfied with more general answers. Yet others use a blend of the two approaches.

If failure of the exam is determined by the faculty panel, students are permitted a one-time repeat. The repeat exam covers all four courses and follows the same procedures as outlined above.
The Course Option program of study of the Master's Degree in Anatomy includes the writing of a review paper—the Scholarly Project—that integrates and evaluates previously published material, and the subsequent approval of this paper by a faculty committee. The Scholarly Project is letter graded (3 credit hours).

Students select a topic of interest that is relevant to anatomy, and select a graduate faculty member in the Department of Neuroscience, Cell Biology and Physiology to serve as mentor. This faculty member is not necessarily the student's academic advisor. Two additional faculty members are invited to serve on the Scholarly Project committee along with the student's mentor. One of the additional faculty members may be from outside the Department of Neuroscience, Cell Biology and Physiology.

The object of the Scholarly Project is to thoroughly review one scientific topic, or one aspect of a scientific topic. The paper should begin with the earliest known information and progress to the very latest scientific knowledge. The most critical experiments or discoveries relevant to the topic should be chronicled. The scope and depth of the topic, and the starting point for the chronological review should be carefully determined in consultation with the mentor.

Note: Clinical case studies or “clinical research topics” are not appropriate for the Scholarly Project.

Contact the Anatomy Master’s Program Director for permission to write.

Guidelines:
1. A minimum of 10 empirical papers reporting original research should be cited. While review papers may be read for background information, review papers may not be cited in the bibliography. Likewise, textbooks, reference books, and Internet references should not be cited in the bibliography without the permission of your advisor. Make hard copies of all articles listed in the bibliography, and be prepared to submit these articles to your advisor or committee, if asked.
2. The text of the paper should be 10 to 20 pages in length (typewritten in standard font and double-spaced) plus references. Tables, drawings, and graphs may be added as appendices.
3. The paper should be written in a scientific style commensurate with the topic and should include an introduction and summary. The scientific content should be at the appropriate depth for a graduate level paper.
4. The student should work with the faculty mentor to develop a draft suitable for submission to the committee. This draft should be given to the other members of the committee for review no later than the twelfth week of the semester. Faculty committee members should return the draft with comments no later than one week after receipt.
5. After the opportunity for one re-write, the paper will be resubmitted to the committee who will then collectively decide on a letter grade for the paper.
6. Organization and time management are important aspects in the completion of the Scholarly Project within the time frame of the semester. Students and faculty need to work together to arrange appropriate deadlines.
Master of Science Degree in Physiology and Neuroscience

The Master's degree in Physiology and Neuroscience provides training in research techniques and in the preparation of scholarly papers, and culminates in the preparation and defense of a thesis based on original research. The student's program of study is an initiation into methods of intense study and research in some selected area of physiology, biophysics or neuroscience.

**Thesis Option — 30 Credits.** The purpose of the Master's degree is to provide the student with a strong research-oriented background in one of several areas of physiology, biophysics or neuroscience. A program of study is designed for each student by the student's faculty advisor and an advisory committee. The second year is devoted almost exclusively to research and culminates in the writing and oral defense of a thesis based upon original research performed while enrolled as a graduate student at the university. The degree requires successfully completing a minimum of 30 credits of graduate-level course work offered by the College of Science and Mathematics and defending a research thesis.

Two years in residence are normally required to complete the Master’s degree in Physiology and Neuroscience, although this length of time may vary depending on the background and goals of the student. Below is a suggested course of study.

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<th>Credit Hours</th>
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<td></td>
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<td>4</td>
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<tr>
<td></td>
<td>P&amp;N 8600</td>
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<td></td>
<td>P&amp;N 8000</td>
<td>Physiology Seminar I</td>
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<td>Spring</td>
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<td>Introductory Neurophysiology</td>
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<td>P&amp;N 7760</td>
<td>Intercellular Communication</td>
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<td>P&amp;N 8000</td>
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<td>Fall and Spring Semesters</td>
<td>P&amp;B 8990</td>
<td>Thesis Defense</td>
<td>1-14</td>
</tr>
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General Descriptions of Physiology and Neuroscience Courses

P&N 6100  Human Physiology
An overview of human/mammalian organ physiology. Fundamental mechanisms and the experimental basis for current understanding are emphasized. Letter graded; 5 credit hours. Dan Halm, Ph.D., Course Director

P&N 6990  Special Problems in Physiology
Enables students to explore potential careers in physiology. Varies from working on an ongoing physiological research project to historical survey related to a completed research project. Letter graded or pass/fail; 1 to 5 credit hours per semester. Staff

P&N 7010  Selected Topics in Physiology
A selected area is discussed in greater detail than in basic courses. Some topics may include laboratory. 1 to 5 credit hours per semester. Staff

P&N 7220  Ion Channels
This course explores the role of ion channels in a variety of cell types with an emphasis on both electrophysiological and biochemical methods for evaluation of channel function. 4 credit hours. Dan Halm, Ph.D., Course Director

P&N 7760  Intercellular Communication
Introduces the concepts of intercellular communication through an interdisciplinary presentation of immune and neuroendocrine system functions. Emphasizes the similarities between the systems and the multidisciplinary approaches used to study each. Letter graded; 4 credit hours. Adrian Corbett, Ph.D., Course Director

P&N 7920  Mechanisms of Cell Death
Detailed molecular mechanisms of cell death, involvement in human diseases, and therapeutic design strategies. Taught every other year. Letter graded; 3 credit hours. Thomas Brown, Ph.D., Course Director

P&N 8000  Physiology Seminar
Two seminars (Physiology Seminars I and II) run concurrent with the Department of Neuroscience, Cell Biology and Physiology Seminar Series. The seminars are graded pass/fail; 1 credit hour.

P&N 8080  Neuroscience Seminar
Students present a current scientific article to colleagues and faculty. Graded pass/fail; 1 credit hour. Adrian Corbett, Ph.D., Course Director

P&N 8600  Principles of Biomedical Research
Principles of Biomedical Research is appropriate for students involved in biomedical research. PBR provides a lecture and student interactive series designed to introduce students to the basics of biomedical research. Letter graded; 1 credit hour. Thomas Brown, Ph.D., Course Director
P&N 8990 Physiology Research.
Supervised thesis research. Letter graded; 2 to 18 credit hours. Staff
**The Galen Award**

The Department of Neuroscience, Cell Biology and Physiology annually gives *The Galen Award* to a student who has achieved the highest combined grade average for the four core graduate anatomy courses.

<table>
<thead>
<tr>
<th>Galen of Pergamum</th>
</tr>
</thead>
<tbody>
<tr>
<td>AD 129 Pergamum, Mysia, Anatolia (now Bergama, Turkey) — 199, Rome?</td>
</tr>
<tr>
<td>byname of Greek CLAUDIOS GALENOS, Latin CLAUDIUS GALENUS</td>
</tr>
</tbody>
</table>

Greek physician who was one of the most distinguished physicians of antiquity—by far, the greatest medical scholar of the Ancient World. Before Galen, the structure and functions of the body were great enigmas to physicians. Galen's influence on medical theory and practice was dominant in Europe throughout the Middle Ages and during the Renaissance. His 22 volumes of written treatises survived as the medical authority until the 16th century, when Andreas Vasalius and, later, William Harvey amended Galen's theories with their discoveries.

**Early life and training.**

Galen studied Greek natural philosophy, especially Aristotle's works, and he began to specialize in medicine at the early age of seventeen. The city of his birth, site of a shrine of the healing god Asclepius, significantly affected Galen's education. Many of the most distinguished personalities of the Roman Empire visited the shrine for cures. A medical school was attached to the shrine, and there Galen met important men and observed the treatment of a variety of diseases. The high priest maintained a troop of gladiators, which provided Galen with the opportunities to examine wounds and to judge the effects of medical treatment.

Galen continued his studies at several major medical centers of that time, including Smyrna on the west coast of Asia Minor, Corinth in Greece, and Alexandria in Egypt, where he practiced the dissection of animals and broadened his contacts with contemporary physicians. In 157 he returned to Pergamum, where, as chief physician for the gladiators, he increased his practical knowledge of anatomy and tested the best remedies for treating wounds. In 161 the ambitious Galen traveled to Rome, where he received the honor of becoming the personal physician of the emperor Marcus Aurelius. In addition, he was given the responsibility of lecturing and experimenting, which helped to refine his knowledge of anatomy.

**Anatomical studies.**

Galen based his descriptive anatomy on the dissection of lower animals, particularly the African monkey, often called the Barbary ape. Because this animal is a primate and shares certain characteristics with man, Galen made inferences concerning human anatomy. There is no doubt that he was an accurate observer, particularly of the muscles and bones. He distinguished seven pairs of cranial nerves, described the valves of the heart, and observed the structural differences between veins and arteries. Notable also were his vivisection experiments, such as tying off the recurrent laryngeal nerve to show that the brain controls the voice, performing a series of transections of the spinal cord to study muscle control, and tying off the ureters to demonstrate kidney and bladder functions. One of his most important demonstrations was that the arteries carry blood, not air as had been taught for 400 years.

Although Galen did not discover that the blood circulates, he did achieve a valid and rational interpretation of the observed facts. According to his view, the most important organ in the vascular system was the liver, where blood was formed and the veins originated; blood vessels carried the blood out to the periphery of the body, where, according to him, it was transformed into flesh. He accounted for the large amount of blood in the aorta by suggesting a passage from the right ventricle to the left ventricle of the heart through minute pores in the wall that separates the two. He also suggested that a small amount of blood seeps through the lungs between the pulmonary artery and pulmonary veins, and so from the right to the left ventricle.

Galen believed that human health required an equilibrium between the four humours—phlegm, black bile, yellow bile, and the blood—and that, furthermore, the pneuma (thought to be a material, but a very subtle component carried by the blood) was responsible for guiding many body processes. As a continuation of the earlier Hippocratic conception of the unity of the organism, Galenic physiology became a powerful influence in medicine for the next 1,400 years.
The Sherrington Award

The Department of Neuroscience, Cell Biology and Physiology annually gives The Sherrington Award to a student who has excelled academically in the graduate physiology and neuro-science courses and who has demonstrated significant research progress during the first year of study.

Dr. Charles Scott Sherrington
1857-1952

English neurophysiologist whose 50 years of experimentation laid the foundations for an understanding of integrated nervous function in higher animals and brought him the Nobel Prize for Physiology or Medicine in 1932. Dr. Sherrington is considered as one of the Fathers of Neuroscience.

Charles Scott Sherrington was born in London, England. He was educated at Gonville and Caius College, Cambridge; at St. Thomas’ Hospital Medical School, where he qualified in medicine in 1885; and at the University of Berlin, where he worked with Rudolf Virchow and Robert Koch. After serving as lecturer at St. Thomas’ Hospital, he was successively a professor of physiology at the universities of London, Liverpool, and Oxford. He was made a fellow of the Royal Society in 1893 and served as its president for 5 years. As a physician, he did important work in the study of cholera and of diphtheria and tetanus antitoxins, and played an important role in the improvement of health and safety conditions in British factories during World War I. Sherrington was knighted in 1922 and with Edgar Douglas Adrian shared the 1932 Nobel Prize in Physiology or Medicine “for their discoveries regarding the functions of neurons.” Sherrington was also known as a philosopher and poet.

Working with cats, dogs, monkeys, and apes that had been deprived of their cerebral hemispheres, Sherrington found that reflexes must be regarded as integrated activities of the total organism, not as the result of the activities of isolated “reflex arcs,” a notion that was currently accepted. The first major piece of evidence supporting “total integration” of muscles, also known as “Sherrington’s law of reciprocal innervation”: when one set of muscles is stimulated, muscles opposing the action of the first are simultaneously inhibited.

In his classic work, The Integrated Action of the Nervous System (1906), he distinguished three main groups of sense organs: exteroceptive, such as those that detect light, sound, odor, and tactile stimuli; interoceptive, exemplified by taste receptors; and proprioceptive, or those receptors that detect events occurring in the interior of the organism. He found — especially in his study of the maintenance of posture as a reflex activity — that the muscles’ proprioceptors and their nerve trunks play an important role in reflex action, maintaining the animal’s upright stance against the force of gravity, despite the removal of the cerebrum and the severing of the tactile sensory nerves of the skin.

His investigations of nearly every aspect of mammalian nervous function directly influenced the development of brain surgery and the treatment of such disorders as paralysis and atrophy. Sherrington also coined the terms neuron and synapse to denote the nerve cell and the point at which the nervous impulse is transmitted from one nerve cell to another, respectively.
GRADUATE CREDIT

Categories of Graduate Credit

Graduate Courses
In order to take graduate courses for graduate credit, students must be officially accepted for admission to the Graduate School. Anatomy courses and Physiology & Neuroscience courses are listed in the course section of this handbook.

Transfer Credit
Upon the recommendation of the student’s advisor and the approval of the NCBP Department Program Director and the Graduate School, graduate credit (courses) completed at another regionally accredited academic institution may be transferred to a student’s graduate academic record and applied toward the requirements of the student’s graduate degree program at Wright State. The graduate credit to be transferred must be within the seven-year term limit for completing a master’s degree, and the amount of credit to be transferred must not exceed 50% of that required by this program. The transfer of credit request must be approved by the Graduate School.

At least 50% of the hours must be completed at Wright State and must be within the seven-year time limit. All required (other than elective) program course requirements must be completed within the seven-year time limit.

Graduate courses completed at Wright State in nondegree status and later applied toward degree requirements are not considered as transfer credit from outside the university.

Graduate Credit Hour Limits
The maximum number of credit hours for which graduate students may register in a quarter is 10. In a summer term of five weeks, six hours is a maximum.

Students holding graduate assistantships must register for a minimum of six-semester hours of graduate credit during each semester they hold appointment.

Students who wish to deviate from the normal registration loads listed above must have the approval of the NCBP Department’s Graduate Program Director and the Graduate School.
The Grading System

Academic achievement is indicated by the following letter grades and points used in calculating grade point averages.

- **A**  Highest quality/4 points per credit hour
- **B**  Second quality/3 points per credit hour
- **C**  Third quality/2 points per credit hour
- **D**  Lowest quality/1 point per credit hour
- **F**  Failure/0 points
- **X**  Failure to complete a course for which registered, without officially withdrawing/0 points (figured as an F in the grade point average)

The following symbols appear on the record, but are *not included in calculating grade point average*.

- **L**  Audit; given only if arranged for at time of registration.
- **N**  No report; instructor did not report grade.
- **P**  Passing; *indicates work of B quality or better* for graduate courses. (Credit is earned but is not computed in grade point averages.)
- **M**  Satisfactory progress; final grade will be assigned upon completion of project.
- **U**  Unsatisfactory performance; indicates work of C quality or below for graduate courses; given only for specifically approved courses.
- **I**  Incomplete; given only when part of required work is missing and arrangements have been made with instructor to complete the work. Incomplete grades are reported to the Registrar’s Office on the grade report sheet. An incomplete grade agreement between the instructor and the student is not required. The “I” grade may remain on the student’s academic record for up to two consecutive terms. The student will have to make up an Incomplete grade by the date the instructor has stipulated or, if no date was stipulated, no later than the last day of classes of the second quarter. Failure to make up an Incomplete grade will result in it being changed to a grade of “F.”
- **W**  Withdrawn; given for courses from which the student officially withdrew or dropped during the fourth through fifth weeks of classes or equivalent or for which the student petitioned for withdrawal.

**FINANCIAL ASSISTANCE**

**Graduate Teaching Assistantships**
Assistantships are awarded through the Neuroscience, Cell Biology and Physiology Department and require students to spend about 20 hours per week assisting either in instruction, research, or academic support. Graduate assistants are required by the graduate school to register for a minimum of six hours of graduate credit per semester. Students who are assisting in instruction are required to enroll in Topics of Instruction (ANT 7000) for each semester they teach. Assistantships are usually awarded to second year students. For information regarding assistantships, contact the NCBP Department Graduate Program Director.
ADMISSION AND REGISTRATION

Admission Categories

Regular Status

The student is admitted as fully qualified to pursue a program leading toward a graduate degree.

Provisional Status

Under certain conditions, a student may be admitted provisionally (for one term only), pending receipt of credentials. If admission requirements are not met during the term in which a student was admitted provisionally, registration for future terms will be denied and the student will lose graduate credit for any graduate courses completed during the semester.

Conditional Status

The student who does not meet the admission requirements for regular status, or who has conditions placed on his or her admission by the Department of NCBP, is admitted to the anatomy degree program in this status. Graduate credit earned while in this status will apply toward degree requirements. If all admission requirements are satisfied and the student has completed the first 8 hours of graduate credit, after being admitted into this status, with a 3.0 GPA, regular status will be granted upon approval of the graduate program. A student who does not meet these conditions will be dismissed from the Graduate School.

Nondegree Status

A student who does not plan to work toward a degree, or does not meet the admission requirements of the Graduate School, may be admitted on a nondegree basis in order to take graduate courses. A student cannot receive a degree while in this status. A student in nondegree status must maintain a 3.0 GPA. Furthermore, a student in this status who does not have a 3.0 GPA during the semester in which he or she completes 8 hours of graduate course work while in this status will be dismissed. [This option involves admission to the Graduate School, not the Department of NCBP. Written permission to enroll in each anatomy course is obtained from the appropriate course director.]
Registration

Students must be admitted to the Graduate School in order to register for and earn graduate credit. The academic year is divided into two semesters (fall and spring) and a summer session. Students should register by the period indicated in the Class Schedule.

Upon completion of the admission requirements and acceptance by the Graduate School, students are authorized to register. Registration must be completed by the date indicated in the Class Schedule.

Students cannot register after the first week of the term without instructor permission. Fees must be paid on or before the date scheduled. No students may be admitted to classes for which they have not been properly registered.

Refer to the sample ‘Permission to Register’ form on the next page. All anatomy, physiology, and neuroscience courses require the course director’s permission to register. Advisor approval is by the Program Director.

Auditing Courses

Graduate students may audit courses with the approval of the course instructor. All audits must be clearly indicated on the registration form. Changes from audit to credit or credit to audit cannot be made after the first week of the term. The fee per credit hour for auditing a course is the same as for credit courses.

Withdrawal From Courses

Students may drop a course without a grade appearing on their record or withdraw from a course with a "W" appearing on their transcript for the course grade up to specific dates each term. Refer to the Class Schedule for the time periods that are applicable to dropping or withdrawing from a class. Students who stop attending a course and do not make an official withdrawal through WINGS Express or the Office of the Registrar will receive a grade of "F" or "X" at the instructor's discretion. The "X" grade remains on the students' permanent record and is computed in the grade point average as an "F". Non-attendance of the courses or notification to an instructor does not constitute official withdrawal.

Course Repeat

Graduate students may repeat only two courses previously taken for which the grade received was below a “B”. Only the hours and grade points earned the second time the course is taken will be included in the computation of the grade point average and the meeting of degree requirements. Repeats are permitted only twice in any master’s degree program. Graduate students may repeat a repeated course a second time to satisfy
completion of a required course. Under these circumstances both courses are averaged into the graduate cumulative grade point average.
Continuing Registration

Note: *Each semester prior to registering*, make an appointment with the Program Director.

FOR ALL STUDENTS DOING THE THESIS OPTION:

Students must be registered for at least 1 hour of graduate credit as designated by the NCBP department *during the semester in which the successful defense of a thesis is accomplished.*
ACADEMIC POLICIES AND REQUIREMENTS FOR THE MASTER’S DEGREE

Program of Study
A student's program of study is administered by the Neuroscience, Cell Biology and Physiology Department and is subject to approval by the Graduate School. The program of study is a defined program that is negotiated between a student and an academic department offering a program. The institution specifically indicates that it will award the degree sought by the student if the work stipulated in the program of study is satisfactorily completed. Similarly, a student specifically agrees to the responsibility for completing the program as stipulated in his or her program of study. Programs of study should be consistent with published curricula and degree requirements.

The program of study will be used by the Graduate School to certify students for graduation. Degree certifications, transfer credit requests, and petitions will not be processed without a completed current and/or amended program of study on file in the student’s academic folder in the Graduate School.

Use the sample Program of Study on the next two pages as a guide when completing the form. The form can be obtained from the Program Director; sign and return the completed form to the Program Director.

Credit Hour Requirement
All master’s degree programs at the university require completion of 30 or more credit hours of graduate course work. In the Anatomy Program and in the Physiology and Neuroscience Program, the minimum number of credit hours for the Thesis option is 30; for the Anatomy Course option, the minimum is 33-34 credit hours.

Residence Requirements
A minimum of 50% of the required graduate credit hours toward the master’s degree must be completed at Wright State.

Academic Standards
All students in graduate study programs are expected to maintain a minimum grade point average of 3.0. The grade of C is the minimum passing grade for graduate credit. However, no more than six credit hours of C may be applied toward a master’s degree. The attainment of a large proportion of C grades, even when balanced by A’s, can be considered by the faculty as unsatisfactory course work. A course taken for graduate credit in which a D is received may not be applied toward the requirements of a graduate degree. An average of 3.0 for all graduate course work is required for graduation.

Student Evaluation
At the end of 8 credit hours of graduate work, the Graduate School will review a student’s grade point average. Based on this review, a student who has a cumulative grade point average of less than 3.0 may be placed on probation or dismissed from the Graduate School.
# Program of Study

Department of Neuroscience, Cell Biology and Physiology  
Wright State University  
Dayton, Ohio 45435

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**Degree sought:** Master of Science  
**College of Science and Mathematics**  
**Thesis required**  
Yes ____ No ____  
**Anatomy**  
Major Major number

**Student’s name/Last, first, middle**  
**Student’s UID number**

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### Planned Graduate Program

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**THESIS OPTION**  
**ANT 8990**  
Research  
**30**

**COURSE OPTION**  
**ANT 7000**  
Topics of Instruction  
**33**

**COURSE OPTION-TEACHER EDUCATION**  
**ED 6660**  
Adolescent and Young Adult Science  
**34**

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**Acceptance/Signature**

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<th>Program director</th>
<th>Date</th>
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Program of Study
Department of Neuroscience, Cell Biology and Physiology
Wright State University
Dayton, Ohio 45435

XXXX, XXXX, XXXX
Student's name/Last, first, middle

UXXXXXXXX
Student's UID number

Degree sought: Master of Science

College of Science and Mathematics

Physiology & Neuroscience 417
Major
Major number

Thesis required
Yes _____ No _____

Project required
Yes _____ No _____

Planned Graduate Program

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<td>S/</td>
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<td>Research</td>
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</table>

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Acceptance/Signature

Student____________________________________ Program director____________________________________ Date_________________________

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Probation

A student placed on probation will be required to change this status by achieving a cumulative grade point average of 3.0 within the completion of the next 8-semester hours of credit work. Failure to achieve the 3.0 grade point average will result in the student’s dismissal from the Graduate School. If a portion of these credits is in research for the thesis requirement, the NCBP Department must certify the student’s eligibility to continue studies at the university.

Thesis

The Anatomy Master’s Thesis Option and the Physiology and Neuroscience Master’s Thesis Option specify the presentation of a thesis as a requirement for the master’s degree. Students completing this requirement should secure a copy of the Graduate Thesis/Dissertation Handbook, published by the Graduate School and available in the graduate office. The requirements outlined in this manual are basic minimal criteria that have been approved by the Graduate Council for preparing the thesis. Students should seek the advice of their thesis supervisors and departments for further details. Students are encouraged, but not required, to obtain a format check prior to the final deposit of the thesis. This format check significantly reduces the likelihood of a last-minute rejection.

One (1) electronic copy of the thesis, in portable document format (pdf), must be deposited with OhioLINK not later than 30 days after the end of the semester in which the degree will be granted (due dates are published by the Graduate School). The electronic thesis and dissertation is called an ETD. OhioLINK, in Columbus, is the repository for ETD’s for the state university system in Ohio.

Students may seek assistance in preparing and setting up their ETD files either from the Graduate School (E344 Student Union) or at the Student Technical Assistance Center (STAC) in 240 Paul Laurence Dunbar Library. The ETD submitted to OhioLINK must be carefully produced and free of errors in style, mechanics, and format; therefore, a format check by the Graduate School in advance of submitting the final ETD is strongly recommended. The student should submit the ETD file as an email attachment to etd@wright.edu or on a CD to the Graduate School for the format check.

Once the format has been checked and all additions and corrections made, the student may submit the final ETD directly to OhioLINK at http://etd.ohiolink.edu/submit/ or through the Graduate School, either as an e-mail attachment or on CD-Rom, for transmittal to OhioLINK. The ETD is e-mailed as an attachment to OhioLINK, or it can be submitted to the Graduate School either as an e-mail attachment to etd@wright.edu or on a CD. When a Wright State ETD has been received, OhioLINK notifies the Graduate School of receipt by e-mail. The ETD is not placed online at OhioLINK until the Graduate School has approved it for release.
The department program office would like to have one paper or electronic copy of the completed and approved thesis. Students are responsible for paying binding fees for their own personal copies.

One original paper copy of the signed approval page must be submitted to the Graduate School before the student’s ETD can be approved. The signed approval page is kept on file in the Graduate School. The ETD will be submitted to OhioLINK, either by the student or the Graduate School, with the approval page containing the typed names of the faculty, but with no signatures. The signature of the department chair on the original approval page of the thesis verifies only that the student has successfully passed the oral defense and that the format is acceptable to the department. The Dean of the Graduate School must approve the final copy.

Time Limit

* A student must complete all requirements for a master’s degree within seven years.*

Graduate students who fail to take courses or otherwise to pursue their graduate education for a period of one calendar year will automatically be retired from the active files of the Graduate School. Reapplication for admission will be required to reactivate the student’s records.

Fresh Start

Graduate students may request a "fresh start" when changing or returning to graduate programs within the Graduate School. A "fresh start" is defined as beginning a graduate program and having the graduate academic record recalculated to reflect no hours attempted and no graduate grade point average for the new program. A "new program," for fresh start purposes, is defined as a program into which a student transfers while in active status or a program to which a student returns from inactive status. All courses previously taken (and grades earned) at Wright State will remain on the student’s academic record.

Course work completed in a previous Wright State program or other institutions' graduate programs will *not* be automatically transferred or applied to the requirements of the new program. The new graduate program may, however, recommend to the Graduate School which courses previously taken are acceptable for transfer into the new program.

A student granted a fresh start will be admitted into the new program as a *conditional* degree-seeking student. The new program must be completed within a minimum of 30 semester hours of graduate credit. The seven-year rule for completing the program requirements starts with the quarter in which the student first registers for courses required for the new program. Only one fresh start will be granted to a student.
Graduation

The following is a summary of the requirements for a Master’s Degree.

1. Completed Program of Study on file in the Graduate School.
2. Completion of the requirements for the graduate degree within seven calendar years.
3. Achievement of a cumulative grade point/hour ratio of at least 3.0 in all courses taken for graduate credit (no more than nine hours of C are acceptable).
4. Successful completion of an approved thesis (if required).
5. Presentation of an approved thesis (if required).
6. Registration during the quarter in which the thesis is defended.
7. Successful completion of the final comprehensive examination (if required).
8. Presentation of an approved scholarly project (if required).
9. Completion of a minimum of 30 credit hours of program required graduate credit. At least 50% of the graduate credit must have been completed at Wright State.