Pathology

School of Medicine
M263 Medical Sciences Building
(573) 882-1201
pathology-anatomy.missouri.edu

About Pathology and Anatomical Sciences

The Department of Pathology and Anatomical Sciences in the School of Medicine, along with the department of Veterinary Pathobiology in the College of Veterinary Medicine, offers a PhD degree through the Pathobiology Area Program. Faculty also participate in other doctoral programs such as the Integrative Neuroscience Program, Genetics Area Program, and Molecular Pharmacology and Physiology. The MS degree is designed primarily to prepare students for supervisory roles in basic-science and clinical laboratories, and to offer greater in-depth study in pathology and anatomical sciences concurrent with studies leading to the PhD and/or MD degree.

Faculty

Professor G. E. Davis, W. J. Krause**, J. H. Miles, G. Y. Sun, C. V. Ward**
Associate Professor E. H. Adelstein*, A. A. Diaz-Arias*, E. A. Ingram, R. Mitra*
Lecturer D. L. DuPree, R. H. Dunn, S. D. Maddux*
Clinical Instructor J. Jones, D. V. Shin
Clinical Professor D. C. Miller*, M. Petrides*
Associate Clinical Professor A. D. Havey*
Assistant Clinical Professor M. Esebua, S. R. Frazier, C. C. Stacy*, M. X. Wang*
Assistant Research Professor R. R. Little
Assistant Research Professor J. Cui
Adjunct Professor M. J. Ravosa**, M. S. Stack**
Associate Professor Emeritus L. E. Spollen

* Graduate Faculty Member - membership is required to teach graduate-level courses, chair master’s thesis committees, and serve on doctoral examination and dissertation committees.
** Doctoral Faculty Member - membership is required to chair doctoral examination or dissertation committees. Graduate faculty membership is a prerequisite for Doctoral faculty membership.

Undergraduate

While MU does not offer undergraduate degrees specifically in pathology and anatomical sciences, the University does offer baccalaureate opportunities in a number of related areas in the other Schools and Colleges that make up the University. The catalog provides a complete list of these degree options (http://catalog.missouri.edu/degreesanddegreeprograms).

Graduate

- MS in Pathology (http://catalog.missouri.edu/undergraduategraduate/interdisciplinaryacademicprograms/pathology/ms-pathology-anatomical-sciences)

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Financial Aid from the Program

Some programs require an extra form or statement from those who wish to be considered for internal assistantships, fellowships or other funding packages. Check the program website or ask the program contact for details.

PTH_AS 2000: Basic Pathology
Provides nonmedical students with a general understanding of the essential nature of disease, including mechanisms of its development and cause/effect relationships.

Credit Hours: 2
Prerequisites: 5 hours Biological Science or equivalent and 5 hours Chemistry or PTH_AS 2201

PTH_AS 2201: Human Anatomy Lecture
A systems-based survey of human gross anatomy including structure, function and history. Internet access required: lectures and assignments will be online. Graded on A-F basis only.

Credit Hours: 3
Prerequisites or Corequisites: Minimum cumulative MU GPA of 2.5 required

PTH_AS 2203: Human Anatomy Laboratory
A systems-based survey of human gross anatomy. Internet access required: most materials will be online. One on-campus laboratory meeting per week. Graded A-F only.

Credit Hours: 2
Prerequisites or Corequisites: PTH_AS 2201
Prerequisites: Minimum cumulative MU GPA of 2.5

PTH_AS 2600: Cytology Female Genital Tract
A definitive study of normal and abnormal cellular changes occurring within the organ system by means of light microscopy with histologic correlation.

Credit Hours: 10
Prerequisites: instructor’s consent
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Description</th>
<th>Credit Hours</th>
<th>Prerequisites</th>
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</thead>
<tbody>
<tr>
<td>PTH_AS 2610</td>
<td>Respiratory Cytology</td>
<td>A definitive study of the normal and abnormal cellular changes occurring</td>
<td>4</td>
<td>instructor's consent</td>
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<td>within the system by means of light microscopy, with histologic correlation.</td>
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<tr>
<td>PTH_AS 2615</td>
<td>Cytology of Body Fluids</td>
<td>Normal and abnormal cellular changes within pleural, peritoneal, pericardial</td>
<td>4</td>
<td>instructor's consent</td>
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<td>and cerebrospinal fluids by means of light microscopy, with histologic</td>
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<td>correlation.</td>
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<tr>
<td>PTH_AS 2620</td>
<td>Gastrointestinal Cytology</td>
<td>A definitive study of the normal and abnormal cellular changes occurring</td>
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<td>instructor's consent</td>
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<td>within the system by means of light microscopy, with histologic correlation.</td>
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<tr>
<td>PTH_AS 2630</td>
<td>Urinary Cytology</td>
<td>Studies normal and abnormal cellular morphology from kidney, ureter and</td>
<td>4</td>
<td>instructor's consent</td>
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<td>bladder samples, with histologic correlation.</td>
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<td>PTH_AS 2640</td>
<td>Fundamentals of Medical Technology I</td>
<td>Emphasizes diseases and basic laboratory methods used in clinical laboratory</td>
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<td>areas: microbiology, hematology, immunology, virology, tissue typing, blood</td>
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<td>banking and chemistry.</td>
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<td>PTH_AS 2641</td>
<td>Fundamentals of Medical Technology II</td>
<td>Continuation of PTH_AS 2640.</td>
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<tr>
<td>PTH_AS 2642</td>
<td>Fundamentals of Medical Technology III</td>
<td>Continuation of PTH_AS 2640 and PTH_AS 2641.</td>
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<tr>
<td>PTH_AS 2650</td>
<td>Special Problems in Cytology</td>
<td>Relating hematologic morphologic findings in conventional body fluid</td>
<td>2</td>
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<td></td>
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<td>cytology; also review of techniques used in chromosome cultures and</td>
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<td>karyotyping, with emphasis on sex-related abnormalities.</td>
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<td>PTH_AS 2695</td>
<td>Fundamentals of Medical Technology I</td>
<td>Emphasizes diseases and basic laboratory methods used in clinical laboratory</td>
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<td>areas: microbiology, hematology, immunology, virology, tissue typing, blood</td>
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<td>banking and chemistry.</td>
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<td>PTH_AS 3420</td>
<td>Clinical Practicum</td>
<td>Presentation and application of concepts and laboratory method used</td>
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<td>in areas of immunochemistry, toxicology, mycology, uranalysis and</td>
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<td>cytogenetics.</td>
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<td>PTH_AS 3425</td>
<td>Hemostasis</td>
<td>Lectures and laboratory exercises in basic theory and techniques of</td>
<td>2</td>
<td>PTH_AS 3400, PTH_AS</td>
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<td>hemostasis including platelet function and disorders, plasma coabulation</td>
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<td>3410, PTH_AS 3415</td>
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<td>system, acquired and inherited hemostatic disorders.</td>
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<td>PTH_AS 3430</td>
<td>Clinical Immunology</td>
<td>Antigen-antibody reactions and their role in determining infectious, autoallergic</td>
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<td></td>
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<td>and inflammatory disease states.</td>
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<td>PTH_AS 3435</td>
<td>Blood Banking</td>
<td>Principles and techniques of transfusion practices related through</td>
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<td>lectures and experience in the blood bank laboratory.</td>
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<td>PTH_AS 3440</td>
<td>Clinical Hematology</td>
<td>Lectures and laboratory regarding procedures for diagnosing hematologic</td>
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<td>disorders. Experience in collection of specimens from patients; staining,</td>
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<td>counting and identifying blood and bone marrow cells.</td>
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<tr>
<td>PTH_AS 3445</td>
<td>Clinical Microbiology</td>
<td>Diagnostic procedures related to the isolation and identification to</td>
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<td></td>
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<td>infectious microorganisms; bacteria and parasites. Emphasis on human</td>
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<td>pathogens and their sensitivity patterns with commonly used antibiotics.</td>
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<td>PTH_AS 3450</td>
<td>Clinical Chemistry</td>
<td>Principles of quantitative analysis applied to the measurement of</td>
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<td>substances in biological fluids. Significance of these findings in the</td>
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<td>diagnosis and treatment of disease.</td>
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<tr>
<td>PTH_AS 3455</td>
<td>Principles of Management and Education</td>
<td>Lectures and discussion of management techniques and theories used in</td>
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<td>supervising laboratory personnel. Analysis of educational objectives and</td>
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<td>exam questions.</td>
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<tr>
<td>PTH_AS 3460</td>
<td>Research and Instructional Techniques</td>
<td>Involves library and laboratory research. Includes development of oral and</td>
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<td>written communications skills.</td>
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**PTH_AS 3485: Problems in Medical Technology**
Individual supervised work in an area of interest in medical technology.

**Credit Hours:** 1-3  
**Prerequisites:** instructor's consent

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**PTH_AS 3500: Cytology of the Female Genital Tract**
A definitive study by means of light microscopy of normal and abnormal cellular changes occurring within the female genital tract along with histologic correlation.

**Credit Hours:** 8  
**Prerequisites:** senior standing and instructor's consent

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**PTH_AS 3510: Cytology of Respiratory Tract**
A definitive study by means of light microscopy of normal and abnormal cellular changes occurring with the respiratory tract along with immunohistologic correlation. Prerequisites: senior standing and instructor's consent.

**Credit Hours:** 4

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**PTH_AS 3515: Cytology of Urinary Tract**
A definitive study by means of light microscopy of normal and abnormal cellular changes occurring within the urinary tract along with histologic correlation.

**Credit Hours:** 4  
**Prerequisites:** senior standing and instructor's consent

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**PTH_AS 3520: Cytology of Gastrointestinal Tract**
A definitive study by means of light microscopy of normal and abnormal cellular changes occurring within the gastrointestinal tract along with histologic correlation.

**Credit Hours:** 5  
**Prerequisites:** senior standing and instructor's consent

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**PTH_AS 3525: Cytology of Body Fluids**
A definitive study of light microscopy of normal and abnormal cellular changes occurring within body fluid along with histologic correlation.

**Credit Hours:** 4  
**Prerequisites:** senior standing and instructor's consent

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**PTH_AS 3530: Cytology of Breast**
A definitive study by means of light microscopy of normal and abnormal cellular changes occurring within the breast with histologic correlation.

**Credit Hours:** 2  
**Prerequisites:** senior standing and instructor's consent

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**PTH_AS 3535: Fine Needle Aspiration Cytology**
A definitive study by means of light microscopy of normal and abnormal cellular changes occurring within the fine needle aspirations from various body sites along with histologic correlation.

**Credit Hours:** 2  
**Prerequisites:** senior standing and instructor's consent

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**PTH_AS 3540: Special Procedures in Cytology**
Study of hematologic findings in body fluid cytology: chromosome cultures and karyotyping. Emphasizing sex-related abnormalities; hormonal evaluation of smears from the female genital tract and their clinical significance.

**Credit Hours:** 2  
**Prerequisites:** senior standing and instructor's consent

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**PTH_AS 3545: Clinical Management**
Procedures and processes helpful in operating in cytology laboratory, especially at the supervisory level.

**Credit Hour:** 1

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**PTH_AS 3550: Technical Application with Research in Cytotechnology**
Research is an area of interest in cytology resulting in a written and oral presentation.

**Credit Hours:** 2  
**Prerequisites:** senior standing and instructor's consent

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**PTH_AS 3555: Cytologic Preparation**
Independent applications of techniques used to prepare cytologic material.

**Credit Hours:** 2  
**Prerequisites:** senior standing and instructor's consent

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**PTH_AS 3560: Practical Cytotechnology**
Independent application of techniques used to examine cytology material and manage a cytology laboratory.

**Credit Hours:** 6  
**Prerequisites:** senior standing and instructor's consent

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**PTH_AS 3585: Problems in Cytotechnology**
Individual supervised work in an area of interest in cytology.

**Credit Hour:** 1-3  
**Prerequisites:** instructor's consent

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**PTH_AS 3600: Elementary Histology**
Simplified gross and microscopic anatomy of normal organs and tissues commonly found in the routine histopathology laboratory.

**Credit Hours:** 3

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**PTH_AS 3610: Basic Histotechnology**
Theories and technical application of procedures used in the preparation of tissue sections and slides of microscopic examination; including instrumentation, fixation, dehydration, clearing infiltration, embedding, mirotomy, H&E staining and coverslipping.

**Credit Hours:** 6

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**PTH_AS 3615: Special Staining Techniques**
Principles and procedures for special staining techniques for carbohydrates, connective tissues, blood, fat and lipids, pigments and minerals, bacteria and fungi, nerve, and other special cell stains.
Credit Hours: 6

**PTH_AS 3620: Applied Histotechnology**
Application of basic histological techniques in the preparation of histologic sections and slides in a clinical setting.

**Credit Hours: 9**

**PTH_AS 3625: Research and Instructional Techniques**
Involves library and laboratory search. Includes development of oral and written communications skills.

**Credit Hours: 3**
**Prerequisites:** senior students admitted to Histotechnology Curriculum

**PTH_AS 3630: Clinical Management**
Supervisory techniques and procedures helpful in operating a histopathology laboratory: including laboratory safety, workload recording, and personnel management in a laboratory situation.

**Credit Hours: 2**

**PTH_AS 3635: Basic Disease Processes**
Special readings and discussions of basic disease processes of interest to the anatomic pathology laboratory.

**Credit Hours: 2**

**PTH_AS 3680: Advances Histotechnology**
Advanced and specialized techniques used in the preparation and processing of muscle, nerve and rectal biopsies; special techniques in cytology; electron microscopy; enzyme and immunohistochemistry; plastic embedding and neuropathologic techniques.

**Credit Hours: 6**

**PTH_AS 3685: Problems in Histotechnology**
Individual supervised work in a specialized area of histotechnology.

**Credit Hours: 1-3**
**Prerequisites:** instructor's consent

**PTH_AS 4200: General Pathology**
Basic pathological mechanisms of human disease. Introductory principles of clinical laboratory measurements of altered organ system function studied.

**Credit Hours: 5**
**Prerequisites:** PTH_AS 7200, PTH_AS 7220, PTH_AS 7310; and instructor's consent

**PTH_AS 4205: General Pathology Laboratory**
Gross and microscopic applied study of basic pathological disease mechanisms. Laboratory assessment of these basic disease mechanisms.

**Credit Hours: 3**
**Prerequisites:** PTH_AS 7200, PTH_AS 7220, PTH_AS 7310; or the equivalents; and instructor's consent

**PTH_AS 4210: Seminar in Pathology and Anatomical Sciences**
Presentation and discussion of original investigations and current literature.

**Credit Hour: 1**

**PTH_AS 4220: Forensic Pathology and Death Investigation**
Forensic Pathology and Death Investigation.

**Credit Hours: 2**

**PTH_AS 4222W: Forensic Pathology and Death Investigation - Writing Intensive**
Forensic Pathology and Death Investigation.

**Credit Hours: 2**

**PTH_AS 4222: Gross Human Anatomy (The Health Professions)**
Gross structure and neuroanatomy of the human body; dissection of extremities, back, head, neck abdomen and thorax.

**Credit Hours: 7**
**Prerequisites:** instructor's consent

**PTH_AS 4250: Interpretations of Lab Procedures in Primary Health Care**
Discussion and analysis of selected laboratory test procedures used in office and clinic settings involved with primary health care.

**Credit Hour: 1**
**Prerequisites:** graduate level Physiology course and departmental consent

**PTH_AS 6331: ABS Advanced Medical Neurosciences**
ABS Advanced Medical Neurosciences

**Credit Hour: 5-10**

**PTH_AS 6333: ABS Pathology/Anatomical Science Research**
ABS Pathology/Anatomical Science Research

**Credit Hours: 5**

**PTH_AS 6335: ABS Pathology/Anatomical Science Research and Review**
ABS Pathology/Anatomical Science Research and Review

**Credit Hours: 5**

**PTH_AS 6341: ABS Science Anatomical Science Teaching**
ABS Science Anatomical Science Teaching

**Credit Hours: 5**

**PTH_AS 6343: ABS Surgical Anatomy**
ABS Surgical Anatomy

**Credit Hours: 5**

**PTH_AS 6345: ABS Surgical Anatomy of the Head and Neck**
ABS Surgical Anatomy of the Head and Neck
**Pathology**

Credit Hours: 5

**PTH_AS 6347: ABS Surgical Anatomy of the Back and Limbs**  
ABS Surgical Anatomy of the Back and Limbs  
Credit Hours: 5

**PTH_AS 6349: ABS Surgical Anatomy of the Pelvis and Perinium**  
ABS Surgical Anatomy of the Pelvis and Perinium  
Credit Hours: 5-10

**PTH_AS 6600: Anatomic Pathology**  
Anatomic Pathology  
Credit Hours: 5

**PTH_AS 6602: Clinical Pathology**  
Clinical Pathology  
Credit Hours: 5

**PTH_AS 6604: Forensic Pathology**  
Forensic Pathology  
Credit Hours: 5

**PTH_AS 6606: Anatomic/Clinical Pathology**  
Anatomic/Clinical Pathology  
Credit Hours: 5

**PTH_AS 6608: Anatomy Elective**  
Anatomy Elective  
Credit Hours: 5

**PTH_AS 6916: Anatomic Pathology Two-Week**  
This is a two week rotation. Students will learn how to integrate information and apply previously acquired knowledge and concepts to the assessment and interpretation of surgical pathology, cytopathology, and/or autopsy cases. Students will learn about the procedures necessary to arrive at anatomic pathology diagnoses and the work that goes into specimen processing and examination so as to produce diagnoses.  
Credit Hours: 2  
Prerequisites: Successful completion of the first two years of medical school

**PTH_AS 6917: Clinical Pathology - Laboratory Medicine**  
Students will learn how to integrate information and apply previously acquired knowledge and concepts to the assessment and interpretation of clinical laboratory tests. Students will learn about the procedures necessary to arrive at clinical pathology diagnoses and the work that goes into specimen processing and examination so as to produce diagnoses.  
Credit Hours: 2  
Prerequisites: Successful completion of the first two years of medical school

**PTH_AS 7020: Forensic Pathology and Death Investigation**  
Summary of Forensic Death Investigation from beginning to end. Will include some of the current laboratory techniques seen on "CSI" Team taught by experts in the fields including medical examiners, death investigators, forensic anthropologists, police CSI teams, lawyers and others.  
Credit Hours: 2  
Prerequisites: Basic Biology

**PTH_AS 7220: Human Histology and Organology**  
Detailed study of cytology, histology and microscopic anatomy.  
Credit Hours: 4  
Prerequisites: 10 hours of Biological Sciences and instructor's consent

**PTH_AS 7222: Gross Human Anatomy (The Health Professions)**  
Gross/human structure through dissection. Graded on A-F basis only.  
Credit Hours: 7  
Prerequisites: Acceptance into Physical Therapy Programs or instructor's consent

**PTH_AS 7230: Mammalian Reproduction**  
Reproduction in mammals, with emphasis on the neuroendocrine control of the hormones involved in reproductive process: biosyntheses, biologic actions, role.  
Credit Hours: 3  
Prerequisites: graduate standing in one of Animal, Biologic, Medical, or Veterinary Sciences, instructor's consent

**PTH_AS 7300: Advanced Pathology**  
Demonstration and simulation study of gross, microscopic and clinical laboratory pathology of major human organ systems.  
Credit Hours: 5  
Prerequisites: PTH_AS 4200 and PTH_AS 4205 or equivalent and instructor's consent

**PTH_AS 7320: Autonomic Nervous System**  
A comprehensive consideration of the autonomic nervous system in man, with emphasis on morphology.  
Credit Hours: 2  
Prerequisites: PTH_AS 2201, Comparative Anatomy or equivalent, and instructor's consent

**PTH_AS 7330: Hematopoietic Organs**  
Morphological and functional relationships of the blood-forming organs.  
Credit Hours: 2  
Prerequisites: Basic Histology and instructor's consent

**PTH_AS 7350: Advanced Pathology Laboratory**  
Demonstration and simulation and character of work depend upon needs, qualifications, and of major human organ systems.  
Credit Hours: 3  
Prerequisites: PTH_AS 4200 and PTH_AS 4205 or equivalent and instructor's consent
PTH_AS 7400: Seminars in Translational Medicine
Students participate in regular seminars and discussion groups with other students interested in clinical and translational sciences. Students, working together with faculty in biomedical sciences and those working in clinical and translational fields, identify seminar topics. Learning objectives and written assignments are arranged on an individual basis. The course is open to all graduate level students and students enrolled in professional schools, for 0-5 credit hours, with instructor's approval. Graded on S/U basis only.

**Credit Hours:** 0-5

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PTH_AS 7450: Precision Medicine Informatics
This course will introduce students with the theoretical and practical aspects of precision medicine informatics. Topics include: complex diseases, computational genomics/proteomics, informatics of molecular interactions and biological pathways, somatic mutations, signal transduction and cancer, biomarker discovery, machine learning and data mining for PMI, networks methods for PMI, knowledge representation and reasoning for PMI. The course will consist of a set of didactic lectures, computational assignments, in-class demonstrations of PMI methods and discussions of recent publications. Graded on A-F basis only.

**Credit Hours:** 3

**Prerequisites:** INFOINST 8005 with C or better or INFOINST 7010 with C or better or instructor's consent

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PTH_AS 8000: Comparative Pathology
(same as V_PBIO 8430). Biochemical and morphologic lesions related to the mechanism of disease expression in plants and animals.

**Credit Hours:** 3

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PTH_AS 8010: Current Issues in Anatomical Sciences
Survey of the recent literature in integrative anatomy, including functional, evolutionary, developmental and translational anatomy, conducted through readings and discussion. Grade determined by participation and presentation of weekly readings. May be repeated for a maximum of 10 hours. Graded on S/U basis only.

**Credit Hours:** 1

**Prerequisites:** instructor's consent

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PTH_AS 8090: Advanced Pathology
Open only to properly qualified graduate students, with counsel of faculty. Focus of MS-related research in evolutionary morphology, genomics, neuroscience, pathobiology or laboratory sciences. Graded on S/U basis only.

**Credit Hour:** 1-99

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PTH_AS 8100: Fundamentals of Evolutionary Biology
Principles of modern evolutionary biology. Topics include: phylogeny, paleobiology, developmental processes, genetic and phenotypic variation, form and function, speculation, macroevolution, and molecular mechanisms.

**Credit Hours:** 3

**Prerequisites:** instructor's consent

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PTH_AS 8150: Fundamentals of Evolutionary Morphology
This course is a survey of the fundamentals of modern evolutionary morphology. Topics will include: patterns of vertebrate evolution, comparative methods, development and ontogeny, constraint, functional morphology, evolutionary innovations, and experimental methods. Graded on A-F basis only.

**Credit Hours:** 3

**Prerequisites:** instructor's consent required

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PTH_AS 8201: Human Anatomy: Back and Upper Limb
Developmental, gross, and clinical anatomy of the human back and upper limb, including skeletal, muscular, nervous, and vascular tissues. Graded on A-F basis only.

**Credit Hours:** 2

**Prerequisites:** instructor's consent required

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PTH_AS 8202: Human Anatomy: Thorax and Abdomen
Developmental, gross, and clinical anatomy of the human thorax and abdomen. Graded on an A-F basis only.

**Credit Hours:** 2

**Prerequisites:** instructor's consent required

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PTH_AS 8203: Human Anatomy: Head, Neck and Neuroanatomy
Developmental, gross and clinical anatomy of the human head, neck and neuroanatomy. Graded on A-F basis only.

**Credit Hours:** 2

**Prerequisites:** instructor's consent required

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PTH_AS 8204: Human Anatomy: Pelvis and Lower Limb
Developmental, gross and clinical anatomy of the human pelvis and lower limb. Graded A-F basis only.

**Credit Hours:** 2

**Prerequisites:** instructor's consent required

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PTH_AS 8285: Problems in Pathology and Anatomical Sciences
Regions or systems which may include developmental, microscopic, and gross anatomy.

**Credit Hour:** 1-99

**Prerequisites:** instructor's consent

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PTH_AS 8290: Research in Pathology and Anatomical Sciences
Research unrelated to thesis work in evolutionary morphology, genomics, neuroscience, pathobiology or laboratory sciences.

**Credit Hour:** 1-99

**Prerequisites:** instructor's consent

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PTH_AS 8310: Anatomy of the Human Nervous System
A comprehensive consideration of the morphology of the nervous system, emphasizing correlation of structure and function.

**Credit Hours:** 3

**Prerequisites:** PTH_AS 2201, Comparative Anatomy or equivalent, and instructor's consent


**PTH AS 8450: Human Anatomy Teaching Practicum**

Provides practical experience teaching clinically oriented human anatomy in lecture and laboratory settings. For students pursuing doctoral degrees in Pathobiology. Enrollment is limited to students who have completed PTH AS 8201, PTH AS 8202, PTH AS 8203, and PTH AS 8204. Graded on S/U basis only. May be repeated for credit.

**Credit Hour:** 1

**Prerequisites:** instructor's consent

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**PTH AS 8500: Seminar in Translational Neuroscience**

Students participate in seminars and discussion groups. Masters students identify seminar topics and present existing data with findings. PhD students identify seminar topics, conduct research and present findings. Learning objective and written assignments are arranged individually. May be repeated for credit. Graded on S/U basis only.

**Credit Hour:** 1-5

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**PTH AS 9090: Research in Pathology and Anatomical Sciences**

Open only to properly qualified graduate students, with counsel of faculty. Focus of PhD-related research in evolutionary morphology, genomics, neuroscience or pathobiology. Graded on S/U basis only.

**Credit Hour:** 1-99

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**PTH AS 9290: Research in Pathology and Anatomical Sciences**

Open only with instructor's consent. Courses with specialized lectures in various topics such as evolutionary morphology, genomics, neuroscience and pathobiology, depending on faculty expertise and student demand. Graded on S/U basis only.

**Credit Hour:** 1-99