

ANATOMY

Graduate Program Head	Patricia J. McLaughlin
Program Code	ANAT
Campus(es)	Hershey (Ph.D., M.S.)
Degrees Conferred	Doctor of Philosophy (Ph.D.) Master of Science (M.S.) Dual-Title Ph.D. in Anatomy and Clinical and Translational Sciences
The Graduate Faculty	View (https:// secure.gradsch.psu.edu/gpms/? searchType=fac&prog=ANAT)

The Anatomy graduate program provides students curricular training with a unique focus on human anatomy, health and disease, and the opportunity for concentrated research in a related discipline such as:

- Biochemistry
- Cancer biology
- Cell biology
- Embryology
- Genetics
- Immunology
- Neuroscience
- Pharmacology
- Physiology
- Structural biology
- Virology

Students receive rigorous training that provides the skills and scholarship necessary to be educators in human anatomy and leaders in biomedical research. This program also provides training for other endeavors that benefit from a rigorous scientific background, including education, law, journalism, and public policy. A dual-title degree in Anatomy and Clinical and Translational Sciences expands the educational experience of students training in anatomical science to include training, via a unique curriculum and research focus, for career paths that involve clinical trials or clinical research programs.

The Anatomy graduate program is an interdepartmental program that engages faculty from 4 basic science and clinical science departments throughout Penn State University on multiple campuses. This broad-reaching program provides students a wide ranging understanding of multiple disciplines with specific expertise in a chosen area, and encourages interdisciplinary research that is the hallmark of biomedical sciences in the 21st century.

Admission Requirements

Applicants apply for admission to the program via the Graduate School application for admission (<https://gradschool.psu.edu/graduate-admissions/how-to-apply/>). Requirements listed here are in addition to Graduate Council policies listed under GCAC-300 Admissions Policies (<https://gradschool.psu.edu/graduate-education-policies/>).

1. Completed official Penn State Graduate School Application for Admission (<http://gradschool.psu.edu/prospective-students/how-to-apply/>); Master's or Doctoral Degree
2. Three letters of recommendation
3. Statement of goals including

- a. your reasons for applying to the Anatomy graduate program
 - b. particular areas of research interests if known, and
 - c. long-term career goals
4. Post-secondary course work must include biochemistry and molecular biology or genetics.

Degree Requirements

Master of science (M.S.)

Requirements listed here are in addition to Graduate Council policies listed under GCAC-600 Research Degree Policies. (<https://gradschool.psu.edu/graduate-education-policies/>)

The Anatomy program actively recruits students to earn the academic degree of Master of Science. To receive the M.S. degree in Anatomy, at least 30 credits are required (400-, 500-, 600-, or 700-level) with a minimum of 18 credits from courses at the 500 and 600 level courses combined. The first-year fall curriculum provides 12 credits of the necessary core material that encompasses human gross anatomy, human embryology, and human microscopic anatomy (histology) for the anatomy degree. In addition, the Fall curriculum includes a one-credit colloquium which introduces the student to professionalism, scientific communication, and addresses manuscript evaluation and writing, as well as scientific methodology and techniques that will be discussed in subsequent coursework. The professionalism elements reinforce ethics courses but focus on regulatory issues of animal or patient use and research.

Code	Title	Credits
Required Courses		
ANAT 503	Gross Anatomy	6
ANAT 512	Human Embryology and Teratology	2
ANAT 505	Histology and Embryology I	2
ANAT 506	Histology and Embryology II	2
ANAT 590	Colloquium (1 credit assigned an "R" grade)	1
1 semester of a Biomedical Ethics course		1
Electives		
Elective Course Work ¹		10
Culminating Experience		
ANAT 600	Thesis Research	6
Total Credits		30

¹ NEURO 511 is highly recommended as an elective, but is optional.

Students must complete original laboratory research that culminates in a thesis. The thesis must be accepted by the advisers and/or committee members, the head of the graduate program, and the Graduate School, and the student must pass a thesis defense.

Doctor of Philosophy (Ph.D.)

Requirements listed here are in addition to Graduate Council policies listed under GCAC-600 Research Degree Policies. (<https://gradschool.psu.edu/graduate-education-policies/>)

The first-year Fall curriculum provides 12 credits of the necessary core material that encompasses human gross anatomy, human embryology, and human microscopic anatomy (histology) for the anatomy degree. In addition, the Fall curriculum includes a one-credit colloquium which introduces the student to professionalism, scientific communication,

and addresses manuscript evaluation and writing, as well as scientific methodology and techniques that will be discussed in subsequent coursework. The professionalism elements reinforce ethics courses but focus on regulatory issues of animal or patient use and research. The first-year Spring curriculum includes one 3-credit course focusing on neuroanatomical studies.

In addition, during the first year, students complete three research rotations that expose them to the wide range of research interests of The Pennsylvania State University Graduate Faculty from both basic and clinical science departments at the College of Medicine in Hershey. These rotations serve to inform the students with regard to choosing a thesis or dissertation adviser and forming a Ph.D. committee. In addition students are advised to take ethics, statistics and electives. The doctoral students also complete their Qualifying Examination which involves an oral presentation and a written examination on anatomical coursework. In the Fall of the second year, the students register for 2 credits of Supervised Teaching that allows them to have a full complement of experiences in lecturing, dissecting, preparation of exams, and tutoring students. In addition, the requirements involve a 6-credit BMS course on Biomedical Sciences that encompasses didactic and interactive course work on principles of basic molecular and cellular principles of biomedical science.

In addition, each student must complete research rotations, as well as elective courses that may include statistics or other electives. Each student for the Ph.D. degree must fulfill written and spoken English communication requirements that are satisfied by preparing written and oral reports describing the laboratory rotations during the first year.

Code	Title	Credits
Required Courses		
<i>Fall Semester</i>		
ANAT 503	Gross Anatomy	6
ANAT 505	Histology and Embryology I	2
ANAT 506	Histology and Embryology II	2
ANAT 512	Human Embryology and Teratology	2
ANAT 590	Colloquium (1 credit assigned an "R" grade)	1
<i>Spring Semester</i>		
NEURO 511	Neurobiology II	3
PHS 500	Research Ethics for Clinical Investigators	1
ANAT 596	Individual Studies	1-3
<i>Second Year</i>		
BMS 501	Regulation of Cellular & Systemic Energy Metabolism	3
BMS 502	Cell and Systems Biology	3
ANAT 602	Supervised Experience in College Teaching	2-3
Electives		
Elective courses (including statistics and ethics if not otherwise completed) that are selected in consultation with the student's dissertation adviser and Ph.D. committee		
Total Credits		26-29

At the end of the first year, continuation in the program is determined by performance in course work, laboratory rotations, and the ANAT graduate program Qualifying Examination. Students join their research laboratory by July 31 of the first year.

The Ph.D. committee is formed upon entry into the dissertation laboratory, and must comply with the Graduate Council Ph.D. committee requirements (<http://gradschool.psu.edu/graduate-education-policies/gcac/gcac-600/phd-dissertation-committee-formation/>). The committee must include three Anatomy graduate program faculty, with at least *two* faculty members in the major field.

Ph.D. students must pass a written Comprehensive Examination in the format of a grant application prior to the end of the fifth semester of enrollment. As part of this examination, the student also gives an oral presentation of this proposal to the candidate's Ph.D. committee.

It is expected that the Ph.D. candidate will have at least one paper submitted for publication in a major peer-reviewed scientific journal prior to the final oral examination (the dissertation defense). The dissertation must be prepared and defended by each Ph.D. candidate. The dissertation must be accepted by the Ph.D. committee, the head of the graduate program, and the Graduate School.

Dual-Titles

Dual-Title Ph.D. in Anatomy and Clinical and Translational Sciences

Requirements listed here are in addition to requirements listed in GCAC-208 Dual-Title Graduate Degree Programs (<https://gradschool.psu.edu/graduate-education-policies/gcac/gcac-200/gcac-208-dual-titles/>).

Admission Requirements

Potential dual-title trainees will express an interest in the dual-title degree as early as during the recruitment process for the Anatomy Graduate Program, and may apply for the dual-title Ph.D. in Anatomy and Clinical and Translational Sciences following admission to the Graduate School and to the Anatomy program and prior to taking the qualifying examination in Anatomy, no later than the end of the third semester of graduate study in Anatomy. Students interested in the dual-title degree will be considered for admission to the Clinical and Translational Sciences program by a committee consisting of the Clinical and Translational Sciences program co-directors and faculty affiliated with the Clinical and Translational Sciences dual-title program. Refer to the Admission Requirements section of the CTS Bulletin page (<http://bulletins.psu.edu/graduate/programs/majors/clinical-translational-sciences/>).

Degree Requirements

To qualify for the dual-title degree, students must satisfy the degree requirements for the Ph.D. degree, listed on the Degree Requirements tab. In addition, students must complete the degree requirements for the dual-title Ph.D. in CTS, listed on the CTS Bulletin page (<http://bulletins.psu.edu/graduate/programs/majors/clinical-translational-sciences/>). Reciprocity between the CTS dual-title program and the Anatomy graduate program allows for up to 7 of the elective credits required for the Clinical and Translational Sciences degree to be met simultaneously (ethics, statistics, and 1 elective).

Anatomy graduate students accepted to the Clinical and Translational Sciences dual-Title program will take the qualifying examination at the end of the third semester of graduate training:

1. to allow exposure to the Clinical and Translational Sciences curriculum in the Spring semester of the first year and Fall semester of the second year, which will prepare the students for the integrated content of the dual-title qualifying exam, and

2. to allow sufficient time to identify and assure commitment of an appropriate dissertation adviser who embraces the dual-title program of the student.

During the qualifying examination, the student will also be assessed for the dual-title program, and at least one member of the qualifying examination committee must come from the dual-title program. Faculty members who hold appointments in both programs may serve in a combined role.

In addition to the general Graduate Council requirements for Ph.D. committees (<http://gradschool.psu.edu/graduate-education-policies/gcac/gcac-600/phd-dissertation-committee-formation/>), the Ph.D. committee of an Anatomy and Clinical and Translational Sciences dual-title doctoral degree student must include at least one member of the Clinical and Translational Sciences Graduate Faculty. Faculty members who hold appointments in both programs' graduate faculty may serve in a combined role.

The committee chair will be a member of the Graduate Faculty in the primary graduate program. Faculty members who hold appointments in both the primary graduate program and the CTS program may serve in a combined role. If the committee chair does not serve in this combined role, the faculty member representing the CTS program must be designated co-chair of the committee. The CTS representative(s) will be expected to assist in constructing and evaluating comprehensive examination questions that cover the secondary area of study.

Upon completion of the doctoral dissertation, the candidate must pass a final oral examination (the dissertation defense) to earn the Ph.D. degree. Students enrolled in the dual-title program are required to write and orally defend a dissertation on a topic that reflects their original research and expertise in both Anatomy and Clinical and Translational Sciences. The dissertation must be accepted by the Ph.D. committee, the head of the graduate program, and the Graduate School.

Minor

A graduate minor is available in any approved graduate major or dual-title program. The default requirements for a graduate minor are stated in Graduate Council policies listed under GCAC-600 Research Degree Policies (<https://gradschool.psu.edu/graduate-education-policies/>) and GCAC-700 Professional Degree Policies (<https://gradschool.psu.edu/graduate-education-policies/>), depending on the type of degree the student is pursuing:

- GCAC-611 Minor - Research Doctorate (<https://gradschool.psu.edu/graduate-education-policies/gcac/gcac-600/gcac-611-minor-research-doctorate/>)
- GCAC-641 Minor - Research Master's (<https://gradschool.psu.edu/graduate-education-policies/gcac/gcac-600/gcac-641-minor-research-masters/>)
- GCAC-709 Minor - Professional Doctorate (<https://gradschool.psu.edu/graduate-education-policies/gcac/gcac-700/gcac-709-professional-doctoral-minor/>)
- GCAC-741 Minor - Professional Master's (<https://gradschool.psu.edu/graduate-education-policies/gcac/gcac-700/gcac-741-masters-minor-professional/>)

Student Aid

Graduate assistantships available to students in this program and other forms of student aid are described in the Tuition & Funding (<https://gradschool.psu.edu/graduate-funding/>) section of The Graduate School's

website. Students on graduate assistantships must adhere to the course load limits (<https://gradschool.psu.edu/graduate-education-policies/gsad/gsad-900/gsad-901-graduate-assistants/>) set by The Graduate School.

Courses

Graduate courses carry numbers from 500 to 699 and 800 to 899. Advanced undergraduate courses numbered between 400 and 499 may be used to meet some graduate degree requirements when taken by graduate students. Courses below the 400 level may not. A graduate student may register for or audit these courses in order to make up deficiencies or to fill in gaps in previous education but not to meet requirements for an advanced degree.

Anatomy (ANAT) Course List (<https://bulletins.psu.edu/university-course-descriptions/graduate/anat/>)

Learning Outcomes

Master of Science (M.S.)

1. **KNOW:** Anatomy master's degree graduates will demonstrate a) a broad base of knowledge in the anatomical sciences including human gross anatomy, human microscopic anatomy (histology), and human development, b) a broad base of biological knowledge required to understand the molecular, cellular, and organismal processes related to biomedical sciences; c) a broad understanding of experimental approaches used to investigate biomedical problems; d) in-depth knowledge within their specific areas of research interests, and e) the highest standards of research ethics.
2. **CREATE:** Anatomy master's degree graduates will creatively synthesize theory and literature to generate questions, ideas, or hypotheses addressing current problems in human health and disease, and will devise critical experimental approaches to test these ideas and hypotheses.
3. **APPLY:** Anatomy master's degree graduates will perform hypothesis-driven, original research that addresses current problems in biomedical sciences - often related to their mentor's primary research.
4. **COMMUNICATE:** Anatomy master's degree graduates will perform independent and original research studies that address current problems in biomedical sciences leading to rigorous and reproducible experimental outcomes.
5. **CRITICAL THINKING:** Anatomy master's degree graduates will critically evaluate experimental approaches and results of their own research and the research of others.
6. **PRACTICE:** Anatomy master's degree graduates will conduct all activities in research practices and interactions with medical professionals with the highest level of ethics and integrity.
7. **APPLY:** Anatomy master's degree graduates will capitalize on their knowledge and research skills to obtain placement in professional schools, to continue their education in alternative careers, and/or to obtain careers in biomedical research or anatomical teaching.

Doctor of Philosophy (Ph.D.)

1. **Know:** Anatomy graduates will demonstrate a) a broad base of knowledge in the anatomical sciences including human gross anatomy, human microscopic anatomy (histology), and human development, b) a broad base of biological knowledge required to understand the molecular, cellular, and organismal processes related to biomedical sciences; c) a broad understanding of experimental

approaches used to investigate biomedical problems; d) in-depth knowledge within their specific areas of research interests, and e) the highest standards of research ethics.

2. **Create:** Anatomy graduates will synthesize material in the anatomical sciences to formulate didactic lectures, flipped-classrooms, problem-based learning modules, and team-based learning. Students will creatively organize material for classroom and laboratory (cadaver prosections) presentations. Graduates will creatively synthesize theory and literature to generate questions, ideas, or hypotheses addressing current problems in human health and disease, and will devise critical experimental approaches to test these ideas and hypotheses.
3. **Apply:** Anatomy graduates will demonstrate their anatomical knowledge by providing lectures to first and second year medical students and physician assistant students, as well as upper-class medical students and residents. Graduates will be involved in hands-on training of medical and PA students in cadaver-based laboratory settings including (i) assisting in preparation of laboratory and written examinations, (ii) identification of structures for laboratory practical exams, and (iii) preparing and grading written exams. Graduates will perform independent and original research studies that address current problems in biomedical sciences leading to rigorous and reproducible experimental outcomes.
4. **Critical thinking:** Anatomy graduates will be required to interpret a large body of knowledge and condense material to provide important components to medical and physician assistant students. In terms of research, graduates will critically evaluate experimental approaches and results of their own research and the research of others.
5. **Communicate:** Anatomy graduates will convey knowledge on the subjects of human gross anatomy, embryology and microscopic anatomy (histology) and neuroanatomy to a variety of audiences including undergraduate students (Brain Bee), medical students, physician assistant students, as well as to graduate medical students in residency programs at Penn State Hershey. In terms of research activities, graduates will convey ideas, experimental approaches, and results in clear, concise, well-organized papers, posters, proposals, oral presentations, and discussions.
6. **Professional practice:** Anatomy graduates will begin interactions with other professionals within 2 years of matriculation, as they are included in teams of faculty involved in medical education oversight and curriculum design and review. In terms of research, graduates will collaborate in a collegial and ethical manner with other professionals within their field or with diverse scientific backgrounds.
7. **Career development:** Anatomy graduates will pursue academic teaching positions at undergraduate school, graduate schools with allied health science centers, and professional medical universities with programs in a variety of medical health fields. Graduates will participate in, and attend, professional career seminars at the College of Medicine, Career Day activities, and maintain a yearly IDP (individual development plan). In many cases for university employment, both teaching and research expertise are required.

Contact

Campus

Hershey Med Ctr

Graduate Program Head

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Program Website

View (<http://med.psu.edu/anatomy-phd/>)