

BIOLOGICAL CHEMISTRY • cancer biology • cell regulation •

genetics and development • immunology • integrative biology •

molecular biophysics • molecular microbiology • neuroscience



BIOLOGICAL CHEMISTRY■ **CHAIR, GRADUATE PROGRAM**

Russell A. DeBose-Boyd, Ph.D.

■ **DEGREE OFFERED**

Doctor of Philosophy

FACULTY AND RESEARCH INTERESTS**Richard J. Auchus, Professor**

M.D., Ph.D., Washington University, St. Louis, 1988

Biochemical, structural and genetic studies of the enzymes and pathways of steroid hormone biosynthesis in humans.

Michael S. Brown, Professor

M.D., University of Pennsylvania School of Medicine, 1966

Regulation of gene expression; cell-surface receptor function; genetics and biochemistry of lipoprotein and cholesterol metabolism.

Richard Bruick, Associate Professor

Ph.D., Scripps Research Institute, 1998

Regulation of the mammalian hypoxic response pathway.

Chuo Chen, Assistant Professor

Ph.D., Harvard University, 2001

Natural product synthesis; synthetic methodology development; small-molecule library synthesis and chemical biology.

David Chuang, Professor

Ph.D., Utah State University, 1970

Structure/function and biogenesis of macromolecular machines.

Nicholas K. Conrad, Assistant Professor

Ph.D., Johns Hopkins University, 2001

Gene expression and RNA biogenesis in viruses.

David R. Corey, Professor

Ph.D., University of California, Berkeley, 1990

Engineering proteins and nucleic acids for novel function.

Russell A. DeBose-Boyd, Associate Professor

Ph.D., University of Oklahoma Health Sciences Center, 1998

Regulation of HMG-CoA reductase and sterol metabolism.

Jef K. DeBrabander, Professor

Ph.D., University of Ghent, Belgium, 1993

Synthesis of natural products and other molecular architectures and interrogation of their mode of action using molecular pharmacology and biochemistry.

George N. DeMartino, Professor

Ph.D., University of Rochester, 1976

Biochemical mechanisms and regulation of intracellular protein degradation; structure and function of intracellular proteases.

J. Russell Falck, Professor

Ph.D., Imperial College, London, 1974

Total synthesis of natural products; synthetic methodology; organometallics; eicosanoids; medicinal chemistry.

Kevin H. Gardner, Professor

Ph.D., Yale University, 1995

Biophysical and biochemical studies of photosensors and other environmental sensors.

Marie-Alda Gilles-Gonzalez, Associate Professor

Ph.D., Massachusetts Institute of Technology, 1988

Mechanisms of O₂, CO and NO sensing and in novel signal-transduction heme proteins.

Elizabeth J. Goldsmith, Professor

Ph.D., University of California, Los Angeles, 1972

Crystallographic studies of recognition and signal transduction in protein molecules.

Joseph L. Goldstein, Professor

M.D., UT Southwestern Medical Center, 1966

Genetics and biochemistry of lipoprotein and cholesterol metabolism; cell-surface receptor function; regulation of gene expression.

Bethany Janowski, Assistant Professor

Ph.D., UT Southwestern Medical Center, 1999

Gene regulation by small RNAs.

Jennifer J. Kohler, Assistant Professor

Ph.D., Yale University, 2000

Molecular foundations of glycoconjugate biosynthesis.

Mark A. Lehrman, Professor

Ph.D., Duke University, 1982

Molecular biology of asparagine-linked glycosylation; structure and regulation of glycosylation enzymes; topology of oligosaccharide assembly.

Wen-Hong Li, Associate Professor

Ph.D., University of California, San Diego, 1996
 Intercellular communications through gap junctions; molecular engineering of fluorescent sensors for cellular imaging; wide-field, confocal and multiphoton fluorescence microscopy; mechanisms and functions of cellular calcium signaling.

Qinghua Liu, Assistant Professor

Ph.D., Baylor College of Medicine, 2000
 Cellular use of small RNAs to specifically silence gene expression; harnessing the power of RNAi to shut down expression of pathological genes to cure human disease.

John B. MacMillan, Assistant Professor

Ph.D., University of California, Davis, 2004
 Isolation and structural determination of biologically active natural products from marine bacteria; new methodology for stereochemical assignment; medicinal chemistry.

Steven L. McKnight, Professor

Ph.D., University of Virginia, 1977
 Molecular genetics and biochemical studies of mammalian gene regulation.

Carole R. Mendelson, Professor

Ph.D., Rutgers University, 1970
 Identification of genetic elements and transcription factors that mediate tissue/cell-specific, developmental and hormonal regulation of gene expression.

Peter Michaely, Assistant Professor

Ph.D., Duke University,
 Biochemical and structural study of receptor-mediated endocytosis and the membrane skeleton of the plasma membrane.

Marc C. Mumby, Professor

Ph.D., University of California, Riverside, 1978
 Signaling pathways controlling cell growth and transformation.

Kim Orth, Associate Professor

Ph.D., UT Southwestern Medical Center, 1993
 Signal transduction in the microbial pathogen *Yersinia pestis*.

Steven Patrie, Assistant Professor

Ph.D., University of Illinois, Urbana, 2004
 Post-translational modifications in disease biology.

Margaret A. Phillips, Professor

Ph.D., University of California, San Francisco, 1988
 Structure and function studies of polyamine and

glutathione biosynthetic enzymes from parasitic protozoa.

Rama Ranganathan, Professor

Ph.D., M.D., University of California, San Diego, 1992, 1994
 Biophysical mechanisms that underlie cellular signal transduction in sensory neurons.

Joseph Ready, Associate Professor

Ph.D., Harvard University, 2001
 Discovery and application of new chemical reaction; total synthesis of complex molecules.

Michael Rosen, Professor

Ph.D., Harvard University, 1993
 Structural and biochemical studies of cytoskeletal control by Rho-family GTPases.

Vanessa Sperandio, Associate Professor

Ph.D., State University of Campinas, Brazil, 1995
 Quorum-sensing regulation of virulence genes in enterohemorrhagic *Escherichia coli* O157:H7.

Uttam Tambar, Assistant Professor

Ph.D., California Institute of Technology, 2006
 Synthesis of complex, biologically active natural products; development of new tandem chemical reactions.

Diana Tomchick, Associate Professor

Ph.D., University of Wisconsin, Madison, 1990
 Structural characterization of signal-transduction protein complexes, proteins involved in reproductive biology and novel proteins from pathogenic bacteria; improved methods of crystallographic data collection, processing and phasing; automated crystallization techniques.

Benjamin Tu, Assistant Professor

Ph.D., University of California, San Francisco, 2003
 Mechanisms by which cellular processes are coupled to metabolic oscillations.

Gomika Udugamasooriya, Assistant Professor

Ph.D., Wayne State University, 2006
 Development of high-affinity and specific peptidomimetics; targeting specific-cell surface receptors at a genome-wide approach for early detection and treatment of cancer.

Kosaku Uyeda, Professor

Ph.D., University of California, Berkeley, 1962
Elucidation of biochemical mechanisms for regulation of carbohydrate metabolism in mammalian cells.

Xiaodong Wang, Professor

Ph.D., UT Southwestern Medical Center, 1991
Activation and execution of apoptosis in mammalian cells.

Noelle Williams, Associate Professor

Ph.D., University of Virginia Health Sciences Center, 1996
Total synthesis of natural products; synthetic methodology; organometallics; eicosanoids; medicinal chemistry.

Wade Winkler, Assistant Professor

Ph.D., Ohio State University, 2002
RNA biology; biochemistry of gene regulation; RNA structure and function; post-transcriptional genetic control; microbial metabolism.

Jin Ye, Assistant Professor

Ph.D., UT Southwestern Medical Center, 2000
Geranylgeranylation and HCV replication; regulation of geranylgeranyl lipid homeostasis; regulated intramembrane proteolysis.

OBJECTIVES

The Biological Chemistry Graduate Program offers state-of-the-art training in biochemistry, synthetic organic chemistry and molecular biology with the goal of preparing students to make significant research contributions at the interface of chemistry and biology. Faculty within the program are actively engaged in researching a wide range of topics, including enzymology, RNA-mediated cellular processes, hormone receptors, metabolism, small-molecule control of cellular function and synthetic organic chemistry.

A characteristic of the scientific environment of UT Southwestern is the close proximity of basic science and clinical departments. The extensive collaborations of the program faculty with faculty of clinical departments provide additional opportunities for students to contribute significantly to research with direct patient and medical relevance. The faculty of the program are also well-recognized in their fields and maintain a lively

communication with colleagues around the world. Numerous seminars by outstanding visiting scientists also are offered and are a vital component of the educational experience.

SPECIAL REQUIREMENTS FOR ADMISSION

Students wishing to join the Biological Chemistry Graduate Program must be enrolled in the Division of Basic Science and be in good standing academically. It is not necessary for a student within the program to choose a mentor who is a member of the faculty of the program, provided that the student has sound reasons for this choice. Students ordinarily will apply for formal admission to the program after completing the first-year curriculum but may participate in the program informally at any time after successful admission into the Division of Basic Science.

The program has two training tracks: Biochemistry and Chemistry.

BIOCHEMISTRY TRAINING TRACK

The Biochemistry Training Track is designed to train students in theory and techniques related to the molecular mechanisms that control cellular activities. Topics encompassed within the program include gene regulation, RNA-mediated processes, protein interactions, enzyme functions and cellular metabolism.

■ CURRICULUM

Students in the Biochemistry Training Track must complete nine credit hours of advanced course work following successful completion of the first-year Core Course. The required Physical Biochemistry I and II courses make up three of these units and provide a rigorous background in protein biochemistry, methods of macromolecular analysis and enzymology. The additional six units are taken from among the suggested electives listed below and/or other courses offered within the Division of Basic Science.

■ REQUIRED COURSES

Physical Biochemistry I
Physical Biochemistry II

■ ELECTIVES

Gene Regulation
 Mechanism of Drug Action
 Molecular Basis of Metabolic Regulation
 Signal Transduction I
 Signal Transduction II

Descriptions of these courses may be found in the Division of Basic Science chapter.

■ STUDENT RESEARCH SEMINAR

Weekly works-in-progress seminars provide a format in which students are encouraged to think critically about their own research and how it relates to related topics in biochemistry. Students receive critical feedback and suggestions from students and faculty with a range of biochemical expertise as well as gaining experience with formal presentations, a critical skill for a successful scientist. Several faculty mentors attend regularly and assist in facilitating discussion of the research presented. All track students are required to attend the WIP series weekly and to actively participate in the discussions, in addition to presenting their ongoing research once each year.

■ FACULTY-MENTORED JOURNAL CLUBS

Journal Clubs are run jointly with the Cell Regulation Graduate Program to expose students to a broad spectrum of cellular and biochemical research as well as foster interaction between students and program faculty. Six or seven journal clubs are offered each semester on topics that change each semester. Each journal club is run by two or three faculty members who select a group of papers on subjects of their choice. Students choose from among the topics offered. Papers are presented by students, while faculty mentors facilitate discussion by the audience.

■ DISSERTATION COMMITTEE

The dissertation committee oversees the scientific progress of students toward the completion of their degrees. The faculty on the committee are selected for expertise in the thesis area so they can contribute substantial intellectual insight in



direction of the project. The committee must have at least four members, including the thesis adviser, and at least two must be program faculty. The committee meets at least once a year to provide guidance and advice and to ensure a student's satisfactory progression toward a degree.

■ QUALIFYING EXAMINATION

The qualifying examination evaluates the student's ability to develop a hypothesis-based research proposal that addresses a specific question in modern biochemistry. The proposal must be presented in written and oral forms. To distinguish the student's abilities from those of the dissertation adviser, the student may not prepare a proposal related to his or her dissertation research or to research being carried out by other members of the student's laboratory. The examination tests the student's ability to defend work described in the proposal and to demonstrate an understanding of the underlying concepts and experimental approaches and designs and their limitations. Advancement to Ph.D. candidacy depends on successful completion of the oral

proposal examination. The qualifying examination process takes place during the late spring of the first year in the program after course work is completed.

CHEMISTRY TRAINING TRACK

The Chemistry Training Track is designed to prepare students for emerging research opportunities at the crossroads of modern chemistry and discovery biology. Research projects focus on topics at the forefront of synthetic and mechanistic chemistry, chemical biology, and biochemistry. The program is committed to providing an educational experience that is challenging, broad-based and rigorous.

■ CURRICULUM

Students in the Chemistry Training Track begin advanced course work in the first year. Prospective students should mention their intention to join the Chemistry Training Track as part of their application to the graduate school. Required courses are listed below. The first-year Core Course and other courses offered in the Division of Basic Science may be taken as electives with approval.

■ FALL, FIRST YEAR

Chemical Structure and Reactivity I
 Chemical Structure and Reactivity II
 Chemical Synthesis I
 Chemical Synthesis II
 Advanced Problems in Reaction Mechanisms

■ SPRING, FIRST YEAR

Advanced Synthesis and Catalysis
 Small Molecule Structure Elucidation
 Advanced Problems in Reaction Mechanisms

Descriptions of these courses may be found in the Division of Basic Science chapter.

■ STUDENT SEMINARS

A weekly seminar provides a format in which students are encouraged to think critically about their own research and how it relates to topics in chemistry. Each student presents one works-in-progress talk and one journal club annually.

WIPs are designed to generate feedback and suggestions for students regarding their research from a diverse audience and to provide experience with formal presentations, a critical skill for successful scientists. Faculty mentors attend regularly and facilitate discussion of the research presented.

Journal club presentations provide a forum for students to learn and describe an area of chemistry not directly related to their thesis topics. This forum aims to broaden students' knowledge and sophistication regarding important areas in synthetic chemistry. Topics are chosen by students in consultation with thesis advisers. Postdoctoral fellows also have an opportunity to present journal clubs.

In addition, a biweekly Chemistry Evening Seminar series provides students an opportunity to become familiar with research from leading laboratories and institutions worldwide.

■ DISSERTATION COMMITTEE

This committee oversees the scientific progress of the student toward completion of a degree. The faculty on the committee are selected for expertise in the thesis area so they can contribute substantial intellectual insight in direction of the project. The committee must have at least four members, including the thesis adviser and at least two program faculty members. The committee meets at least once a year to provide guidance and advice and to ensure the student's satisfactory progress toward a degree.

■ QUALIFYING EXAMINATION

The qualifying examination evaluates the student's ability to develop a hypothesis-based research proposal that addresses a specific question in modern chemistry. The proposal must be presented in written and oral forms. To distinguish the student's abilities from those of the dissertation adviser, the student may not prepare a proposal related to dissertation research or to research being carried out by other members of the student's laboratory. The examination tests the student's ability to defend work described in the proposal and to demonstrate an understand-

ing of the underlying concepts and experimental approaches and designs and their limitations. Advancement to Ph.D. candidacy depends on successful completion of the oral examination. The qualifying examination process takes place during the spring of the first year after course work is completed.

■ **FACULTY**

The following faculty have a particular focus on chemistry:

Richard Auchus
Chuo Chen
Jef DeBrabander
Wen-hong Li
John MacMillan
Joseph Ready
Uttam Tambar