

# ANATOMY – M.S., PH.D.

The School of Medicine's Division of Anatomy offers curricula leading to the Master of Science or the Doctor of Philosophy degree. The core curriculum coursework provides a broad biomedical background, with opportunities for qualified students to not only study all aspects of human morphology from both didactic and investigative points of view, but to also develop a special area of research interest. Study and research on other species and in other biomedical disciplines may be included in the student's curriculum. While working on a significant research problem, students are introduced to research methods through scientific literature and the laboratory. They acquire experience in scientific communication by participating in seminars, writing critical reviews, and reporting results of research experience either in thesis/dissertation form or as publishable/published papers.

The Doctor of Philosophy degree is designed to prepare the graduate for a career in independent research and teaching in university, clinical, biotechnological, or government environments. In addition to technical skills, doctoral degree students are expected to develop creativity and independence.

The Master of Science degree provides content appropriate for persons preparing to teach at the secondary level or in related professional school areas, or for persons intending to pursue careers as research technicians.

The first-year curriculum includes a course sequence taught by an interdisciplinary faculty that integrates all disciplines of the biomedical basic science areas—moving from molecules through cellular mechanisms to integrated systems. In addition, a supplemental course covers research-related topics such as scientific communication and integrity, information handling and statistics, and successful grant-proposal writing. Students learn of new developments in the biomedical sciences through weekly seminars and gain presentation skills in a weekly student presentation seminar series. During the subsequent years, formal courses continue to broaden and integrate, into a meaningful whole, an understanding of the clinical consequences of cellular events.

## Religion requirement

Students in the Master of Science (M.S.) degree curriculum are required to complete one, 3-unit graduate-level religion course. Students in the Ph.D. degree curriculum are required to complete three graduate-level religion courses of 3 or more units each. Please see curriculum for details.

## Research units

A student will, at all times, enroll for research units. The units should be spread over the time it takes to complete the thesis or dissertation research satisfactorily.

## Program learning outcomes

By the end of the anatomy program, the graduate should be able to:

1. Apply the biomedical sciences to the study of human anatomy.
2. Demonstrate mastery of molecular, cellular, and integrative aspects of anatomy.
3. Interpret current literature in anatomy.
4. Make original contributions to biomedical science.

5. Demonstrate scientific and professional ethics.
6. Explain the process of applying for external funding.\*

\*This objective is not applicable to M.S. degree students.

## First-year curriculum (Ph.D. degree) Admissions

In addition to Loma Linda University (<http://llucatalog.llu.edu/about-university/admission-policies-information/#admissionrequirements>) application requirements, the applicant must also complete the following requirements:

- A bachelor's degree from an accredited U.S. college or the equivalent from an international university.
- General test of the Graduate Record Examination (GRE): A total (verbal plus quantitative) score of no less than the sum of the scores corresponding to the 50th percentile of each, with neither score less than the 35th percentile; analytical writing 4.0. GRE scores older than five years from the date of matriculation are not considered.

Course prerequisites

**PLEASE NOTE:** CLEP (College-Level Examination Program), pass/fail performances, and online classes are not acceptable for the science required courses. Additionally, science credits earned in professional schools (e.g., allied health professions, business, dentistry, nursing or pharmacy) do not fulfill requirements for admissions to the graduate program.

The program reserves the right to decide on the equivalence of courses presented by the applicant.

## M.S. Degree

A minimum of 45 units is required for the M.S. degree, as detailed in the table below. Two options—a research track and a coursework track—are available. Students must maintain a G.P.A. of at least 3.0. Students must adhere to all University and program policies as published in the *Student Handbook*, University CATALOG, or *Student Guide*. Policies and requirements are subject to change.

### Basic science core

IBGS 501	Biomedical Communication and Integrity	2
IBGS 502	Biomedical Information and Statistics	2
<b>Major</b>		
ANAT 516	Neuroscience GS	6
ANAT 541	Gross Anatomy GS	7
ANAT 542	Cell Structure and Function GS	7
ANAT 544	Human Embryology Lecture	2

### Seminars

IBGS 604	Introduction to Integrative Biology Presentation Seminar	1
IBGS 607	Integrated Biomedical Graduate Studies Seminar <sup>1</sup>	1

### Religion

RELR 540	Wholeness and Health <sup>2</sup>	3
----------	-----------------------------------	---

### Degree completion options

<b>15</b>	
Coursework track:	
ANAT__	Anatomy/Embryology electives (15 units)

Research track:

ANAT 697	Research (14 units)	
IBGS 605	Integrative Biology Presentation Seminar (1 unit)	
<b>Total Units</b>		<b>45</b>

<sup>1</sup> Registration and attendance required every quarter in residence, but units do not count toward total required for graduation.

<sup>2</sup> Fulfills service learning requirement.

#### NONCOURSE REQUIREMENTS

Coursework option: a comprehensive written examination over the graduate coursework in lieu of writing a thesis.

Research option: pass an oral examination administered by the student's graduate guidance committee after thesis has been completed.

#### NORMAL TIME TO COMPLETE THE PROGRAM

Two (2) years—based on full-time enrollment; part time permitted.

M.S., Ph.D. Comparison (<http://llucatalog.llu.edu/medicine/pathology/comparison/>)

## Ph.D. Degree

For the Ph.D. degree, students must complete a minimum of 70 units, as detailed in the table below, and must maintain a G.P.A. of at least 3.0. In addition, doctoral students are required to pass both written and oral comprehensive examinations in order to advance to candidacy. They must successfully defend their dissertations before their guidance committee prior to being awarded the Ph.D. degree.

Students must adhere to all University and program policies as published in the *Student Handbook*, University CATALOG, or *Student Guide*. Policies and requirements are subject to change.

#### Basic science core

IBGS 501	Biomedical Communication and Integrity	2
IBGS 502	Biomedical Information and Statistics	2
IBGS 503	Biomedical Grant Writing	2
IBGS 511	Cellular Mechanisms and Integrated Systems I	6
IBGS 512	Cellular Mechanisms and Integrated Systems II	6
IBGS 522	Cellular Mechanisms and Integrated Systems II Journal Club	2
IBGS 523	Cellular Mechanisms and Integrated Systems III Journal Club	2

#### Major

ANAT 516	Neuroscience GS	6
ANAT 541	Gross Anatomy GS	7
ANAT 542	Cell Structure and Function GS	7
ANAT 544	Human Embryology Lecture	2

#### Seminars

IBGS 604	Introduction to Integrative Biology Presentation Seminar	1
IBGS 605	Integrative Biology Presentation Seminar (1.0) <sup>2</sup>	2
IBGS 607	Integrated Biomedical Graduate Studies Seminar <sup>1</sup>	1

#### Religion

RELE 525	Ethics for Scientists	3
RELR 540	Wholeness and Health <sup>3</sup>	3
RELT 617	Seminar in Religion and the Sciences	3

#### Research/Dissertation or Thesis

ANAT 697	Research (1-8)	12
IBGS 696	Research Rotations (1)	2
<b>Total Units</b>		<b>70</b>

<sup>1</sup> Registration and attendance required every quarter in residence, but units do not count toward total required for graduation.

<sup>2</sup> Fulfills service learning requirement.

<sup>3</sup> Fulfill service learning requirement.

#### NORMAL TIME TO COMPLETE THE PROGRAM

Four (4) years—based on full-time enrollment; part-time permitted.

M.S., Ph.D. Comparison (<http://llucatalog.llu.edu/medicine/pathology/comparison/>)

#### Courses

##### ANAT 301. Head and Neck Anatomy, DH. 4 Units.

Gross anatomy of the head and neck. Lecture and demonstration.

##### ANAT 303. General and Oral Histology and Embryology. 3 Units.

Microscopic study of fundamental cells, organs, tissues, and systems of the body. Analyzes in detail the pulp, periodontal tissues, alveolar process, oral mucosa, and calcified tissues of the tooth. Includes development of head and neck structures.

##### ANAT 507. Stem Cell Biology and Medicine. 4 Units.

Provides students with information on the latest developments in animal and human stem cell research and on the potential application of stem cells to medicine. Explores the derivation, manipulation, and differentiation of embryonic, germ, and adult stem cells. Lectures presented by faculty participating in stem cell research in areas of their expertise.

##### ANAT 510. Gross Anatomy. 8.5 Units.

Supports the organ system curriculum in the first year of medical education. Teaches students the morphological setting upon which clinical knowledge and experiences are built. Approaches anatomy from a gross structural perspective. Students use knowledge to recognize clinical variations and abnormalities in preparation for their medical careers.

##### ANAT 515. Human Embryology. 2 Units.

Reviews the morphologic processes and molecular basis of human development. Includes the production of human gametes, fertilization, gastrulation, placentation, and development of the major organ systems. Emphasizes clinically relevant features of pregnancy and developmental processes that are susceptible to malformation.

##### ANAT 516. Neuroscience GS. 6 Units.

Integrated approach to the fundamentals of neuroanatomy and neurophysiology, with applications to clinical neurology.

##### ANAT 525. Special Topics: Advanced Dissection. 1-4 Units.

Detailed dissection of a specified body region. Demonstration and lecture. May be repeated for additional credit. Offered on demand. Prerequisite: ANAT 541; or equivalent with approval of program director or department chair.

##### ANAT 527. Advanced Clinical Anatomy for Nurse Anesthetists. 5 Units.

Emphasizes detailed description and applied anatomy of the body systems (cardiovascular, respiratory renal, hepatic nervous, and endocrine) relevant to the nurse anesthetist.

**ANAT 529. Gross Anatomy and Embryology. 10.5 Units.**

Provides the morphological foundation upon which clinical knowledge and experiences are built. Supports the organ-system curriculum in the freshman year. Approaches anatomy from gross structural and embryological perspectives. Provides students with the knowledge necessary to recognize clinical variations and abnormalities during their medical careers.

**ANAT 541. Gross Anatomy GS. 7 Units.**

Anatomy of the head, neck, locomotor system, thorax, abdomen, pelvis, and perineum. Correlated with radiology, applied features, and embryological development. Summer and Autumn quarters.

**ANAT 542. Cell Structure and Function GS. 7 Units.**

The microscopic structure of cells, tissues, and organs of the human body. Autumn Quarter.

**ANAT 544. Human Embryology Lecture. 2 Units.**

The plan of development as it pertains to humans. Considers principles.

**ANAT 546. Oral Histology. 2 Units.**

Provides an in-depth study of tissues found in the oral environment and includes an introduction to orofacial development. Prerequisite: ANAT 542.

**ANAT 548. Introductory Flow Cytometry. 1 Unit.**

Introduction to basic flow cytometry-based techniques used to identify experimental, basic science and translational research questions, and to develop research proposals. Includes flow cytometry sample preparation, and data collection, analysis, and presentation.

**ANAT 558. Applied Gross Anatomy GS. 3 Units.**

Emphasizes practical application of the anatomical knowledge covered in human gross anatomy. Considers applied anatomy problems involving biomechanical functions of the body, as well as application of anatomical principles to specific fields of human activity. Prerequisite: ANAT 541; or consent of instructor.

**ANAT 594. Directed Study in Anatomy. 1-7 Units.**

Intensive study of a selected topic approved by the chair of the department. Individual guidance by a staff member.

**ANAT 697. Research. 1-8 Units.****ANAT 699. Dissertation. 1-5 Units.****ANAT 891. Anatomy Elective. 1.5-18 Units.**

A self-designed and self-directed dissection elective in the fourth year of the MD curriculum with emphasis on the head, neck, abdomen, pelvis, thorax, back, or limbs—correlating basic anatomy with clinical applications.