Department of Biochemistry and Molecular Biophysics

The faculty of the Department of Biochemistry and Molecular Biophysics perform research in a broad spectrum of medically relevant areas, including DNA and RNA structure and enzymology; protein folding, misfolding and aggregation; cellular mechanics, membrane receptor-mediated signaling, and hemostasis, thrombosis and vascular biology. The department offers training opportunities at the crossroads of biochemistry, biophysics, systems biology, computational science and pharmacological sciences.

The department’s approaches to research focus on understanding the energetics, structure and mechanisms of biological processes. Investigators employ a variety of experimental methods such as X-ray crystallography, NMR, optical spectroscopy, thermodynamics and rapid kinetics, in combination with computational approaches, to unravel the molecular underpinnings of processes of relevance to health and disease. Novel single-molecule methods are providing new insight into the molecular details of enzyme mechanisms and macromolecule dynamics. High-throughput screening of chemical libraries and synthetic medicinal chemistry to develop small molecule probes of biological systems provide new avenues for translational research and the development of experimental therapeutics.

The faculty in the department organize and teach basic science courses in the medical school curriculum, including Molecular Foundations of Medicine (Biochem 502). In the Graduate School curriculum, the faculty teach courses in Nucleic Acids & Protein Biosynthesis (Biol 548), Chemistry and Physics of Biomolecules (Biol 5357), and Macromolecular Interactions (Biol 5312). The overarching theme of these courses is to understand the principles of the molecular interactions that underlie the biological process of health and disease. Students in the School of Medicine and the Graduate School are eligible for these courses and may elect to pursue biomedical research under the direction of our faculty. A full listing of advanced courses topics (https://biochem.wustl.edu/studentinfo/courses) can be found on our website.

Website: http://biochem.wustl.edu

Degrees & Requirements

More information about Department of Biochemistry and Molecular Biophysics degrees (http://bulletin.wustl.edu/grad/gsas/dbbs) and requirements can be found in the Graduate School Bulletin.

Research

**Biochem 900**

Cross-listed with L41 Biol 590

**Wayne M. Barnes, PhD**

McDonnell Sciences Building, 2nd Floor
Phone: 314-362-3351

We are developing a new way to sequence DNA, under the "$1000 Genome Project." This project involves the addition of experimental fluorescent probes to DNA polymerase, with the goal of watching a single molecule flicker as it copies DNA. Student involvement may be at the level of designing mutations and purifying mutant enzymes, testing ways to prepare the templates, or testing observations of working molecules.

**T7 RNA polymerase** is used to express our proteins, and we have double and triple mutants of it that improve expression of problematic proteins, but we only have theory as to how they work better: We think they are slower, and that slower is better. Student involvement may be in constructing comparative strains that use the enzyme, and measuring the speed somehow, in vivo and in vitro.

**Greg Bowman, PhD**

South Building, 2nd Floor
Phone: 314-362-7433

Systems Biophysics. We combine simulation and experiment to understand the conformational changes proteins undergo and how these changes allow information to flow, both within single proteins and within networks of interacting proteins. Two major application areas are (1) understanding hidden allosteric sites and the opportunities they present for drug design and (2) understanding the molecular mechanisms of vision, especially the origins of inherited forms of blindness. To facilitate these applications, we also develop enhanced sampling algorithms for simulating long timescale dynamics of proteins and nucleic acids.

**Peter M.J. Burgers, PhD**

South Building, 1st Floor
Phone: 314-362-3872

Molecular biology of DNA replication, DNA damage response mechanisms, and DNA repair in eukaryotes.

**John Cooper, MD, PhD**

South Building, 2nd Floor
Phone: 314-362-0287

Molecular mechanisms of cell motility and cytoskeleton assembly.

**Carl Frieden, PhD**

McDonnell Sciences Building, 2nd Floor
Phone: 314-362-3344

Use of single-molecule biophysical techniques such as magnetic and optical trapping to study DNA transcription.

**Roberto Galletto, PhD**
McDonnell Sciences Building, 2nd Floor
Phone: 314-362-4368
Mechanistic studies of DNA motor proteins and telomere binding proteins; single-molecule approaches.

**Michael Greenberg, PhD**
McDonnell Sciences Building, 2nd Floor
Phone: 314-362-8670
Cytoskeletal molecular motors in health and disease. We are currently studying the effects of mutations that cause heart disease.

**Kathleen Hall, PhD**
North Building, 2nd Floor
Phone: 314-362-4196
RNA structure/function. RNA protein interactions. NMR spectroscopy.

**Jim Janetka, PhD**
Cancer Research Building, 2nd Floor
Phone: 314-362-0509
The rational structure-based ligand design and synthesis of chemical tools useful for studying cancer and infectious disease.

**Andrzej Krezel, PhD**
McDonnell Sciences Building, 2nd Floor
Phone: 314-362-8482
Structural biology of transcriptional regulation in gastric pathogen Helicobacter pylori.

**Weikai Li, PhD**
McDonnell Sciences Building, 2nd Floor
Phone: 314-362-8687
Membrane protein crystallography and functional studies.

**Timothy M. Lohman, PhD**
North Building, 2nd Floor
Phone: 314-362-4393
Biophysical chemistry of proteins, nucleic acids and their mechanism of interaction. Mechanisms of DNA unwinding and translocation by helicases and SSB proteins.

**Garland R. Marshall, PhD**
Center for Chemical Genomics
Cancer Research Building, 2nd Floor
Phone: 314-935-7911
Targeting Epigenetic Control in Pathology. A major concern regarding the use of therapeutics targeting the epigenetic control of gene expression is undesirable side effects, particularly those associated with fetal development. Despite the intense interest in targeting histone deacetylases (HDACs, eleven zinc-based enzymes expressed in humans) for multiple therapeutic applications and the fact that two non-specific HDACIs are already FDA-approved in oncology, isofrom-specific HDACIs are not available. Professor Marshall and his collaborators in Rome have a comprehensive program to develop isoform-specific inhibitors for applications for reversing HIV latency with Professor Lee Ratner for treatment of HIV, with Dr. Michael D. Onkin for treatment of uveal melanoma, and for potential antiparasitics with Professors Dan Goldberg, Eva Istvan, Makedonka Mitreve and Audrey Odom. Two uniquely specific inhibitors of HDAC6 have already been discovered in the Marshall lab.

The research involves bioinformatics to identify homologs of HDACs in parasites, molecular modeling to generate homology models of target proteins, virtual screening to identify potential inhibitors and bioassays to quantitate efficacy. Projects can be customized to fit individual preferences.

**Linda Pike, PhD**
South Building, 1st Floor
Phone: 314-362-9502
Mechanism of EGF and ErbB receptor function. We use a combination of radioligand binding and molecular imaging via luciferase fragment complementation to study the interactions of ErbB family receptors. The goal is to gain insight into structure/function relationships within these receptors to better understand how to target them therapeutically.

**Andrea Soranno, PhD**
South Building, 2nd Floor
Phone: 314-273-1632
Our main research interests are the physical principles and molecular mechanisms determining biomolecular function.

**Rui Zhang, PhD**
McDonnell Sciences Building, 2nd Floor
Phone: 314-273-1663
We combine single-molecule fluorescence spectroscopy and concepts from polymer physics to investigate intrinsically disordered proteins; we develop innovative methods to study macromolecular conformations and dynamics within cells and in membraneless organelles.

**Faculty**

**Department Chair**

John A. Cooper, MD, PhD
Visit our website for more information about our faculty (http://biochem.wustl.edu/faculty) and their appointments.

**Jacques Ulrich Baenziger, PHD, MD**
Professor Emeritus of Biochemistry and Molecular Biophysics (primary appointment)
PHD Washington Univ in St. Louis 1975
MD Washington Univ in St. Louis 1975
Wayne Morris Barnes, PHD
Associate Professor of Biochemistry and Molecular Biophysics (primary appointment)
BA University of CA Riverside 1969
PHD Univ of Wisconsin Madison 1974

Gregory R. Bowman, PHD
Assistant Professor of Biochemistry and Molecular Biophysics (primary appointment)
Adjunct Assistant Professor of Chemistry (Courtesy Affiliation)
BS Cornell University 2006
PHD Stanford University 2010

Peter M Burgers, MS, PHD
Marvin A. Brennecke Professor of Biological Chemistry (primary appointment)
MS Leiden University 1972
BS Leiden University 1969
PHD Leiden University 1977

John A Cooper, MD, PHD
Head of the Department of Biochemistry
Professor of Biochemistry and Molecular Biophysics
Professor of Cell Biology and Physiology
MD Johns Hopkins University 1982
BS Brown University 1977
PHD Johns Hopkins University 1983

Sudha Mahajan Cowsik, PHD, MS
Instructor in Biochemistry and Molecular Biophysics (primary appointment)
PHD Institute of Medical Science 1976
BS Panjab University 1969
MS Panjab University 1970

Roland Ellwood Dolle, PHD, MS
Associate Professor of Biochemistry and Molecular Biophysics (primary appointment)
PHD University of Pennsylvania 1984
MS State University of New York 1980
BS Arizona State University 1978

Thomas E Ellenberger, PHD, DVM
Professor of Biochemistry and Molecular Biophysics (primary appointment)
Chairman of the Executive Council of the Division of Biology and Biomedical Sciences
PHD Harvard University 1989
DVM Iowa State University 1983

Kathleen Hall, PHD
Professor of Biochemistry and Molecular Biophysics (primary appointment)
BA Harvard University 1959
PHD Stanford University 1966

Carl Frieden, PHD
Professor of Biochemistry and Molecular Biophysics (primary appointment)
BA Carleton College 1951
PHD Univ of Wisconsin Madison 1955

Eric A Galburt, PHD
Associate Professor of Biochemistry and Molecular Biophysics (primary appointment)
PHD University of Washington 2002

Roberto Galletto, MS, PHD
Associate Professor of Biochemistry and Molecular Biophysics (primary appointment)
MS University of Genova 1996
PHD University of Texas Galveston 2002

Michael Jonathan Greenberg, PHD
Assistant Professor of Biochemistry and Molecular Biophysics (primary appointment)
BS Brandeis University 2004
PHD Boston University 2010

Kathleen Hall, PHD
Professor of Biochemistry and Molecular Biophysics (primary appointment)
BA Harvard University 1959
PHD Stanford University 1966

Maxenia Garcia Ilagan, PHD
Assistant Professor of Biochemistry and Molecular Biophysics (primary appointment)
Assistant Professor of Developmental Biology
PHD University of Missouri 2000
BS School Not Listed 1992

James W Janetka, PHD
Associate Professor of Biochemistry and Molecular Biophysics (primary appointment)
PHD Univ of Wisconsin Madison 1996
BS University of Illinois 1990

Michael S Kinch, PHD
Courses

The Department of Biochemistry and Molecular Biophysics also offers courses through the Graduate School. For a full listing of courses offered, please visit the university online course catalog (https://courses.wustl.edu/CourseInfo.aspx?sch=L&dept=L41&crslvl=5:9).


M15 Biochem 502 Molecular Foundations of Medicine
This course is designed primarily for medical students and will cover fundamental aspects of biochemistry and cell biology. The course begins with a treatment of protein structure and the function of proteins in the cytoskeleton and cell motility. The principles of enzyme kinetics and regulation are then discussed, and basic pathways for the synthesis and metabolism of carbohydrates and lipids are introduced. This leads into a discussion of membrane structure and the function cellular organelles in biological processes including energy production, protein degradation and protein trafficking. Small group case study sections serve to link the basic science to the clinic. Credit 46.5 units.
M15 Biochem 5068 Fundamentals of Molecular Cell Biology
This is a core course for incoming graduate students in Cell and Molecular Biology programs to learn about research and experimental strategies used to dissect molecular mechanisms that underlie cell structure and function, including techniques of protein biochemistry. Enrolling students should have backgrounds in cell biology and biochemistry, such as courses comparable to L41 Biol 334 and L41 Biol 4501. The format is two lectures and one small group discussion section per week. Discussion section focuses on original research articles. Same as M04 5068 and Arts & Sciences L41 Biol 5068.
Credit 47 units.

M15 Biochem 5357 Chemistry and Physics of Biomolecules
This course covers three major types of biomolecular structure: proteins, nucleic acids and membranes. Basic structural chemistry is presented, as well as biophysical techniques used to probe each type of structure. Selected topics include: protein folding, protein design, x-ray crystallography, NMR spectroscopy, nucleic acid bending and supercoiling, nucleic acid:protein interactions, RNA folding, membrane organization, fluidity, permeability and transport, and membrane channels. Weekly discussion section will cover problem sets and present current research papers. One of the required courses for the Biochemistry and for the Molecular Biophysics graduate programs. Prerequisites: Prior course work in Biochemistry and in Physical Chemistry is recommended, but not required.
Credit 46.5 units.