James S. McDonnell Department of Genetics

The Department of Genetics (http://genetics.wustl.edu) is at the forefront of the rapidly developing field known as genomic (or personalized) medicine, in which genetic and epigenetic analysis coupled with clinical information enables treatments to be tailored specifically to the individual patient. The rapid evolution of sequencing technologies, genome engineering, automated cellular imaging and mass spectrometry methods to rapidly perform proteomic and metabolomics studies, coupled with powerful computational tools, is revolutionizing the biological sciences. Investigators in the department are developing new methods of genomic analysis — including technology and software, epigenomics and copy number variation as well as studies of disease pathways using model organisms — to identify and study the genes responsible for human disease and treatment responses.

The department supports a broad program of preclinical and graduate instruction in genetics, with research opportunities that include studies of transcriptional networks, population genetics, protein evolution, neurological disorders, developmental genetics, models of human disease, genome architecture, statistical genetics and computational biology, genome technologies and infertility.

A significant portion of the first-year course in basic medical sciences is devoted to human and clinical genetics, with emphasis on how genomic information will transform the practice of medicine. This includes specialized selective courses in addition to the core genetic curriculum. Advanced training in clinical genetics and in genetic research is available from the faculty in the Department of Genetics and from geneticists with principal appointments in many other departments within the School of Medicine (http://medicine.wustl.edu).

Advanced courses and seminars are offered that focus on the genetics of complex disease, gene expression, genome engineering, induced pluripotent stem cells, single-cell genomics, molecular genetics, genetic epidemiology, computational biology, developmental genetics, microbial genetics, cancer genetics, and population and evolutionary genetics. Extraordinary opportunities for research training and experience are available in all of these areas and at all levels. The programs are tailored to meet the needs of medical students, graduate students, and both MD and PhD postdoctoral fellows pursuing advanced training in biomedical research.

Website: http://genetics.wustl.edu

Degrees & Requirements

Although the Department of Genetics does not offer its own degree, some of the department's courses are open to students in the MD and MSTP (MD/PhD) programs. Further information about the MD and MSTP degrees can be found in the Degrees & Programs (http://bulletin.wustl.edu/medicine/degrees) section of this Bulletin.

Research

M20 Genetics 900
Cross-listed with L41 Biol 590

Barak Cohen, PhD
Couch Biomedical Research Building, Room 4308
Phone: 314-362-3674
cohen@wustl.edu

Functional genomics in yeast; gene regulatory networks, complex trait genetics, and synthetic biology studies of cis-regulation.

Joseph Dougherty, PhD
Couch Biomedical Research Building, Room 6316
Phone: 314-286-0752
jdougherty@wustl.edu

Our laboratory utilizes a variety of techniques spanning from human molecular genetics and informatics to mouse behavioral neuroscience and neuroanatomy. We develop and employ mouse models of psychiatric disorders, particularly those that mimic genetic variations that we have identified in human patient populations, with the goal of trying to understand the cellular and molecular underpinnings of these disorders.

Susan K. Dutcher, PhD
Couch Biomedical Research Building, Room 5301
Phone: 314-362-2765
dutcher@wustl.edu

Studies of the role of centrioles and basal bodies in ciliary signaling, assembly, and motility using molecular genetics and computational and biochemical approaches.

Heather Lawson, PhD
Couch Biomedical Research Building, Room 6312
Phone: 314-362-7269
lawson@wustl.edu

Our lab focuses on translating genetic and epigenetic molecular and analytical observations to physiological endpoints. We apply several complementary and integrated approaches, including bench science, cultured cells, mouse phenotyping and husbandry, and computational and systems biology.
Jeffrey Milbrandt, MD, PhD  
Couch Biomedical Research Building, Room 6306  
Phone: 314-362-4651  
jmilbrandt@wustl.edu

We are performing Cas9/CRISPR activation and repression screens in iPSC-derived neurons together with single-cell transcriptomics analysis to evaluate the causal effects of genetic variants associated with neuropsychiatric diseases. We are also studying how metabolism influences the axonal/glial interactions important for proper nerve function. We use genetic and metabolomic analysis to identify molecular mechanisms of axonal degeneration, a self-destructive process that plays an important role in many neurodegenerative conditions.

Rob Mitra, PhD  
Couch Biomedical Research Building, Room 4301  
Phone: 314-362-2751  
mitra@wustl.edu

Our focus is on systems biology, gene regulation and technology development. Projects in the lab fall into three general categories: (1) understanding the molecular logic of transcription factor cooperativity; (2) mapping the gene regulatory networks that control developmental processes and using this knowledge to reprogram fibroblasts into useful cell types; and (3) developing novel technologies to more efficiently achieve the first two aims.

Samantha Morris, PhD  
Couch Biomedical Research Building, Room 3316  
Phone: 314-747-8618  
s.morris@wustl.edu

This lab strives to engineer cell fate to generate clinically valuable cell populations via stem cell and developmental biology. Our research focuses on dissecting the gene regulatory networks that define cell identity, using the developing embryo and tissue regeneration as a guide to engineer fate in vitro. We apply insight from these analyses to generate clinically relevant populations by differentiating cells from a pluripotent state or by directly converting cells between mature fates. We employ a combination of computational, single-cell transcriptomics with cell and developmental biology approaches.

Zachary Pincus, PhD  
Couch Biomedical Research Building, Room 5304  
Phone: 314-747-5520  
zpincus@wustl.edu

Interindividual variability in aging and lifespan; developmental origins of longevity and adult health; quantitative microscope and image analysis of C. elegans.

Michael A. Province, PhD  
Farrell Learning and Teaching Center (FLTC), 6th floor, Suite 605  
Phone: 314-362-3616  
mprovince@wustl.edu

Development and evaluation of novel statistical genetics methodology, especially as applied to genomic identification and validation of variants for human complex quantitative traits, such as heart disease, cancer, pulmonary function, diabetes and human longevity.

Nancy L. Saccone, PhD  
Farrell Learning and Teaching Center (FLTC), 6th floor, Suite 606  
Phone: 314-747-3263  
nlism@wustl.edu (nlms@wustl.edu)

Statistical genetics and psychiatric genetics; development and application of analysis methods for studying the genetics of human disease and complex traits.

Tim Schedl, PhD  
Couch Biomedical Research Building, Room 5305  
Phone: 314-362-6162  
ts@wustl.edu

Our lab studies germ cell development in the model organism Caenorhabditis elegans. The major focuses are control of the decision to proliferate or enter the meiotic pathway, control and coordination of meiotic prophase progression and gametogenesis, and control of meiotic maturation and ovulation.

James Skeath, PhD  
Couch Biomedical Research Building, Room 6315  
Phone: 314-362-0535  
jskeath@wustl.edu

Identification of the genes and the elucidation of the molecular mechanisms that regulate the early events of Drosophila central neurogenesis; illumination of the mechanisms that form, pattern and specify the individual identities of the progenitor cells of the Drosophila embryonic central nervous system.

Gary D. Stormo, PhD  
Couch Biomedical Research Building, Room 4208  
Phone: 314-747-5534  
stormo@wustl.edu

Computational biology of protein-DNA interactions, RNA folding, gene and promoter finding; biochemical analysis of DNA-protein interactions and gene regulation.

Ting Wang, PhD  
Couch Biomedical Research Building, Room 5211  
Phone: 314-286-0865
We work in the general field of computational genomics and epigenomics. We study the evolution of human regulatory networks, with a focus on mobile elements (or transposable elements) and their impact on gene regulation, their genetic and epigenetic control, and their roles in human biology and diseases.

### Faculty

#### Department Head
Jeffrey D. Milbrandt, MD, PhD

#### Executive Director, McDonnell Genome Institute
Jeffrey D. Milbrandt, MD, PhD

#### Director, Division of Statistical Genomics
Michael Province, PhD

#### Director, Genome Technology Access Center
Rich Head, MS

#### Director, Genome Engineering and iPSC Center
Xiaoxia Cui, PhD

Visit our website for more information about our faculty (http://genetics.wustl.edu/faculty) and their appointments.

### B

**Ruteja A. Barve, PHD, MS**  
Instructor in Genetics (primary appointment)  
BS University of Pune 1995  
PHD Washington Univ in St. Louis 2014  
MS Washington Univ in St. Louis 2008

**John Rutledge Bermingham Jr, PHD**  
Associate Professor of Genetics (primary appointment)  
PHD University of Colorado Boulder 2016  
BS Yale University 2016

**Adam J. Bloom, PHD**  
Assistant Professor of Genetics (primary appointment)  
Assistant Professor of Anesthesiology  
BS University of CA Berkeley 1997  
PHD Washington Univ in St. Louis 2006

**Ingrid B Borecki, MS, PHD**  
Adjunct Professor of Genetics (primary appointment)  
MS University of Hawaii 1980  
BS University of Illinois 1977

### C

**Paul F Cliften, MS, PHD**  
Associate Professor of Genetics (primary appointment)  
BS Utah St University 1992  
MS Utah St University 1995  
PHD University of California 1999

**Barak Alon Cohen, PHD**  
Professor of Genetics (primary appointment)  
Alvin Goldfarb Distinguished Professor of Computational Biology  
PHD Harvard University 1998  
BS Cornell University 1992

**Donald Franklin Conrad, MS, PHD**  
Adjunct Associate Professor of Genetics (primary appointment)  
BS Dartmouth College 1999  
MS Stanford University 2017  
PHD University of Chicago 2007

**Seth Daniel Crosby, MD**  
Assistant Professor of Genetics (primary appointment)  
BS University of California 1984  
MD University Texas San Antonio 1989

**Xiaoxia Cui, MS, PHD**  
Assistant Professor of Genetics (primary appointment)  
MS University of Alabama 2017  
BS Nanjing University 2017  
PHD University of Texas Austin 2017

### D

**Joseph D Dougherty, PHD**  
Associate Professor of Genetics (primary appointment)  
Associate Professor of Psychiatry  
BS Truman State University 1999  
PHD University of California 2005

**Susan K. Dutcher, PHD**  
Professor of Genetics (primary appointment)  
Professor of Cell Biology and Physiology  
BA Colorado College 1974  
PHD University of Washington 1980

### F

**Justin C. Fay, PHD**  
Adjunct Associate Professor of Genetics (primary appointment)  
PHD University of Chicago 2001

### H

**Richard D Head, MS**
**K**

Sungsu Kim, MS, PHD  
Instructor in Genetics (primary appointment)  
MS Korea University 2002  
BS Korea University 2000  
PHD Washington Univ in St. Louis 2010

**L**

Haluk Lacin, PHD  
Instructor in Genetics (primary appointment)  
PHD Washington Univ in St. Louis 2010  
BS Bogazici University 2003

Heather A Lawson, MA, PHD  
Assistant Professor of Genetics (primary appointment)  
BA Univ of Wisconsin Milwaukee 2002  
MA Pennsylvania State University 2004  
PHD Pennsylvania State University 2008

**M**

Xianrong Mao, MS, PHD  
Instructor in Genetics (primary appointment)  
BS Lanzhou University 1993  
MS Chinese Academy of Sciences 1996  
PHD University of Arkansas 2001

James P Mc Carter, MD, PHD  
Adjunct Professor of Genetics (primary appointment)  
BA Princeton University 1989  
MD Washington Univ in St. Louis 1998  
PHD Washington Univ in St. Louis 1998

Jeffrey D Milbrandt, MD, PHD  
James S McDonnell Professor of Genetics (primary appointment)  
Executive Director of the McDonnell Genome Institute  
Head of the Department of Genetics  
Professor of Medicine  
Professor of Neurology  
Professor of Pathology and Immunology  
MD Washington Univ in St. Louis 1978  
PHD University of Virginia 1983  
BS Univ of Nebraska at Kearney 1974

Robi D. Mitra, PHD  
Professor of Genetics (primary appointment)  
Alvin Goldfarb Distinguished Professor of Computational Biology  
PHD Mass Inst of Technology (MIT) 2000

**P**

Zachary Scott Pincus, PHD  
Assistant Professor of Genetics (primary appointment)  
Assistant Professor of Developmental Biology  
PHD Stanford University 2007  
BS Stanford University 2002

Michael A Province, MA, PHD  
Professor of Genetics (primary appointment)  
Professor of Biostatistics  
MA Washington Univ in St. Louis 1979  
PHD Washington Univ in St. Louis 1987  
BA University of Dallas 1973

**S**

Nancy L. Saccone, PHD, MS  
Associate Professor of Genetics (primary appointment)  
Associate Professor of Biostatistics  
PHD Brown University 1993  
MS Brown University 1990  
BA University of California 1988

Yo Sasaki, MS, PHD  
Associate Professor of Genetics (primary appointment)  
MS Tokyo U of Agric & Technology 1994  
BS Tokyo U of Agric & Technology 1991  
PHD Gunma University, Med School 1997

Tim B Schedl, PHD  
Professor of Genetics (primary appointment)  
BA Lawrence University 1977  
PHD Univ of Wisconsin Madison 1984

James B Skeath, PHD  
Professor of Genetics (primary appointment)  
PHD Univ of Wisconsin Madison 1993  
BA Haverford College 1988

Gary D Stormo, MA, PHD  
Professor of Genetics (primary appointment)  
Joseph Erlanger Professor  
Professor of Biomedical Engineering  
Professor of Computer Science  
BS California Institute Technolo 1972  
MA University of Colorado Boulder 1975  
PHD University of Colorado Boulder 1981

**W**

Ting Wang, MS, PHD  
Professor of Genetics (primary appointment)  
Professor of Biostatistics  
Professor of Computer Science and Engineering  
Sanford and Karen Loewenthal Distinguished Professor of Medicine  
MS Washington Univ in St. Louis 2001  
BS School Not Listed 1997  
PHD Washington Univ in St. Louis 2006

Michael Aaron White, MS, PHD  
Assistant Professor of Genetics (primary appointment)  
BA Brigham Young University 2000

M20 Genetics 511 Medical Genetics
Medical genetics is both a science and a clinical area or specialty of medicine, and the boundary between research and clinical application is increasingly blurred. The pace at which genomic and epigenomic tools are being developed is unprecedented. These tools result in continual conceptual advancements, which inevitably affect how we approach the study of disease risk, diagnosis, and management in all areas of medicine, not just medical genetics. We are moving into a time when the interpretable data from the examination of individual genomes will be incorporated into all other clinical data to assess individual risks and to guide clinical management and decision making. This course is intended as the first step toward life-long training in medical genetics and genomics.

The course begins with a number of sessions devoted to basic principles of genetics. Drawing on this foundation, we move on to discuss genomic and epigenomic tools, to learn from leaders in their fields about the big questions in genetics and genomics (e.g., microbiome research, cancer genomics, current clinical uses of exome sequencing), and to discover how the tools are being used to answer these questions. Students are exposed to the use of genetic and genomic databases and information resources, which will allow them to keep up with new information and to critically appraise its validity and clinical utility. We begin to discuss the implication of this shift to the "genomic era," particularly regarding ethical aspects, regulatory aspects, equal access, healthcare costs, and patient education. Clinical geneticists actively participate in the course and use a series of genetic disorders to help students apply their knowledge, focusing mainly on genetic etiology, pattern of inheritance, inheritance risk, and molecular diagnostic testing. Frequent patient interviews further enhance the exposure to clinical genetics. Overall, the course aims to enhance genetic and genomic literacy, which is an essential first step in preparing students to participate in the multidisciplinary teams that effectively make cutting-edge genetic and genomic research results accessible to patients. This course is cross-listed with L41 Biol 550. Credit 34 units.