

Graduate School of Biomedical Sciences

Thomas A. Pressley, Ph.D., Interim Dean

About the School

Development of a strong program of graduate education in the basic biomedical and related health sciences is one of the responsibilities and goals of the Texas Tech University Health Sciences Center. Present-day medicine cannot exist outside the academic framework and intellectual discipline which the biological, chemical, and medical sciences provide. Graduate training in these areas, an integral component of the overall program of the Health Sciences Center, is provided by the Graduate School of Biomedical Sciences (GSBS).

Opportunities for study and research lead to the following degrees:

Biotechnology Program

- Master of Science in Biotechnology

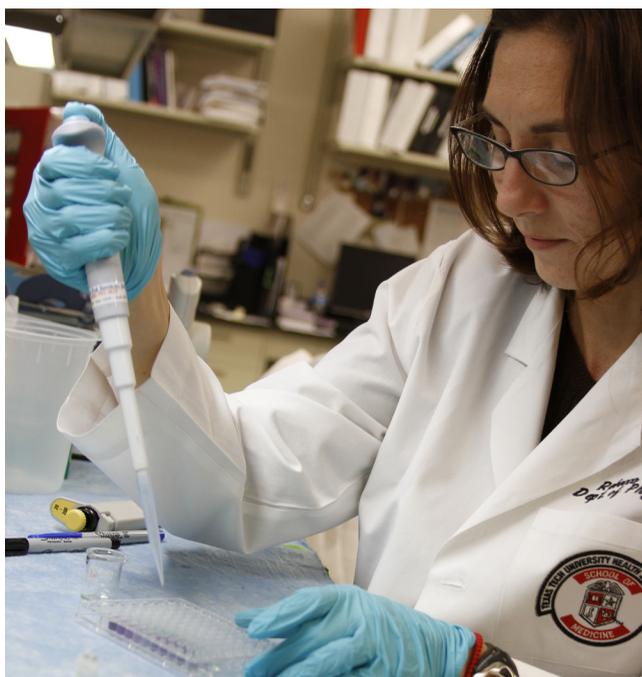
Biomedical Sciences Program

- Master of Science in Biomedical Sciences
Concentration Areas:
 - Cell and Molecular Biology
 - Medical Microbiology
 - Pharmacology and Neuroscience
 - Physiology
 - Pre-Medical Sciences
- Doctor of Philosophy in Biomedical Sciences
Concentration Areas:
 - Biochemistry and Molecular Genetics
 - Cell and Molecular Biology
 - Medical Microbiology
 - Pharmacology and Neuroscience
 - Physiology

Pharmaceutical Sciences Program

- Master of Science in Pharmaceutical Sciences
- Doctor of Philosophy in Pharmaceutical Sciences

Courses and descriptions of the various programs and concentrations can be found in this course listing.



Students interested in pursuing a career in academic medicine as a physician-scientist may apply to the M.D.–Ph.D. program. The M.D.–Ph.D. program permits a student to complete the requirements of the Ph.D. degree in one of the approved Biomedical Sciences Concentrations. M.D.–Ph.D. students may receive a stipend, tuition scholarships for both the medical and graduate portions of the program, and health benefits for the duration of the stipend. This program is designed to be completed in seven years and will provide the student with rigorous training in both clinical medicine and biomedical research. Students interested in this program should indicate their interest on the application form submitted to the American Medical College Application Service at www.amc.org/students/amcas/start.htm.

GSBS graduate courses are available to graduate students at Texas Tech University as a non-degree student (NDGD).

Further information about graduate programs offered through the Health Sciences Center Graduate School of Biomedical Sciences may be obtained by contacting the Graduate School of Biomedical Sciences, Texas Tech University Health Sciences Center, 3601 4th Street, Lubbock, Texas 79430-6206, 806.743.2556, 800.528.5391, FAX 806.743.2656, or e-mail graduate.school@ttuhsc.edu. For more information and to apply online, visit www.ttuhsc.edu/gsbs.

The policies and procedures for the Graduate School of Biomedical Sciences differ from those established by Texas Tech University Graduate School. Policy information is available on the Web site at www.ttuhsc.edu/gsbs. Policies relating to curriculum can be found in the GSBS catalog which is located at: <http://www.ttuhsc.edu/gsbs/catalogs.aspx>. Programs are subject to change, depending on availability of resources and educational goals.

Interdisciplinary Courses

The following interdisciplinary courses are available in addition to course offerings within each research area throughout the Graduate School of Biomedical Sciences.

Graduate School of Biomedical Sciences (GSBS)

- 5099. Topics in Biomedical Sciences (V1-6).** Specific areas in biomedical sciences or related research not normally included in other courses. May be repeated for credit.
- 5101. Responsible Conduct of Research (1:1:0).** This course will address the regulatory and ethical environment of today's biomedical research as well as such topics as authorship and data management. The class format is lectures and case discussions. Course is required for all GSBS students.
- 5102. How to be a Scientist: Professional Skills for the Biomedical Sciences Graduate Student (1:1:0).** Teaches useful concepts in the scientific professionalism that might not be learned elsewhere: how science is conducted in the United States and at TTUHSC, the importance of oral communication in science and tips for teaching in a science classroom.
- 5174. GSBS Seminar (1:1:0).** Lectures in specific areas of biomedical sciences.
- 5201 Scientific Writing in the Biomedical Sciences (2:2:0).** Tactics for effective writing and communication in the biomedical sciences. Instruction will focus on the process of writing and publishing scientific manuscripts and writing fellowship applications. Students will complete short writing and editing exercises that focus on tactics of effective, clear, and concise writing, and prepare a manuscript or application in their area of study.

Biochemistry and Molecular Genetics (GBMG)

Harry M. Weitlauf, M.D., Chairperson for the School of Medicine Department of Cell Biology & Biochemistry
Sandra Whelley, Ph.D., Graduate Advisor

Primary Faculty: Everse, Faust, Hardy, MacDonald, Pelley, Schneider, Sridhara, Stocco, Urbatsch, Whelley, Williams
Associate Faculty: Chilton, Cornwall, Coué, Dufour, Kang, Lee, Maurer, Reynolds, Thomas, Webster

About the Concentration

Biochemistry and Molecular Genetics is designed to prepare students for research and teaching careers in biochemistry and molecular biology as related to the medical and life sciences. Admission requires prior coursework in mathematics, general physics, organic chemistry, analytical chemistry, and biological science. Students with deficiencies in any of these areas may be conditionally admitted pending successful completion of leveling courses. Students are required to take GBMG 5421, 6323, 6333, and 6441 or their equivalents. In addition, students are urged to take or to have successfully completed courses in physical chemistry, statistics, and computer programming.

Students rotate through at least three different laboratories to broaden their education and research experience and to help them identify a field of specialization for their dissertation research. Major areas of current research include studies of the regulation of gene expression in a variety of eukaryotic tissues, biochemistry of development, mechanisms of hormone action, biochemistry of neoplasia, genetics of somatic cells in culture, biochemistry of membranes, mechanisms of enzyme action, and protein amyloidogenesis.

For more information on Biochemistry and Molecular Genetics, contact Dr. Sandra Whelley, Graduate Advisor, at 806.743.2700, Ext. 247.

GBMG Courses:

5421. General Biochemistry (4:4:0). Human life processes at the molecular level with emphasis on biochemical homeostasis and control mechanisms.

6000-6010 Master's Thesis (V1-6).

6055. Research Methods (V1-6). Prerequisite: Consent of instructor. Taken as (1) a hands-on introduction to the laboratories in which a student may wish to do dissertation research or (2) after a student is well established in dissertation research, additional rotations can be done to gain expertise in techniques applicable to research. May be repeated with change of content.

6101. Biochemistry Conference (1:1:0). Informal conferences between faculty and students considering topics of current interest in biochemistry not normally included in other courses. Literature search, evaluation, organization, writing, and oral presentation by the student are emphasized. Different topic each semester. May be repeated for credit.

6121. History of Biochemistry (1:1:0). Discussion of highlights in the advancement of biochemical knowledge.

6135, 6235, 6335, 6535. Topics in Biochemistry (1:1:0, 2:2:0, 3:3:0, 5:5:0). Prerequisite: Consent of instructor. Lectures in specific areas of biochemistry not normally included in other courses. May be repeated for credit with change of content.

6323. Advanced Molecular Genetics (3:3:0). Based on readings and discussions of primary literature in the areas of molecular genetics and nucleic acid biology. This course will give the student a firm foundation in molecular genetics

5303. Introduction to Clinical Research (3:2:3). Students will be involved in all aspects of preparation for and execution of prospective human studies and retrospective chart reviews. The didactic training deals with the regulations and ethical considerations related to research in humans, the process of obtaining approval for a study and the requirements associated with conducting a study. Prerequisites include the required courses in the first year GSBS Curriculum and preferably at least one laboratory rotation.

5310. Introduction to Statistical Methods in the Biomedical Sciences (3:3:0). Provide students explanation and application of classical test theory involving univariate statistics. The course will include discussion about classical test theory (p values, scales of measurement, assumptions of analyses, etc.) and application of this theory for various statistical analyses, such as t tests, anova, correlation. There will be a small introduction to non-parametric analyses.

5350. Laboratory Methods in Biomedical Sciences (3:3:0). Introduces the first-year graduate student to the fundamental principles and techniques in basic science research. Following a lecture and/or a laboratory demonstration, students conduct a well-defined laboratory exercise and provide a written report on the results.

5372. Biomedical Sciences Core II (3:3:0). The structure/function relationships that underlie basic cellular processes, including translation, protein trafficking, cytoskeletal organization and motility, cell adhesion, and cell division. Required for first year students.

5373. Biomedical Sciences Core III (3:3:0). Teaches essential scientific concepts underlying the field of Molecular Biology and Molecular Genetics. Required for first year students.

5399. Topics in Biomedical Sciences (3:0:0). Specific areas in biomedical sciences or related research not normally included in other courses. May be repeated for credit.

5471. Biomedical Sciences Core I (4:4:0). This course offers a broad coverage of biochemistry with an emphasis on structure and function of macromolecules, biosynthesis of small molecule precursors of macromolecules, and the pathways of intermediary metabolism. Required for first year students.

Neuroscience (GIDN)

5910. Integrated Neurosciences (9:8:1). This cooperative, interdepartmental effort offers a detailed study of the nervous system. Students examine both gross and fine structure and function from the subcellular through the behavioral level.

Health Communications (GIHC)

5319. Seminar in Current Topics of Information Sciences (3:3:0). Prerequisite: Must be enrolled or accepted in a graduate program. Course varies each semester emphasizing information science topics and includes searching relevant scientific databases. (Writing Intensive.)

Preventive Medicine (GIPM)

6303. Principles of Epidemiology (3:3:0). Considers the variety, behavior, and distribution of both infectious and noninfectious diseases in populations. It will show how an understanding of the etiology, transmission, and pathogenesis of disease can lead to methods of disease prevention. Emphasis will be placed on the principles and methods of epidemiologic investigation. Arranged.

and prepare the student to read, discuss, and understand literature from the disciplines of DNA and RNA structure and function, gene expression, molecular biology, molecular genetics, and genomics, and cancer biology.

6333. Advanced Protein Biochemistry (3:3:0). Teaches advanced concepts in the field of protein biochemistry with emphasis on the fundamentals of protein biosynthesis, structure, and folding; methods of characterizing protein structural properties and conformation; and techniques for purifying proteins with diverse properties. Prerequisite: Successful completion of the GSBS common first year curriculum or consent of the course director.

6441. Cell Signaling (4:4:0). Topics include structure and function of membranes and organelles, mechanisms of transcription and translation, and regulation of cellular processes including both the endocrine and nonendocrine aspects.

7000-7010. Research (V1-12).
7101-7110. Biochemistry Seminar (1:1:0).
8000-8010. Doctor's Dissertation (V1-12).

Biotechnology (GBTC)

Thomas A. Pressley, Ph.D., Interim Dean of the Graduate School of Biomedical Sciences

Primary Faculty: Filleur, Rumbaugh
Joint Faculty: Bergeson, Blanton, Chaffin, Cornwall, Dufour, Everse, Fralick, Hamood, Hardy, Jansen, Kang, Lee, MacDonald, Schneider, Stocco, Straus, Sutton, Syapin, Thomas, Urbatsch, Williams
Associate Faculty: Zhang

About the Program

This program is an interdisciplinary degree supported by all basic science departments in the Texas Tech University Health Sciences Center (TTUHSC). The Texas Tech University general academic campus administers a complimentary track in Applied Science Biotechnology.

The biomedical sciences track is a 21-month curriculum consisting of two terms (nine months) of coursework and 12 months of full-time laboratory research. It is typically a nonthesis degree with an optional thesis at the end of the second year by arrangement with the advisor. The research component may be completed either at the TTUHSC campus or at a biotechnology industry laboratory. Students who choose to do their research at the TTUHSC campus will work with a member of the biotechnology graduate faculty. All biotechnology graduate faculty have active research programs that emphasize use of molecular biology methods. Prerequisites for the program include a bachelor's degree in science with at least one semester of organic chemistry.

GBTC Courses:

5338. Biochemical Methods (3:1:6). Provides integrated approach to modern biochemical techniques and present methods used to manipulate a gene, purify and characterize the enzymatic properties of the encoded protein.

6000. Master's Thesis (V1-6).

6001. Biotechnology Internship (V1-9). Research and training in a private-sector or government biotechnology laboratory (by prior arrangement with program director).

6101. Biotechnology Seminar (1:1:0).

6202. Biomedical Informatics (2:0:2). Prerequisite: GBTC 6301. Personal laptop meeting the School of Medicine laptop guidelines is required.

Provides a broad introduction to the field of bioinformatics in medical research. Emphasizes use of modern software packages and internet-based genomic and other databases to solve research problems.

6301. Introduction to Biotechnology (3:3:0). Broad coverage of topics with high current interest and utility to the medi-

cal and agricultural biotechnology industries. Emphasizes application of technologies.

7000. Research (V1-12).

Cell and Molecular Biology (GCMB)

Harry M. Weitlauf, M.D., Chairperson for the School of Medicine Department of Cell Biology & Biochemistry
Brandt Schneider, Ph.D., Graduate Advisor

Primary Faculty: Chilton, Cornwall, Dufour, Hutson, Kang,

Lado, Lee, Maurer, Reynolds, Thomas, Webster, Weitlauf
Joint Faculty: Hardy, MacDonald, Schneider, Stocco, Urbatsch, Williams

Associate Faculty: Beale, Coué, Dai, Rumbaugh

About the Concentration

Cell and Molecular Biology will prepare students for careers in cellular, developmental, and molecular biology. Employment opportunities for graduates include traditional university professorships, positions in the biotechnology industry, and governmental appointments. The curriculum centers around three courses: Cell Structure and Function, Advanced Cell Biology, and Biochemistry. During the first year of study, the student will progress through a minimum of three laboratory rotations in order to determine his or her research interest. Dissertation topics can be pursued in the following areas: Regulation of gene expression, RNA processing, the role of transcription factors in cellular transformation and differentiation, cell cycle, cell and molecular biology of intercellular communication, control of microtubular function, embryo implantation, molecular mechanisms of epididymal sperm function, proliferation and differentiation of gonadal cells, molecular basis of gamete interactions, molecular regulation of ovarian development and function, development and regeneration of the nervous system, genetics of human cancer and congenital human disorders, diagnosis and treatment of human cancer, molecular basis of sex differences in maintenance and repair of connective tissues, morphogenesis, developmental genetics, actin cytoskeleton, embryonic development, cellular genetics, cell biology of epithelia, immune privilege and transplantation, molecular mechanisms of ABC transporters in cholesterol homeostasis and multidrug resistance of cancer cells.

Cell and Molecular Biology offers two instructional tracks for masters students. The research track is designed for students who need extra preparation for the Ph.D. program or whose career track is geared toward technical or staff level positions in industry or universities. Students undertake study and research in similar areas as that of the Ph.D. program. The pre-medical sciences track is designed for students whose eventual goal is towards a teaching career in the anatomical sciences or who need additional preparation for medical school. Students in the pre-medical sciences track take courses in the anatomical sciences and in modern instructional methods and design, and will participate in the teaching mission of the medical school as teaching assistants.

Students with undergraduate degrees in biology and chemistry are well suited for this concentration. Please contact Terri Lloyd at 806.743.2701 for more information concerning admissions. Website: <http://www.ttuhs.edu/cbb/>.

GCMB Courses:

5112, 5212, 5312, 5612. Laboratory Methods (1:0:2, 2:0:4, 3:0:6, 6:0:12). Prerequisite: Consent of instructor. Taken as (1) a hands-on introduction to the laboratories in which

Medical Microbiology (GMIB)

Ronald C. Kennedy, Ph.D., Chairperson for the School of Medicine Department of Microbiology and Immunology
Robert Bright, Ph.D., Graduate Advisor

Primary Faculty: Brackee, Bright, Chaffin, Colmer-Hamood, Fralick, Hamood, Kennedy, Rolfe, Siddiqui, Straus,
Joint Faculty: Reilly, Rumbaugh, San Francisco,
Associate Faculty: Grammas, Griswold, Larppanichpoonphol, Lyte, Reid, Schneider, Warner, Williams, Winn, Wright
Adjunct Faculty: Dowd, Molineux, Wolcott

About the Concentration

Medical Microbiology is designed to graduate exceptionally well trained professionals who possess the necessary background and experience for a career in research and teaching in Microbiology and Immunology. Applicants are urged to possess research experience and should have a basic knowledge of microbiology and prior course work in several disciplines of biological sciences. Prior coursework in certain areas such as Microbiology (General and Pathogenic), Cell Biology, Immunology, and Biochemistry, though not a requirement, would be helpful. Students with deficiencies in these areas may be admitted and required to enroll in these classes as part of their first year of graduate school.

Students have the opportunity to rotate through research laboratories (three are recommended, but not a requirement) to broaden their education and research experience, and to assist in the identification of a field of specialization for their thesis or dissertation research. Major areas of current research activities include: microbial pathogenesis, bacterial gene regulation, biofilms, multi-drug resistance, immunology (cancer and infectious diseases), tumor antigen identification, vaccines and phage and immunotherapy. For further information, see www.ttuhs.edu/microbiology.

GMIB Courses:

- 5181, 5281, 5381. Selected Topics in Microbiology (1:1:0; 2:2:0; 3:3:0).** Prerequisite: Consent of instructor. Specific areas in microbiology and immunology or related research not normally included in other sources. May be repeated for credit.
- 5340. Cellular and Molecular Immunology (3:0:3).** Consent of instructor. Cellular and Molecular Immunology is a study of the development of the immune system, and immunity



a student may wish to do dissertation research or (2) after a student is well established in his or her dissertation research, additional rotations can be done to gain expertise in techniques applicable to the student's research but not available in the faculty advisor's laboratory. Repeatable if different methods are covered for each registration.

- 5113, 5213, 5313. Selected Topics in Cell and Developmental Biology (1:1:0, 2:2:0, 3:3:0).** Topics vary from semester to semester and reflect the research interests of the faculty. Recent offerings have included oncogenes and molecular biology of hormone action. May be repeated provided that different topics are covered for each registration.
- 5121. Surgical Gross Anatomy (1:1:0).** This block will provide an introduction and overview to surgical approaches to different regions of the human body from a clinical perspective. Students will observe and assist surgeons with surgical dissections of cadavers. The experience in surgical anatomy will provide students with a relevant correlation of anatomy to applied surgical procedures.
- 5231. Advanced Training in Histology II (2:0:2).** Students will participate in the histology laboratories in the Structure and Function of Major Organ Systems block of the first year School of Medicine curriculum, attend all histology lectures, and attend all pre-laboratory meetings in preparation for the laboratory sessions. The students will also assist in preparing the practical exams. Prerequisites include successful completion of the first year course work in Pre-Medical Sciences.
- 5331. Advanced Training in Histology (3:0:3).** Students will participate in the histology laboratories as teaching assistants and attend all pre-laboratory meetings in preparation for the laboratory sessions. The students will also assist in preparing the practical exams. Prerequisites include successful completion of the first year course work in Pre-Medical Sciences.
- 5332. Advanced Training in Anatomy (3:0:3).** Students will participate in the gross anatomy laboratories as teaching assistants and attend all pre-laboratory meetings in preparation for the laboratory sessions. The students will also assist in preparing the practical exams. Prerequisites include successful completion of the first year course work in Pre-Medical Sciences.
- 5340. Educational Project in Biomedical Sciences (3:0:0).** Students will design and carry out an educational project in either Anatomy or Histology. The project will be designed according to the needs of these courses and matched to the interest of the student. Projects might include self-directed learning units/sessions, or upgrading or creation of educational materials as presented on WebCT. Required of all Pre-Medical Sciences students.
- 5510. Biology of Cells and Tissues (5:5:5).** Biology of Cells and Tissues is designed to provide students with fundamental information concerning the traditional areas of biochemistry, genetics, and cell biology. The principles presented in this course will proceed from molecules to cells and then to tissues integrating structure and function.
- 5611. Gross Anatomy (6:2:10).** A highly integrated introductory course of anatomical study (including human prosection) which embodies the gross morphology of the body and coordinates it with the clinical, developmental, and microscopic aspects of the human body.
- 6000-6010. Master's Thesis (V1-6).**
- 6340. Cell Structure and Function (3:3:0).** Topics include structure/function relationships involved in DNA replication, transcription, protein tracking, cytoskeletal organization and function, cell division, and adhesion.
- 6620. Advanced Cell Biology (6:6:0).** Prerequisite: GCMB 6340. This course will cover advanced topics in cell biology and is designed for senior students who have completed introductory cell biology courses. The topics covered will include regulatory mechanisms that control the development of metazoan organisms, cell cycle regulation, cancer, and reproductive and stem cell biology.
- 7000-7010. Research (V1-12).**
- 7101-7110. Seminar (1:1:0).** Students will attend and participate in departmental seminars.
- 8000-8010. Doctoral Dissertation (V1-12).**

against microbes and tumors, and diseases caused by inappropriate immune responses.

- 5350. Introduction to Medical Microbiology (3:0:3).** Consent of instructor. A study of the classification, structure, virulence and pathogenesis of the microorganisms that cause human disease and the ways to control these organisms.
- 5399. Introduction to Microbiological Research (3:0:3).** Exposure to experimental design, research methodology and data analysis in the laboratories of three faculty members.
- 6000-6010. Master's Thesis (V1-6).**
- 6323. Genetics and Molecular Biology of Prokaryotes (3:3:0).** Prerequisite: Biochemistry and general microbiology. Current concepts on the molecular biology and genetics of prokaryotes with emphasis on regulation of gene expression.
- 6324. The Molecular Biology of Pathogenic Bacteria (3:3:0).** Prerequisite: Medical microbiology, biochemistry. Lectures and discussions concerning the molecular analysis of mechanisms by which pathogenic bacteria produce infections. The regulation and expression of virulence factors are emphasized.
- 6325. The Biology of Animal Viruses (3:3:0).** Prerequisite: General biochemistry and general microbiology. Emphasis will be placed on DNA and RNA tumor viruses, tumor suppressor genes and human immunodeficiency virus.
- 6329. Advances in Immunology (3:3:0).** Prerequisite: GMIB 6346, 6347 or consent of instructor. Current knowledge of the immune system with emphasis on molecular and cellular interactions.
- 6335. The Pathogenesis of Infectious Disease (3:3:0).** Prerequisite: Medical or pathogenic microbiology or consent of the instructor. A study of the processes by which microorganisms produce disease in humans and how the host responds.
- 6346. Medical Bacteriology (3:3:0).** Beginning student. A study of bacterial classification, structure, virulence and pathogenesis of the bacteria that cause human disease and the ways to control these organisms.
- 6347. Medical Mycology, Parasitology, and Virology (3:3:0).** Beginning student. A study of the classification, structure, and pathogenesis of fungi, parasites, and viruses that cause human disease and the ways used to control these organisms.
- 7000-7010. Research (V1-12).**
- 7101-7110. Microbiology Seminar (1:1:0).**
- 8000-8010. Doctoral Dissertation (V1-12).**

Pharmaceutical Sciences (GPSC)

Thomas Abbruscato, Ph.D., GSBS Associate Dean,
Graduate Advisor

Ruiwen Zhang, M.D., Ph.D., Chair, Pharmaceutical
Sciences

Junxuan Lu, Ph.D., Chair, Biomedical Sciences

Primary Faculty: Abbruscato, Ahsan, Bickel, Gunaje,
Karamyan, Kwon, Liu, Lockman, Mark, Mehvar, Moridani,
Rao, Smith, Srivastava, Srivenugopal, Stoll, Thekkumkara,
Wang, Weidanz, Weis, Zhang

Joint Faculty: Wright

Associate Faculty: Leff

Adjunct Faculty: Arumugam, Klein

About the Program

Pharmaceutical Sciences encompass all those areas of pharmacy research that pertain to drug design, delivery, formulations, and therapeutics. The faculty members of the

department exhibit research interests and expertise in drug design and delivery, pharmacology, pharmaceuticals (including formulations and industrial pharmacy), pharmacokinetics, drug receptor modeling, molecular biology, biochemistry, pathophysiology, immunology and cancer therapy, toxicology, and pharmacy administration. The graduate program in pharmaceutical sciences is designed to educate students for careers in pharmaceutical industry, academia, and federal agencies including the FDA. Admissions requirements include a degree in pharmacy, chemistry, biology, or related areas. Teaching and research assistantships are awarded on a competitive basis. The departmental courses are listed below. For more information contact Teresa Carlisle, graduate program coordinator, 806.356.4015 ext. 287 or email pharmsci.gradadv@ttuhsc.edu.

GPSC Courses:

- 5101. Topics in Pharmaceutical Sciences (1:1:0).** Special topics in pharmaceutical sciences that are not normally included in other courses. May be repeated for credit with change in content.
- 5201. Topics in Pharmaceutical Sciences (2:2:0).** Special topics in pharmaceutical sciences that are not normally included in other courses. May be repeated for credit with change in content.
- 5210. Graduate Pharmaceutics Part 1 (2:3:0).** This course will cover various pharmaceutical dosage forms and drug delivery systems.
- 5211. Graduate Pharmaceutics Part 2 (2:3:0).** This course will cover the basic principles of pharmaceutics for the development of formulations that are stable and therapeutically effective.
- 5220. Drugs of Abuse (2:2:0).** This course is designed to teach the pharmacology of different classes of abused drugs and the physiologic and societal aspects of addiction. Course Prerequisite: Biochemistry, Principles of Drug Action and Physiology-based Pharmacology.
- 5301-5304. Topics in Pharmaceutical Sciences (3:3:0).** Special topics in pharmaceutical sciences that are not normally included in other courses. May be repeated for credit with change in content.
- 5304. Principles of Drug Action (3:3:0).** Principles that govern drug action within the body (pharmacodynamics) as well as drug absorption, distribution, metabolism, and excretion (pharmacokinetics).
- 5307. Pharmaceutical Sciences Research Methods (3:3:3).** A lecture and laboratory course designed to provide an overview of current research methods in pharmaceutical sciences under direct guidance of a faculty member.
- 5310. Drug Design and Discovery (3:3:0).** Prerequisite: GPSC 5304. Overview of new methods for quantitative SAR, computer-aided drug design, mass screening, and combinatorial chemistry.
- 5312. Toxicology (3:3:0).** This course is designed to familiarize students with the general principles of toxicology. Course Prerequisite: Biochemistry and Principles of Drug Action. In addition, though not required, the completions of Pharmacology is recommended.
- 5320. Drug Metabolism (3:3:0).** Analysis of primary metabolic enzymatic systems involved in the clearance of drugs from the body and the mechanisms that regulate their activity.
- 5325. Medicinal Chemistry (3:3:0).** A comprehensive study of the chemistry molecules and their interactions to aid in the understanding of concepts such as drug discovery and design.
- 5326. Cancer Biology and Therapeutics (3:3:0).** This course is designed for graduate students studying molecular and cellular basis of cancer. It offers principles of cancer biology from origin of cancer to therapeutic intervention principles. Admission to the Pharmaceutical Sciences Graduate Program and basic knowledge of biochemistry and cell biology are required. Permission from the advisor and the team leader are also required.
- 5329. Basic Pharmacokinetics (3:3:0).** Course Prerequisite: Principles of Drug Action. Fundamentals of the kinetics of

drug absorption, distribution, and elimination, with particular emphasis on application to design of dosage regimens.

- 5330. Pharmacokinetics (3:3:0).** A quantitative treatment at the graduate level of the dynamics of drug disposition in the body and the national design of drug dosage regimens.
- 5335. Physiology-based Pharmacology Part 1. (3:3:0).** Drug classes and mechanisms of action. Drugs acting on chemical mediators. Drugs affecting major organ systems including the cardiovascular, peripheral and central nervous systems.
- 5336. Physiology-based Pharmacology Part 2. (3:3:0).** Drug classes and mechanisms of action. Drugs acting on chemical mediators. Drugs affecting major organ systems including the cardiovascular, peripheral and central nervous systems.
- 5340. Molecular Drug Action (3:3:0).** Analysis of drug action at the molecular level, including molecular biology and signal transduction.
- 5350. Advanced Pharmaceutics (3:3:0).** Prerequisite: Drug Delivery Systems 3 or equivalent. Quantitative treatment of reactions of pharmaceutical interest. Drug decomposition, approaches to stabilization and preservation, accelerated stability analysis, complexation, and micromeritics.
- 5356. Advanced Principles of Disease (3:3:0).** Pathophysiological mechanisms at the molecular and cellular level. Lecture and discussion will cover the etiology, pathogenesis, functional changes, and clinical significance of general diseases.
- 5360. Industrial Pharmacy (3:3:0).** Principles of formulation of powders, capsules, and compressed and coated tablets for conventional and controlled drug delivery.
- 5370. Biotechnology (3:3:0).** An introduction to the area of molecular biology, genomics, and protein chemistry.
- 5380. Special Topics in Drug Design—Immunopharmacology (3:3:0).** Principles of disease treatment with focus on the immunological system and new advances in immunotherapy.
- 5390. Pharmaceutical Science Research Design and Analysis (3:3:0).** Overview of experimental design implementation and data analysis, including biostatistics for pharmaceutical science investigations.
- 5430. Graduate Immunology (4:4:0).** The student will be required to express complicated immunological concepts in written and oral form. It is expected that the student will make significant intellectual contributions to the development of the specific aims of the team members' grants and will demonstrate independent thinking in regards to several focused areas in immunology.
- 5440. Biopharmaceutics (4:4:0).** Prerequisite: DDS3 and kinetics or equivalent. Advanced treatment of the influence of dosage forms, route of administration, and dosage regimen on drug availability and newer technologies for targeting drug delivery to specific organs and cell types.
- 5610. General Biochemistry (6:6:0).** Human life processes at the molecular level with emphasis on biochemical homeostasis and control mechanisms.
- 6000-6010. Master's Thesis (V1-6).**
- 7000-7010. Pharmaceutical Sciences Research (V1-12).**
- 7101-7110. Pharmaceutical Sciences Seminar (1:1:0).**
 Weekly seminar series designed to provide training in research data presentation and analysis.
- 8000-8010. Doctoral Dissertation (V1-12).**

Pharmacology and Neuroscience (GPHM)

Reid L. Norman, Ph.D., Chairperson for the School of Medicine Department of Pharmacology and Neuroscience
 Michael Blanton, Ph.D., GSBS Associate Dean, Graduate Advisor

Primary Faculty: Bergeson, Blanton, Dickerson, Frame, Freeman, Grammas, Henderson, Kruman, Lombardini, Mahimainathan, Momeni, Norman, Popp, Roghani,

Schrimsher, Syapin, Tenner, Young
 Joint Faculty: Kang
 Associate Faculty: Artigas, McMahon, Reynolds
 Adjunct Faculty: Duncan, O'Boyle

About the Concentration

The objective is to prepare students for careers in research and teaching. The faculty of the concentration seeks to foster a creative and productive research atmosphere, to provide encouragement and positive challenge, and to equip students with the intellectual tools they will need to be effective teachers and investigators. Specialized research training is available in the areas of aging, biochemical and behavioral pharmacology, circadian pharmacology, neuropharmacology, and molecular pharmacology. In addition, the SOM Pharmacology and Neurosciences department houses the South Plains Alcohol and Addiction Research Center (SPAARC), a team of graduate faculty and other investigators with research interests focused on all aspects of drug use.

GPHM Courses:

- 5101, 5201, 5301. Topics in Pharmacology (1:1:0, 2:2:0, 3:3:0).** Prerequisite: Consent of instructor. Specific areas of pharmacology not normally included in other courses. May be repeated for credit with change in content.
- 5225. Techniques in Pharmacological Research (2:2:6).** Prerequisite: Consent of instructor. Standard experimental techniques used in pharmacological research are explored through a series of hands-on laboratory exercises. Numerous techniques common to research in many fields will be introduced.
- 5303. Principles of Pharmacology (3:3:0).** Prerequisite: Biochemistry and physiology or consent of instructor. A study of the principles and theories of pharmacokinetics and pharmacodynamics of chemicals in relationship to dose and time. The course will consist of lectures, discussions, and oral presentations of original papers by the class and is oriented for both pharmacology and nonpharmacology majors.
- 5312. Medical Pharmacology I (3:8:0).** A study of pharmacology with emphasis on mechanisms of drug action, interaction, and therapeutics.
- 5326. Pharmacology of the Autonomic Nervous System (3:3:0).** A conceptual study of drugs which alter the function of the autonomic nervous system. Emphasis will be on mechanisms by which drugs affect transmitter synthesis, release, uptake, and metabolism as well as receptor function.
- 5336. Molecular and Cellular Pharmacology (3:3:0).** Prerequisite: Consent of instructor. Course focuses on experimental methods employed in pharmacological research. Topics include expression cloning, photo-affinity labeling, gene microarrays, patch clamp recording, etc. This course will consist of selected topics, lectures, and student discussions.
- 5337. Neuropsychopharmacology (3:3:0).** Prerequisite: Consent of instructor. A structured in-depth study of specific topics concerning neurochemical pharmacology, behavioral pharmacology, and neuropsychopharmacology. Topics to be studied will vary each semester. The course will consist of lectures, discussions, and oral presentations of original papers by the class.
- 6000-6010. Master's Thesis (V1-8).**
- 6331. Principles of Toxicology I (3:3:0).** Prerequisite: Graduate standing in the department or consent of instructor. First half of a two-semester course. Examines the foundations of toxicological sciences. Covers principles, disposition, and first half of toxicological mechanisms.
- 6332. Principles of Toxicology II (3:3:0).** Prerequisite: GPHM 6331. Second half of a two-semester course. Covers remaining toxicological mechanisms, toxic agents, and applied toxicology.
- 7000-7010. Research (V1-12).**
- 7101-7110. Pharmacology Seminar (1:1:0).** Prerequisite: Consent of instructor. This course will enhance student skills in scientific public speaking through a series of seminars that are critiqued by the Department of Phar-

macology & Neuroscience faculty. Weekly seminars are designed to provide training in research data presentation and analysis or critical evaluation and presentation of a manuscript in press. A required course for pharmacology and neuroscience graduate students, it is taken during the fall and spring semesters. The course is designed such that students must interact by participating in the questions and answer component of all seminars as well as during lunch with invited speakers. Grades are determined by faculty evaluation of seminar presentation, and by participation during seminars.

8000-8010. Doctoral Dissertation (V1-12).

Physiology (GPHY)

Luis Reuss, M.D., Chairperson for the School of Medicine Department of Cell Physiology and Molecular Biophysics
Raul Martinez-Zaguilan, Ph.D., and Roger Sutton, Ph.D.,
Graduate Advisors

Primary Faculty: Altenberg, Artigas, Cuello, Fowler, Guan, Jansen, Lutherer, Martinez-Zaguilan, Perez-Zoghbi, Pressley, Reuss, Sutton

Associate Faculty: Blanton, Heavner, Jumper, Laski, Prien, E. Reuss, Terreros

About the Concentration

The concentration has a research interest focused on the structural biology of membrane proteins ranging from their structure to their function in health and disease, and utilizes both cellular and molecular approaches to study these areas. The research involves studying ion transport and the role of ligand- and electric-gated ion channels in normal physiology and pathophysiological conditions. The concentration is also involved in structural modeling of transporters that include the sodium-potassium pump and proton pumps, and structure-function studies of voltage-gated potassium channels. State-of-the-art approaches and techniques such as X-ray crystallography, patch clamp electrophysiology, and confocal microscopy are used to carry out the various research endeavors. The School of Medicine Department of Cell Physiology and Molecular Biophysics has established the Center for Membrane Protein Research and Center for Cardiovascular Disease and Stroke to enhance research efforts.

GPHY Courses:

- 5302. Human Physiology (3:2:0).** This introductory graduate course provides the student with a basic understanding of the organ systems of the human body, including the functions, regulation and interactions. No prerequisites are required.
- 5350. Laboratory Methods in Physiology (3:0:3).** Fundamental principles of physiology are explored through a series of hands-on laboratory exercises. Numerous techniques common to research in many fields will be introduced.
- 5360. Laboratory Rotations as an Introduction to Modern Physiological Research (3:3:0).** Prerequisite: Consent of instructor. Students work in a specific laboratory assisting an ongoing research project or conducting an independent research effort.
- 5400. General Physiology (4:4:0).** An introduction to the physical properties that underlie physiology at the molecular and cellular level. Lecture material will be supplemented by readings from the textbook, as well as discussion of seminar papers. There are no prerequisites; completion of an undergraduate course in physical chemistry or thermodynamics is recommended.

5904. Systems Physiology (9:4:0). This course provides the student with a basic understanding of the organ systems of the human body. Their functions, regulation and interactions are emphasized.

6000-6010. Master's Thesis (V1-6).

6105, 6205, 6305. Topics in Physiology (1:1:0; 2:2:0; 3:3:0). Prerequisite: Consent of instructor. Advanced training in a specialized area of physiology. May be repeated for credit with change in content.

6311. Cellular and Molecular Physiology (3:3:0). Prerequisite: GPHY 5302 or consent of instructor. The study of the structure and function of ion channels and transporters, excitation-contraction coupling, and mechanisms of cell damage and death.

6314. Membrane Biophysics (3:3:0). Students are introduced to the mechanisms of ion transport through membrane channels; models of membrane excitability; molecular structures of ion channels and their physiological functions.

6318. Physiology of the Neuron (3:3:0). Prerequisite: Consent of the instructor. A contemporary and comprehensive coverage of the biology of nerve cells.

7000-7010. Research (V1-12).

7101, 7104-7110. Physiology Seminar (1:1:0). This weekly seminar series, which showcases internationally acclaimed researchers provides the student with the most current information on a variety of interesting topics in physiology, as well as an introduction to state-of-the-art techniques and instrumentation.

7120-7130. Readings in Physiology (1:1:0). (Seminar Readings) This course is designed to complement the Physiology Seminar Series and provide a forum for the students to become familiar with some of the speakers publications. The readings course will examine the hypothesis that was tested, the techniques employed, the most important results obtained, and the conclusions that were drawn from the study and require that the students further develop skills in reading, analysis, integration of knowledge and oral presentation of original science articles and reviews. May be repeated for credit.

7103. Supervised Teaching in Physiology (1:1:0). Supervised teaching gives the student experience in organizing and presenting lectures.

8000-8010. Doctoral Dissertation (V1-12).

