

Biology & Biomedical Sciences

The Division of Biology & Biomedical Sciences at Washington University offers exceptional doctoral education at one of the nation's preeminent biomedical research centers. The Division includes 12 doctoral programs:

- Biochemistry, Biophysics and Structural Biology
- Cancer Biology
- Computational and Systems Biology
- Developmental, Regenerative and Stem Cell Biology
- Evolution, Ecology and Population Biology
- Human and Statistical Genetics
- Immunology
- Molecular Cell Biology
- Molecular Genetics and Genomics
- Molecular Microbiology and Microbial Pathogenesis
- Neurosciences
- Plant and Microbial Biosciences

A collaborative, interdisciplinary approach to research and education is a hallmark of Washington University and the Division. As a universitywide consortium, the Division transcends departmental lines and removes traditional boundaries of scientific fields. Faculty and graduate students regularly cross disciplines, devising novel questions and approaches that might otherwise go unexplored. The Division consists of approximately 690 PhD and MD PhD students, with more than 500 faculty members from 38 departments.

Washington University in St. Louis provides unique opportunities for translating basic science to practical application. In addition, the Division's associations with internationally prominent local institutions provide exciting opportunities: students in the biomedical sciences enrich their work with the clinical perspective of our outstanding medical school; students in plant, population, evolutionary and ecological sciences benefit from our close affiliation with the internationally renowned Missouri Botanical Garden (<http://www.missouribotanicalgarden.org/>) and the Danforth Plant Science Center (<http://www.danforthcenter.org/>).

To help prepare graduates for careers in academia, government, industry or another field of their choice, educational opportunities are offered for skills development and career exploration. The DBBS offers career-planning curriculum, and students can pursue noncredit elective credentials to build transferable professional skills in four areas that apply to a wide variety of scientific careers: leadership, entrepreneurship, science communication, and teaching. Through the Initiative for Maximizing Student Development Career Pathway Talks

program, professionals from a variety of fields (e.g., biotech startups, patent law) provide presentations and Q&A sessions to students throughout the year. In addition — through partnerships with groups such as the Teaching Center, the Career Center, and student organizations such as ProSPER, InPrint, Sling Health, the BALSAs Group, and the Young Scientist Program — students have additional opportunities to develop experiences relevant to their future career goals.

Email: DBBS-Info@email.wustl.edu

Website: <http://dbbs.wustl.edu>

Programs and Faculty

Biochemistry, Biophysics and Structural Biology (<http://dbbs.wustl.edu/divprograms/biophysics/Pages/BBSB.aspx>)

Areas of study:

- Enzymology and allostery
- Mechanisms of neural degeneration
- Molecular signaling
- Biochemistry of host-pathogen interactions
- Mechanisms of microbial immune evasion
- Protein-nucleic acid interactions
- Cell cycle regulation
- Computational biophysics
- Cellular transport and trafficking
- Nanotechnology and chemical biology

Visit our website for information about our Biochemistry, Biophysics and Structural Biology faculty (<http://dbbs.wustl.edu/divprograms/biophysics/Pages/Faculty.aspx>).

Cancer Biology (<http://dbbs.wustl.edu/divprograms/cancerbiology/Pages/default.aspx>)

Areas of study:

- Apoptosis and autophagy
- Tumor cell biology
- Chromosome stability and genome maintenance
- Cell motility and metastasis
- DNA repair, replication and recombination
- Transcriptional and translational regulation
- Metabolism
- Imaging technologies
- Receptor-ligand interactions
- Signal transduction molecules and pathways
- Biomarker studies
- Genomic mutation profiles and informatics
- Non-coding RNAs
- Tumor immunology and vaccines
- Tumor viruses

- Hematopoiesis
- Cancer disparities
- Small molecule and nanotechnology discoveries
- Tumor microenvironments
- Clinical trial research

Visit our website for information about our Cancer Biology Faculty (<http://dbbs.wustl.edu/divprograms/cancerbiology/Pages/Faculty.aspx>)

Computational and Systems Biology (<http://dbbs.wustl.edu/divprograms/compbio/Pages/default.aspx>)

Areas of study:

- Large-scale genetic network analysis and reconstruction
- Technology development for high-throughput collection of genetic and biochemical data
- Real-time, single-cell analyses of genetic regulatory circuits
- Specificity and evolution of DNA-protein interactions
- Algorithm development for comparison of DNA, RNA, and protein sequences
- Synthetic biology
- Metagenomics and microbiomes
- Epigenetics and epigenomics
- Functional genomic studies of population genetic variation
- Big-biodata integration and modeling

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Developmental, Regenerative and Stem Cell Biology (<http://dbbs.wustl.edu/divprograms/devbio/Pages/default.aspx>)

Areas of study:

- Regenerative and stem cell biology
- Organogenesis
- Animal models of human developmental disorders
- Aging and longevity
- Neuronal development, differentiation and plasticity
- Genetic/developmental basis of cancer
- Growth factors and cell signaling during development
- Establishment of cell and tissue polarity
- Circadian rhythms
- Growth control and nutrition
- Hormonal regulation
- Gene regulatory networks/systems biology
- Epigenetic control of development

Visit our website for information about our Developmental, Regenerative and Stem Cell Biology faculty (<http://dbbs.wustl.edu/divprograms/devbio/Pages/Faculty.aspx>).

Evolution, Ecology and Population Biology (<http://dbbs.wustl.edu/divprograms/eepb/Pages/default.aspx>)

Areas of study:

- Levels and maintenance of genetic variation in natural plant and animal populations
- Variation at medically relevant genes and candidate loci
- Molecular evolution of genes
- Mechanisms of speciation and adaptation
- Factors that contribute to biodiversity across space and time
- Interaction of species and how such interactions affect biodiversity
- Restoration and conservation of species
- Biology of invasive species
- Role of species in the functioning of entire ecosystems
- Phylogenetic relationships among populations, species and higher taxa

Visit our website for information about our Evolution, Ecology and Population Biology faculty (<http://dbbs.wustl.edu/divprograms/eepb/Pages/Faculty.aspx>).

Human and Statistical Genetics (<http://dbbs.wustl.edu/divprograms/hsg/Pages/default.aspx>)

Areas of study:

- Detection of loci for simple and complex/quantitative traits in humans
- Association analyses for common and rare variants
- Development of novel statistical methods for gene discovery
- Mapping of simple and quantitative traits in model organisms
- Genomic approaches to gene expression, transcriptional regulation, and development
- Functional analysis of genes and variants for human disease

Visit our website for information about our Human and Statistical Genetics faculty (<http://dbbs.wustl.edu/divprograms/hsg/Pages/Faculty.aspx>).

Immunology (<http://dbbs.wustl.edu/divprograms/immunology/Pages/default.aspx>)

Areas of study:

- Tumor immunobiology
- Autoimmune diseases
- Host-pathogen interactions
- Immune system development
- Lymphocyte function
- Molecular immunology
- Cytokine function
- Lymphocyte differentiation
- Lymphocyte signaling

- Computational modeling of immune responses

Visit our website for information about our Immunology faculty (<http://dbbs.wustl.edu/divprograms/immunology/Pages/Faculty.aspx>).

Molecular Cell Biology (<http://dbbs.wustl.edu/divprograms/cellbio/Pages/default.aspx>)

Areas of study:

- Apoptosis
- Cancer cell biology
- Chromosome biology and genome maintenance
- Cytoskeleton assembly, cell motility and chemotaxis
- DNA repair, replication, and recombination
- Extracellular matrix and tissue mechanics
- Mechanisms of enzyme catalysis and inhibition
- Mechanisms of transcription and tissue-specific transcription regulation
- Membrane excitability
- Metabolism
- New imaging technologies for cells and whole animals
- Organelle biogenesis
- Prion diseases and neural degeneration
- Protein trafficking
- Receptor-ligand interactions in regulation of cell growth and cell phenotype
- Regulation of gene expression and translational control
- Signal transduction molecules and pathways
- Vascular biology and coagulation

Visit our website for information about our Molecular Cell Biology faculty (<http://dbbs.wustl.edu/divprograms/cellbio/Pages/Faculty.aspx>).

Molecular Genetics and Genomics (<http://dbbs.wustl.edu/divprograms/genetics/Pages/default.aspx>)

Areas of study:

- Genetic basis of human disease
- Epigenetics
- Animal models of human disease
- Cancer genetics
- Model organism genetics
- Computational genomics and epigenomics
- Regulation of transcription and translation
- Population genetics
- Developmental genetics
- Gene therapy
- Gene regulatory networks/systems biology
- Genetic basis of microbial development and pathogenesis
- Functional genomics
- Sequence analysis and gene-structure prediction

Visit our website for information about our Molecular Genetics and Genomics faculty (<http://dbbs.wustl.edu/divprograms/genetics/Pages/Faculty.aspx>).

Molecular Microbiology and Microbial Pathogenesis (<http://dbbs.wustl.edu/divprograms/micro/Pages/default.aspx>)

Areas of study:

- Microbial physiology
- Molecular genetics
- Genomics
- Structural biology
- Environmental microbiology
- Microbial bioenergy
- Bacteriology
- Mycology
- Parasitology
- Virology
- Host defense, allergy and inflammation
- Cell biology of host-pathogen interactions
- Imaging technologies for cells and whole animals
- Immune responses to pathogens

Visit our website for information about our Molecular Microbiology and Microbial Pathogenesis faculty (<http://dbbs.wustl.edu/divprograms/micro/Pages/Faculty.aspx>).

Neurosciences (<http://dbbs.wustl.edu/divprograms/neuro/Pages/default.aspx>)

Areas of study:

- Neurobiology
- Neurology
- Functional imaging
- Behavior
- Cognition
- Computational neuroscience
- Electrophysiology
- Sensory systems
- Motor systems
- Neuroglia
- Neuronal development
- Learning
- Memory
- Language
- Synaptic plasticity
- Mind
- Consciousness
- Neurodegeneration
- Diseases of the nervous system
- Neuronal injury
- Clinical neuroscience
- Motor control
- Biological rhythms

- Connectivity mapping

Visit our website for information about our Neurosciences faculty (<http://dbbs.wustl.edu/divprograms/neuro/Pages/Faculty.aspx>).

Plant and Microbial Biosciences (<http://dbbs.wustl.edu/divprograms/PlantMicroBioSci/Pages/default.aspx>)

Areas of study:

- Molecular mechanisms governing responses of microbes and plants to their environment
- Assembly and regulation of membrane-associated complexes
- Cytoskeleton organization and its role in morphology and cell division
- Structural biology and biochemistry
- Molecular mechanisms underlying cell and organelle size
- Plant-microbe interactions
- Metabolic engineering of natural products, biomaterials, and biofuels
- Microbial ecology and evolution
- Biogeochemical cycles and earth history
- Systems biology
- Astrobiology

Visit our website for information about our Plant and Microbial Biosciences faculty (<http://dbbs.wustl.edu/divprograms/PlantMicroBioSci/Pages/Faculty.aspx>).

Degree Requirements

PhD Degrees

Each program has its own steering committee, which provides students with guidance, addresses their needs, and monitors their progress. The committee also helps each student customize the course of study to match their individual needs. Each of the 12 programs establishes its own degree requirements.

Across all of the programs, the course of study consists of five distinct parts:

Courses

This generally requires two to five semesters and usually consists of four to nine courses in areas fundamental to the student's program. Students are expected to maintain a B average in graduate courses.

Laboratory Rotations

Selecting a thesis adviser is the most important decision a student makes in graduate school. To help each student make an informed, thoughtful choice, the Division builds in flexibility to explore options. Students usually participate in three lab rotations during their first year. Additional rotations can be arranged, and rotation lengths are flexible. Students usually begin their thesis research by the end of their first year.

Qualifying Examination

After required courses are completed, each student takes a preliminary or qualifying examination to assess their mastery of the field and their ability to integrate information across fields. Upon successful completion of the qualifying exam, the student concentrates on thesis research.

Thesis Research

Thesis research begins once the student has chosen a laboratory in which to work. With their mentor — the laboratory's principal investigator — the student devises a thesis project and chooses an advisory committee. Typically between the end of their second year and the middle of their third year, students present their thesis proposals to the thesis committee. Upon successful approval of the thesis proposal, the student officially becomes a doctoral candidate. For the rest of the student's program of study, the thesis committee monitors progress and meets at least once a year to provide analysis and advice. It also serves as the thesis defense committee when the thesis is ready for presentation. Most students complete and defend their dissertations by the end of their sixth year.

Scientific Scholarship

Keeping abreast of scientific developments is critical for faculty and students alike. The Division offers many ways to stay current. More than 15 weekly biology seminars provide excellent opportunities to meet outstanding scientists from outside Washington University. Several annual symposia bring internationally recognized speakers to campus. Journal clubs meet weekly for students, postdoctoral fellows and faculty to present and discuss current scientific literature. A number of Interdisciplinary Research Pathways (<http://dbbs.wustl.edu/curstudents/SpecialEmphasisPathways/Pages/SpecialEmphasisPathways.aspx>) allow students to enhance their PhD program. Program retreats allow for informal interaction among students and faculty. The Division also provides funds for each student to defray the costs of attending a national scientific meeting.