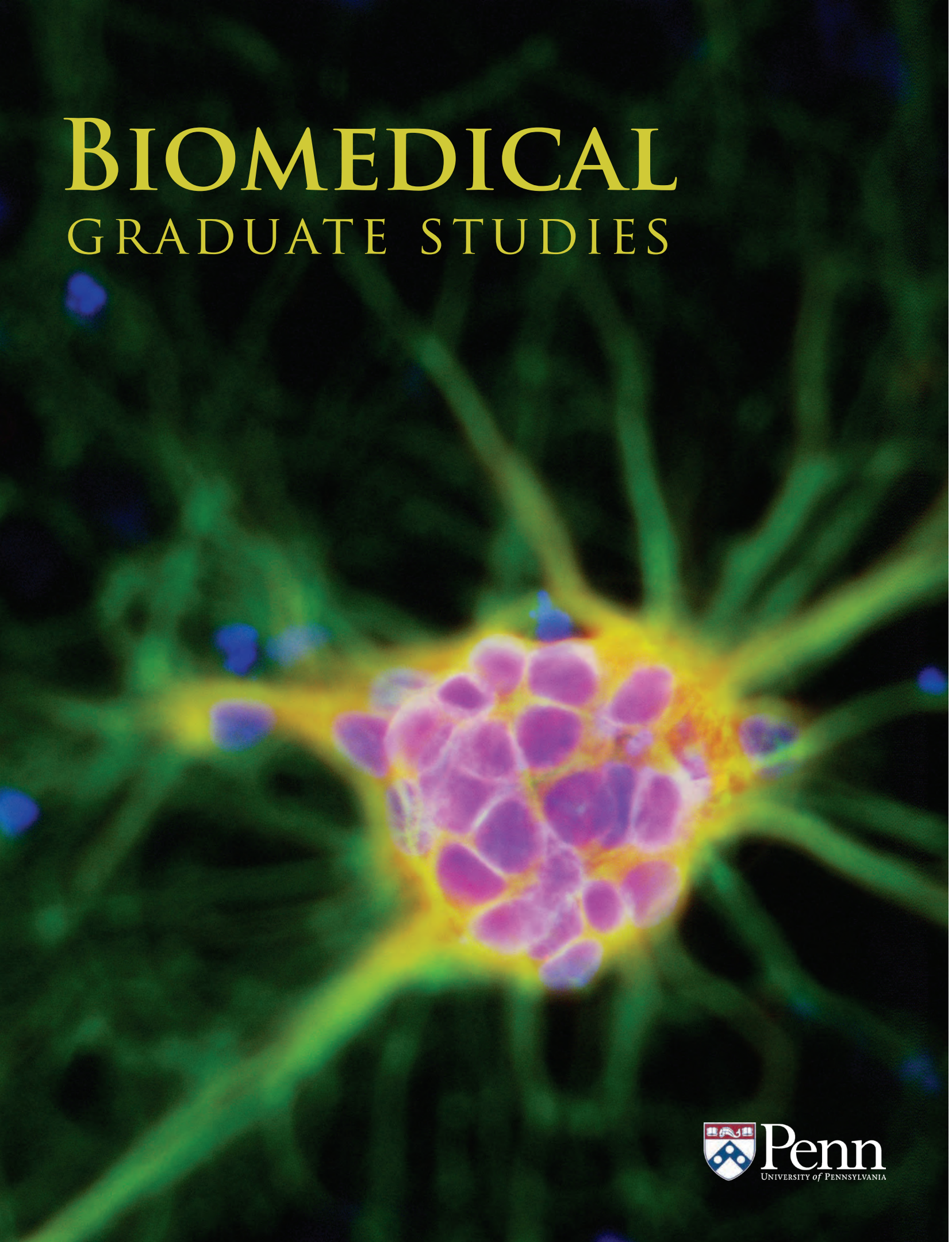
Biomedical
Graduate Studies



Penn
University of Pennsylvania

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On the cover: A neurosphere: Primary rat neuroglial cultures triple stained for MAP-2 (Red), DAPI (blue), and phospho-pRb (green). (Cagla Akay from lab of Kelly Jordan-Sciutto)

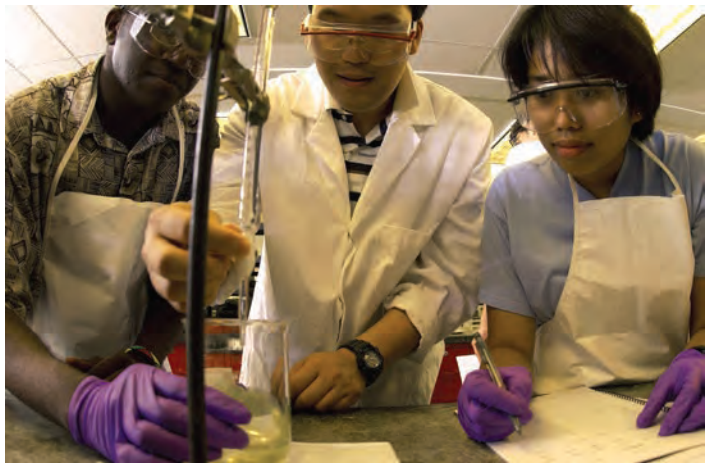
Biomedical Graduate Studies (BGS) serves as the academic home within the University of Pennsylvania for over 700 graduate students pursing a PhD in the basic biomedical sciences. The program is organized into seven interdisciplinary graduate groups: **Biochemistry and Molecular Biophysics, Cell and Molecular Biology, Epidemiology and Biostatistics, Genomics and Computational Biology, Immunology, Neuroscience,** and **Pharmacology.** The seven BGS graduate groups consist of over 600 scientists and educators representing more than 30 academic departments and seven schools – Medicine, Dental Medicine, Veterinary Medicine, Engineering and Applied Science, Wharton, Nursing, and Arts and Sciences – as well as several associated research institutions. BGS faculty cooperate in admitting, funding, advising, teaching, training, and providing career development advice to BGS students. Two affiliated graduate groups, Biology and Bioengineering, are not administered by BGS but overlap with BGS groups in faculty membership, course offerings, and other program attributes.

BGS students have ample time and opportunity to explore modern biomedical science and develop their true academic interests. The graduate groups provide flexible, broad-based, interdisciplinary training; many courses are cross-listed by two or more graduate programs, and most faculty members belong to more than one graduate group. Consequently, students may enroll in any relevant graduate-level course and may conduct research with virtually any faculty member within a given field.

Training consists of a multi-faceted program of formal coursework, informal journal clubs and seminars, interactions with outside senior scientists, and a formal research experience. During the first year of study, students take fundamental courses in the areas of biochemistry, molecular biology, and cell biology, and specialized courses in their chosen field of interest. They also begin structured laboratory rotations that expose them to hands-on research. The second year is devoted to focused laboratory work and a limited number of advanced elective courses and seminars. Beginning in year three, students conduct dissertation research in the laboratory of their choice; this research typically takes three to four years.

Students may also participate in several certificate programs that provide additional training. These include the **Graduate Training in Medical Science Program;** which integrates focused medical education into the doctoral curriculum, affording PhD students an appreciation of medicine and human biology; the **Public Health Certificate Program,** which provides training in population-based approaches and applications for those with expertise in molecular, cellular, and biochemical sciences, and the **Environmental Health Sciences Certificate Program;** which focuses on the mechanistic links that exist between environmental exposures, the molecular and cellular effects that ensue, and diseases of environmental etiology.

The BGS program also provides supplemental training in the responsible conduct of research and career development to students at all stages. Most program graduates accept a prestigious academic postdoctoral fellowship, while other alumni find highly suitable positions in the biomedical industry, in government agencies, or in professions such as patent law, science journalism, or science education.



Research Training Environment

Penn is a leader in biomedical research and research training in its levels of sponsored research and its commitment to interdisciplinary research and training. The university ranks second in the nation in funding from the National Institutes of Health, and the School of Medicine is ranked first in NIH training grant funding.

Penn's commitment to interdisciplinary training, embodied in the structure of graduate groups, is matched by its commitment to interdisciplinary research through campus centers and institutes. The Institute for Biomedical Informatics fosters research projects integrating biology, medicine, engineering and computer science. Similarly, the Institute for Medicine and Engineering promotes basic and clinical research at the interface of biomedicine and bioengineering. Other important biomedical centers and institutes on campus include the Institute for Neurological Sciences, the Cancer Center, the Institute for Translational Medicine and Therapeutics, the Institute for Immunology, the Leonard Davis Institute for Health Economics, and the Center for Bioethics. The integrative nature of research and training at Penn is made possible by the physical layout of the campus. All of Penn's schools are located on a single campus, and most classrooms, offices, and laboratories are located within just a few blocks of one another.

Faculty investigators at independent institutions associated with Penn also play a significant role in graduate student training. Members of the Wistar Institute, a research institution in the heart of campus with outstanding programs in genetics, oncology, immunology, and virology, are active participants in BGS. In addition, researchers at the National Institutes of Health have joined the BGS faculty to participate in training students in the Immunology Graduate Group.

Combined Degree Opportunities

In recognition of the close relationship between the biomedical disciplines and clinical medicine, Penn offers combined doctoral and professional degree programs with the School of Medicine and the School of Veterinary Medicine. Students in these programs are generally able to earn both degrees in seven or eight years. Entrance into a combined degree program requires separate application to, and acceptance by, the Combined Degree Program and professional school.

Certificate Programs

Students enrolling in BGS doctoral programs have the option of applying to certificate programs in medicine, public health, and environmental health sciences. The programs offer intensive supplemental training provided by expert practitioners and researchers in these fields. Participants are expected to complete the certificate program and doctoral program requirements concurrently.

Graduate Training in Medical Science

The Graduate Training in Medical Science (GTMS) Certificate integrates focused medical education into the doctoral curriculum and experience, affording PhD students an appreciation of medicine and human biology not formerly available. The program aims to promote clinically relevant research by producing basic scientists who not only have a clearer understanding of human biology and pathology, but who can effectively interact with clinical scientists to tackle medically relevant research problems. Students take fundamental courses in pathophysiology and medicine, "bench to bedside" electives, and clinical clerkships in addition to their graduate group's requirements.

Public Health Certificate Program

The Public Health Certificate Program provides supplemental training to doctoral candidates who are interested in public health. This program prepares students for careers in academic, industrial, and government institutions by providing training in population-based approaches and applications for those with expertise in molecular, cellular, and biochemical sciences. Students take four courses in public health in addition to their regular doctoral coursework and participate in either a short-term (six week) public health research project or independent study with a public health researcher for elective credit. It is anticipated that students will explore aspects of public health related to the PhD research project during the independent study.

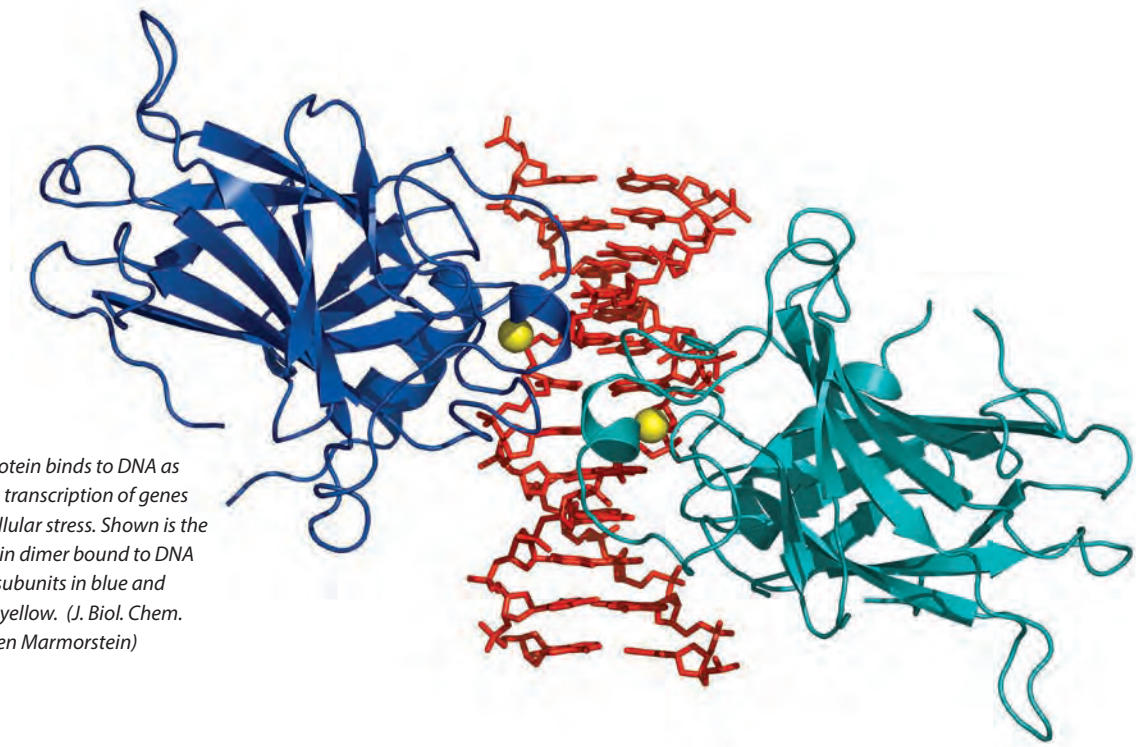
Environmental Health Sciences

Students take specialized courses in addition to their graduate group requirements and receive a PhD from their graduate group and a Certificate in Environmental Health Sciences. Course work covers molecular toxicology, epidemiology, biostatistics, genome science, and occupational and environmental health. All students must complete three laboratory rotations, one of which must be a community or population-based research project.

Application and Financial Aid

Students accepted to Biomedical Graduate Studies receive a fully funded fellowship – including tuition, fees, health insurance, and a competitive stipend – regardless of financial need. Application should be initiated in the fall of the academic year preceding the one in which the individual proposes to matriculate. Applications are accepted online via the BGS website. Applicants considered for admission are invited to campus for interviews during the months of January through March; offers of admissions are made on a rolling basis during this period.

Biochemistry and Molecular Biophysics



The p53 tumor suppressor protein binds to DNA as a dimer of dimers to regulate transcription of genes that mediate responses to cellular stress. Shown is the structure of a p53 core domain dimer bound to DNA with the DNA in red, protein subunits in blue and aqua and bound zinc ions in yellow. (J. Biol. Chem. 281:20494-20502, 2006, Ronen Marmorstein)

Control of gene expression and cellular programming

Research focuses on RNA splicing and disease, transcriptional regulation, histone acetylation, cell cycle control/cancer, chromosome structure and segregation, and programming and function of specialized cell types.

Cell signaling and intracellular trafficking

Research in this area examines mechanisms of transmembrane signaling, nuclear import/export of RNA, membranes and ion channels, and intracellular signaling pathways, apoptosis versus cell survival.

Chemical and structural biology

In the area of chemical and structural biology, topics of research include the structural basis of molecular recognition, protein design and engineering, pathways of protein folding, enzyme reaction mechanisms, and computational approaches to molecular biophysics.

Bioenergetics, metabolism, and membranes

This area involves radical mechanisms in metalloenzymes, insulin action/diabetes, electron transfer/redox proteins, integration of metabolism, and membrane protein structure.

Biomedical imaging and supramolecular assemblies

Research topics include optical imaging in tissues/cancer, *in vivo* Magnetic Resonance Imaging, spectroscopy, structure and function of macromolecular motors, and electron microscopy.

The central focus of the Graduate Group in Biochemistry and Molecular Biophysics is the relationship between structure and function of molecules involved in biological processes. The goal of the program is to provide students with a foundation in the physical, chemical and quantitative methods necessary to explore the molecular basis of biological events.

Cell and Molecular Biology

The Cell and Molecular Biology Graduate Group offers programs in six related areas of study: Cell Biology, Physiology and Metabolism; Cancer Biology; Developmental, Stem Cell, and Regenerative Biology; Gene Therapy and Vaccines; Genetics and Epigenetics; and Microbiology, Virology and Parasitology; each composed of faculty with interests focused on similar areas of research.

Cell Biology, Physiology and Metabolism

The Program in Cell Biology, Physiology and Metabolism focuses on basic functions of the cell and its links to metabolism and disease, with concentrations in signal transduction, subcellular protein trafficking, cytoskeleton and cell motility, cross-membrane transport, cell cycle regulation and cellular metabolism. Much of the research in this program is directed toward dissecting disease models, such as diabetes, muscular dystrophy, and cancer, in systems ranging from yeast to humans.

Cancer Biology

The Program in Cancer Biology provides the opportunity to study the basic biological processes that underlie the initiation and progression of cancer. The program stresses the importance of fundamental genetic and molecular pathways regulating cell proliferation, differentiation, movement, and survival. Current research programs include oncogenesis, cell migration/metatasis, and cancer immunology.

Developmental, Stem Cell, and Regenerative Biology

The Program in Developmental, Stem Cell, and Regenerative Biology offers interdisciplinary training in the embryology of animals and plants. The program encompasses research in gametogenesis, fertilization, pattern formation, signal transduction, gene regulation, cell cycle control, cell death, cytoskeletal dynamics, cell motility, neural connectivity, and adult and embryonic stem cells. Utilizing a diversity of experimental systems, research in developmental biology contributes to the identification of genes and regulatory pathways implicated in congenital malformations and human disease.

Genetics and Epigenetics

The program in Genetics and Epigenetics is diverse, with research focused on basic biological mechanisms to the study of human disease. Basic areas include transcriptional and epigenetic regulation, post-transcriptional regulation, as well as organ development, behavior and cognition. Research labs utilize model organism genetics, human genetics and epigenetics, integrating the latest in genomic, bioinformatic and computational approaches. Emphasis is on interdisciplinary approaches to solving scientific questions.

Gene Therapy and Vaccines

The Gene Therapy and Vaccines Program focuses on using gene transfer for therapeutic purposes or for vaccination. Although the goals of the research are disease-based with an ultimate objective directed to prophylactic and therapeutic applications, the research training focuses on basic investigations relevant to understanding the pathobiology of diseases and to developing approaches for achieving efficient and effective gene transfer in humans.

Microbiology, Virology, and Parasitology

Infectious diseases resulting from viruses, parasites, prions, and bacteria are a major cause of human morbidity and mortality. By studying pathogens, it is possible to learn much about normal cell biology, molecular biology, and immunology. Major research interests include virology, bacterial pathogenesis, parasitology, pathogen immunology, tumor virology, microbial genomics and evolution, and emerging infectious diseases.

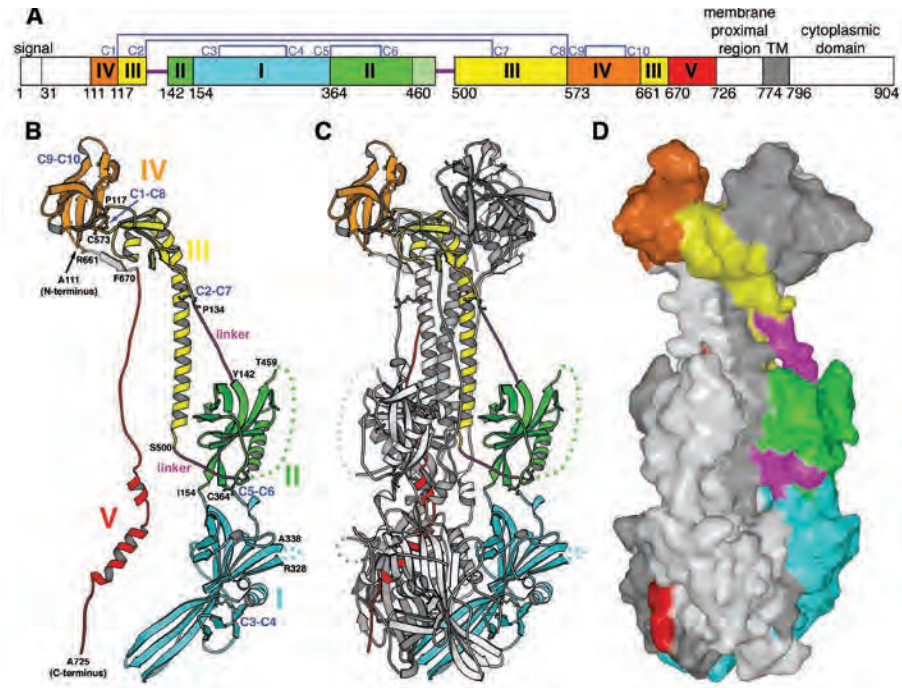
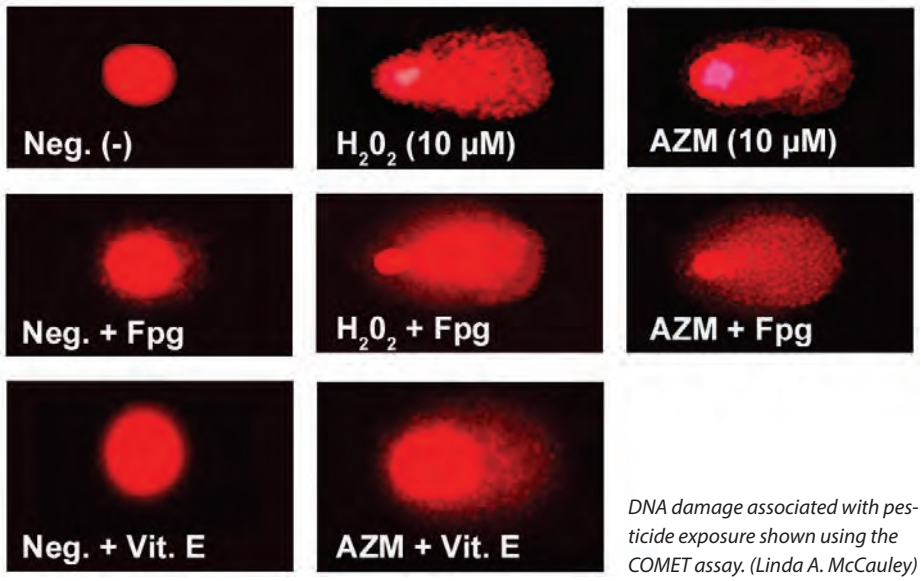


Image of the crystal structure glycoprotein B of herpes simplex virus. (Science 213:217-220, 2006, Roselyn Eisenberg)

Epidemiology and Biostatistics



DNA damage associated with pesticide exposure shown using the COMET assay. (Linda A. McCauley)

Epidemiology

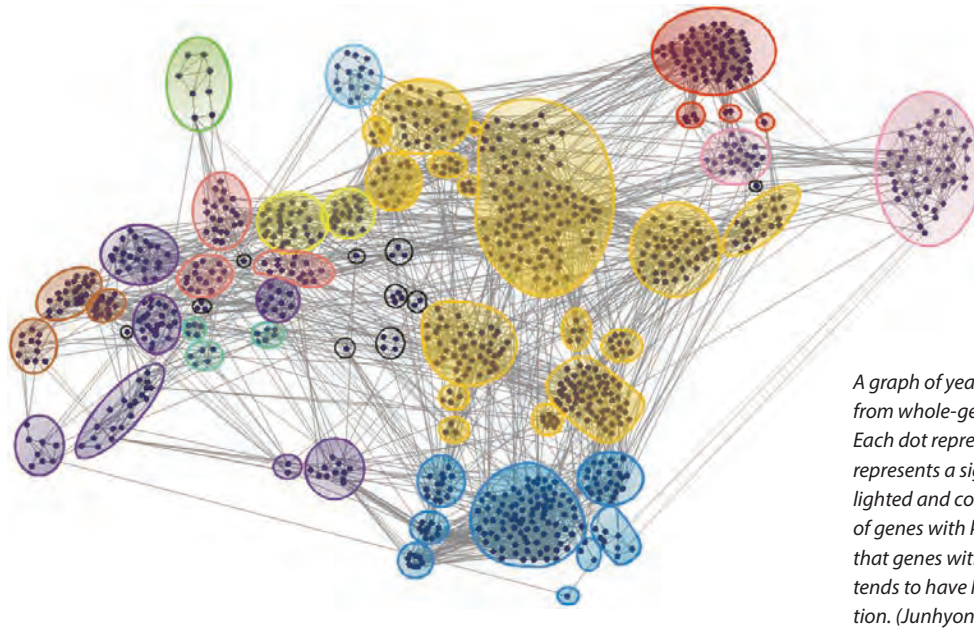
The Epidemiology program trains students in the study of the distribution and determinants of health and disease in populations and the basic science underlying much of public health and preventive medicine. Training in clinical epidemiology extends the principles of epidemiology to the critical evaluation of diagnosis and therapeutic modalities in clinical practice. Clinical epidemiologists investigate the frequency, outcome, prognosis, etiology, treatment, prevention, diagnosis, costs, and policy implications of disease. Specific areas of interest include: adherence, aging, cancer epidemiology, cardiovascular epidemiology, clinical pharmacogenomic epidemiology, complementary and alternative medicine, dermatoepidemiology, gastrointestinal epidemiology, genetic epidemiology, infectious diseases epidemiology, injury epidemiology, international health, medical informatics, molecular epidemiology, nutrition, pharmacoepidemiology, prevention, public health, pulmonary epidemiology, renal epidemiology, reproductive epidemiology, social epidemiology, and women's health.

Biostatistics

The Biostatistics program is concerned with the development and application of statistical theory and methods to the health sciences. Biostatisticians play a crucial role in the research process, from inception of the research plan through the analysis and publication of study results. Every biomedical field of study employs biostatistical methods to some extent. For example, biostatistical tools are used to assess the magnitude, reliability, validity, and precision of associations (e.g., between exposures and disease) to make inferences about target populations using sample data, and to derive conclusions about treatment effects from clinical trials. Methodologic interests include: Bayesian modeling, categorical data, causal inference, clinical trials, clustered data, complex sample surveys, diagnostic testing, epidemiologic methods, health services research, longitudinal methods, measurement errors, missing data, multivariate analysis, nonparametric models, patient-oriented research, repeated measures, statistical genetics and genomics, survival analysis, and time series.

*The Graduate Group in Epidemiology and Biostatistics offers graduate training in two programs: **Epidemiology** and **Biostatistics.** Graduate Group faculty are engaged in multiple active clinical and basic research projects, many of which focus on content-specific areas of interest and include relevant methodologic work.*

Genomics and Computational Biology



A graph of yeast gene interactions estimated from whole-genome gene expression data. Each dot represents a gene and each edge represents a significant interaction. The highlighted and colored ellipses represent groups of genes with known gene function showing that genes with similar biological function tends to have high degree of mutual interaction. (Junhyong Kim)

Genomics and Computational Biology lies at the center of a rapid convergence of biomedical research fields. Research in this graduate group focuses on the entire genome (as DNA) and the entire material determined by genes (as RNA or protein), and asks about the origins, function, and interactions of the system as a whole. Such questions and other developments in this field stimulate experimental laboratory work in genomics, as well as computational activities in bioinformatics.

Evolutionary Genomics

Specific research work includes the evolution of the transcriptome in natural species and cell lines of different genetic composition, the evolution of large gene families, gene duplication and loss in evolution, the evolutionary frequency and significance of horizontal gene transfer, methods for detecting functional non-coding sequences, and the role of retroviral elements in the evolution of new genomic function.

Human Genomics

In the area of human genomics research topics include the analysis of structurally variant chromosome regions, the genomic analysis of predisposition to diseases, genome-wide analysis of gene expression, the genetics of complex diseases, developmental genomics, and chromosome organization.

Statistics

Statistics research includes the development of statistical methods for discovery and clustering of conserved patterns in DNA sequences, evolution of viral genomes, methods for genetic association studies and gene-gene interactions, methods for systems biology, comparative sequence analysis, evolutionary modeling, machine learning in genomics, statistical models for the analysis of microarray data, and statistical methods for mapping genes associated with diseases.

Microbiology

Research programs focus on the investigation of the growth and inhibition of medically significant pathogens, replication of human transposons and consequences for human biology, and retroviral-host interactions.

Computing

Studies in this area include computational analysis and modeling of real-time, systems-level genomics, nanotechnology, computational simulations of the evolutionary processes of cancer, machine learning and datamining, and bioinformatics including management, analysis, and visualization of information generated in molecular biology.

Immunology

Cell, Molecular, and Developmental Biology of the Immune System

Several laboratories at Penn examine issues in molecular immunology, including signal transduction, transcriptional regulation, antigen receptor recombination and DNA repair in immune cells. Others study the cell biology of lymphocyte and natural killer cell activation, as well as the developmental biology and homeostasis of immune cells and tissues.

Immunity to Infections

Penn investigators are studying the interface of innate and adaptive immunity, at the epithelial barriers where defense against pathogens is maintained or breached and in the inductive sites of clonal expansion, such as secondary lymphoid tissue. Numerous researchers explore the role and regulation of the traditional and newly discovered helper T cell subsets, as well as their novel cytokine products, during infection with viral, bacterial and parasitic pathogens. Integrative techniques ranging from 4-dimensional in vivo imaging of the immune response against pathogens to systems biology approaches for high-throughput analyses of anti-viral immunity are being undertaken.

Cancer Immunology

Cancer immunology research at Penn encompasses the entire spectrum from basic research of tumor cell recognition and tumor-immune system interactions to innovative clinical trials in cancer patients. A number of investigators have pioneered novel vaccine approaches against cancer and have developed state-of-the-art techniques for boosting patient immunity.

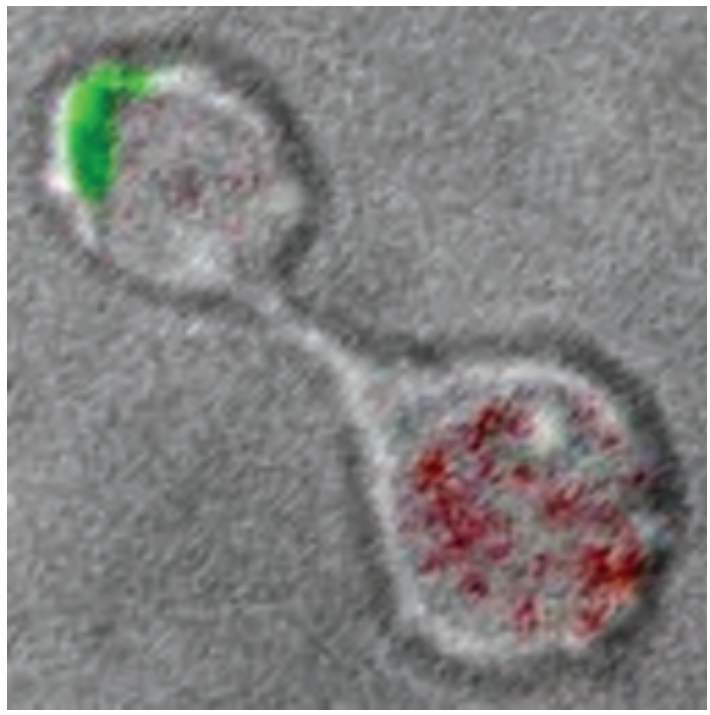
Autoimmunity and Tolerance

Using a wide spectrum of approaches and disease conditions, numerous investigators at Penn are focusing their efforts on the control of immune reactions. Many laboratories are examining fundamental mechanisms involved in breakdown of physiological tolerance and are working to develop strategies to block destructive immune responses. Several investigators at Penn have pioneered the understanding of how excessive immune response during infection is controlled, and are also developing novel approaches for inducing tolerance to organ transplants.

PENN – NIH Partnership

A world-renowned group of investigators from the intramural research program of the NIH in Bethesda, Maryland have joined Penn's faculty in Immunology, bringing to the Immunology Graduate Group the extraordinary resources and scientific expertise present at the NIH, one of the world's largest and most illustrious biomedical research centers. Educational opportunities on the NIH campus are offered to all Immunology students. The NIH faculty participates fully in all aspects of our teaching programs at Penn's Philadelphia campus, including service on thesis committees. The partnership also allows some students to pursue laboratory rotations and thesis research in the NIH laboratories.

The Immunology Graduate Group provides each trainee with an understanding of the conceptual and experimental foundation of modern immunology and imparts comprehensive knowledge of the immune system and its regulation while teaching the skills necessary for a successful career in biomedical science.



A dividing, microbe-specific T lymphocyte displaying unequal inheritance of signaling proteins to its daughter cells. Asymmetric cell division may be a mechanism to generate the spectrum of cell fates required for immunity. (Steve Reiner)

Neuroscience

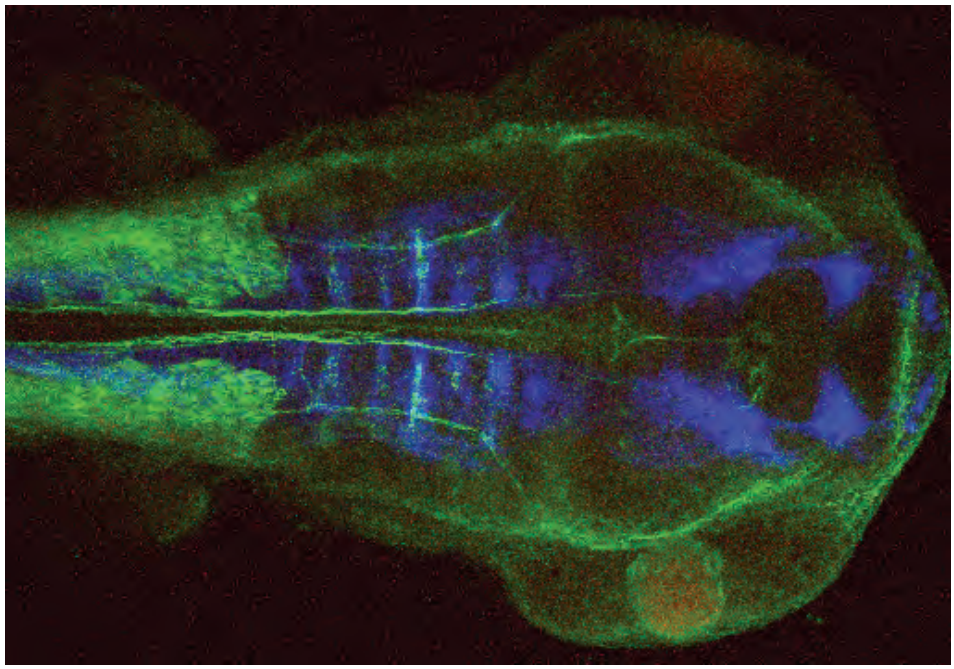
The Neuroscience Graduate Group offers training in virtually all areas of neuroscience research including cellular and molecular aspects of the brain; development, regeneration, and plasticity; systems neuroscience; behavior and cognition; the pathology of brain disease; and computational neuroscience.

Cell and Molecular Neuroscience

Research focuses on the molecular mechanisms of intra- and intercellular signaling that underlies plasticity in both the developing and adult nervous system, as well as changes in signaling underlying diseases of the nervous system and involves cutting edge molecular biological, genetic, immunological, electrophysiological, and behavioral approaches.

Neuronal Development, Regeneration, and Plasticity

Current research uses multidisciplinary approaches to address the molecular and cellular processes that lead to the formation of a functioning brain, including how nerve cells migrate to their final destination, how axons are guided to appropriate targets, and how neurons make and maintain synaptic connections.



A picture of a zebrafish brain. Green is rhombere, Mauthner neuron, and muscle staining. Blue is a pre-synaptic marker. Red is a post-synaptic marker. (Yuanquan Song, Paul Scherer, and Rita Balice-Gordon)

Neurological Disease and Dysfunction

Research programs focus on the cellular and molecular bases of a variety of neurological and psychiatric diseases, including Alzheimer's disease, traumatic brain injury, autoimmune diseases of the nervous system, diseases of the motor system, and the neuronal basis of addiction.

Systems Neuroscience

The study of how information is encoded, processed in the brain and used to generate coordinated movement depends in part on the organization of neurons into networks and systems. Approaches here include cellular-level analyses of small model systems in vitro and larger scale systems studied *in vivo.* All of these studies include realistic neural networks.

Behavioral Neuroscience

Animal behavior represents the external expression of complex patterned activity in the brain and is continually modulated by internal and external sensory information and by internal drives and states. Penn has an active interdisciplinary program that studies the complex relationship between cellular and molecular events and external patterns of behavior.

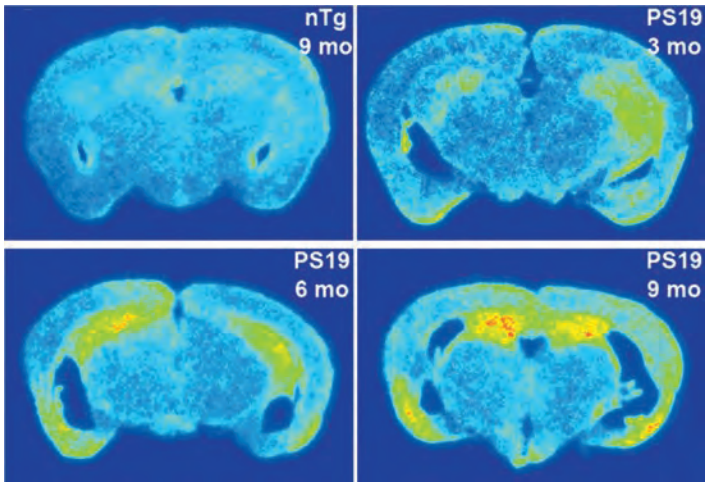
Cognitive Neuroscience

Cognitive neuroscience has a distinctive goal: the mechanistic understanding of human thought. How do people learn, understand language, and plan complex action? Research programs include those focused on understanding visual perception, learning and memory, and cognition-emotion interactions.

Computational Neuroscience

The objective of computational neuroscience is to uncover basic neuronal mechanisms through simulation and prediction based on experimental findings. To carry out these studies, collaborations between experimentalists and computational neuroscientists may be formed.

Pharmacology



Progressive microglial activation in the central nervous system of transgenic tau mice. Microglia are progressively activated with age in the brains of transgenic mice (PS19, 3 months to 9 months) compared to normal mice (nTg). (Virginia Lee)

Pharmacology research employs a variety of experimental approaches to identify natural and design synthetic agents for both treatment of diseases and experimental interventions in animal and cellular models. Understanding the action of these agents, both desirable and toxic, is the key mission of the graduate training program. The program's resources allow students to concentrate on basic science research and to participate in translational research where fundamental discoveries in the laboratory are taken through stages of discovery and development and culminate in the clinical domain.

Cancer Pharmacology

Specific research work includes site-directed mutagenesis, structural and functional characteristics of GTP-binding regulatory proteins, mass spectrometry detection of molecular markers of tumor growth and design of molecular interventions in cancer.

Cardiovascular Pharmacology

Research programs explore the cellular and molecular basis of atherosclerosis, thrombosis, hypertension and inflammation using a variety of approaches including knockout and transgenic technologies, gene therapy techniques, recombinant fusion proteins and modern approaches in chemistry, biochemistry, molecular biology, and cell biology.

Cell Signaling

Signals of special interest include hormones, neurotransmitters, sensory stimuli, and cell-cell or cell-substratum contacts. Specific research works include studies of cellular receptors and membrane channels, signal transduction pathways and nuclear responses in diverse models of (patho) physiological processes.

Environmental Health Sciences

This program explores the mechanisms, pathogenesis, prevention and treatment of diseases of environmental etiology (e.g., lung and airway disease, cancer, neurodegenerative disease, reproductive and developmental disorders, obesity and cardiovascular disease). Graduates of the program will be prepared for careers in toxicology, risk-assessment, environmental and occupational health sciences.

Neuropharmacology

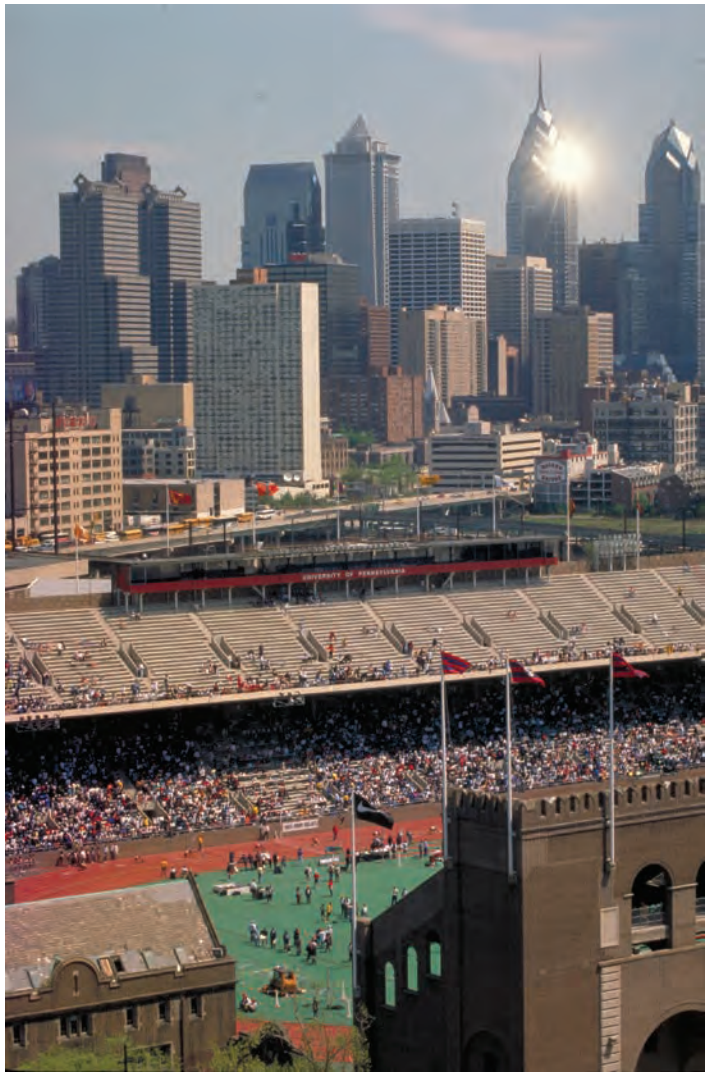
The overall focus of neuropharmacology research and training is to provide students with an integrated understanding of the interactions of neurotransmitters with receptors and the biochemical and functional effects of these interactions.

Pharmacogenetics

This program focuses on the genetic basis of inter-individual variation in response to various classes of drugs and therapeutic protocols and makes use of this information to develop rational "personalized" therapeutic regimens and to identify genetic susceptibility factors for diseases. It encompasses the study of genetic factors that influence drug delivery, bio-availability, metabolism and clearance, and toxicity.

Pharmacological Chemistry

Understanding the chemistry of molecular recognition between drugs and their targets (receptors, ion-channels, enzymes, and nucleic acids) is a primary focus of research and training in pharmacological chemistry. Research work includes synthesizing receptor subtype specific ligands and isoform specific enzyme inhibitors and X-ray crystallography of membrane bound drug targets.



Campus and City

The University of Pennsylvania consists primarily of 260 contiguous acres in University City, a neighborhood set just across the Schuylkill River from center-city Philadelphia and the home of several universities. The Penn campus features many beautiful and architecturally significant buildings representing various periods of the past 130 years. The heart of campus, College Green, is an urban oasis known for its eclectic buildings, mature landscaping, and dramatic sculpture. City streets are replaced with tree lined walkways throughout much of campus, and the tranquil Biopond is nestled behind the School of Medicine and Biology buildings. The surrounding neighborhoods of West Philadelphia, Center City, Squirrel Hill, Powelton Village, and Cedar Park are home to many of Penn's students, faculty, and staff.

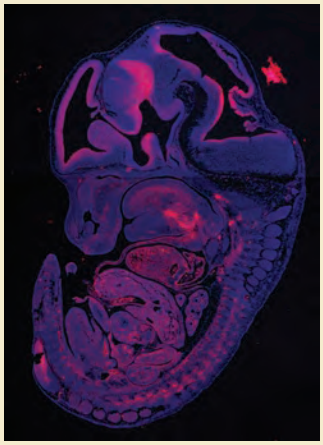
Philadelphia contains an abundance of outstanding recreational, cultural, historic, gastronomic, and entertainment attractions. Historic treasures from the colonial and Revolutionary eras include Constitution Hall, the Liberty Ball, Elfreth's Alley, the Betsy Ross House, and the National Constitution Center. The city boasts numerous world-renowned museums, including the Philadelphia Art Museum, the Academy of Natural Science, the Franklin Institute, the Barnes Museum, the Pennsylvania Academy of Fine Arts, and the Rodin Museum. Other points of interest include the Academy of Music, the Philadelphia Zoo (the nation's first), and Fairmount Park, the largest park in the world contained entirely within city limits. Philadelphia features a Chinatown, an Italian Market, the famous Reading Terminal Market and the magnetic South Street, numerous art galleries, music venues, and film houses, and a wealth of gourmet restaurants. Every major team sport has a club in Philadelphia, and virtually every type of outdoor recreation can be enjoyed within an hour's drive of campus, including rowing, hiking, skiing, beach combing, and horseback riding.

Travel to Penn

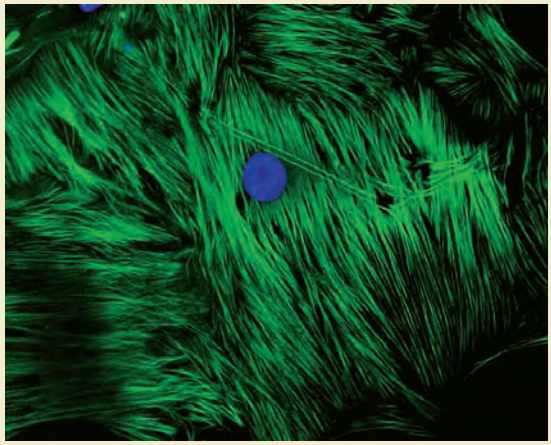
The city's public transit service, SEPTA, serves all city areas and much of the surrounding region. Most students find they do not need a car to travel freely. Rail travel to New York and Washington, DC is within walking distance of campus, and a ride to the Philadelphia International Airport takes 20 minutes.

The University of Pennsylvania

Penn's twelve schools are home to approximately 22,000 students, including over 10,000 graduate and professional students. A member of the Ivy League, Penn is consistently ranked among the top undergraduate, graduate academic, and professional degree programs. Numerous clubs, organizations, and activities on campus unite students with shared interests. Graduate student housing is available on campus.



Ben Kleaveland



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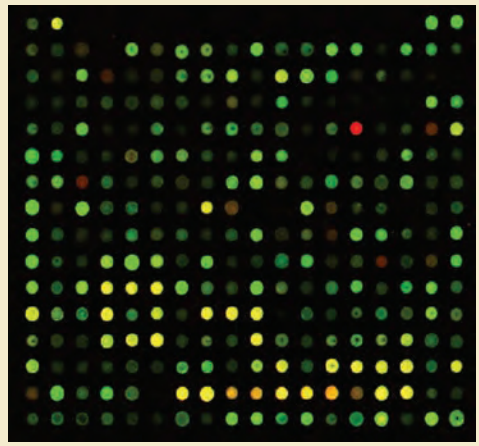

Klaus Kaestner

Graduate Groups

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245A Anatomy-Chemistry Building
www.med.upenn.edu/bmbgrad

Cell and Molecular Biology
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404 Anatomy-Chemistry Building
www.med.upenn.edu/camb

Epidemiology and Biostatistics
215.898.0861
627 Blockley Hall
www.med.upenn.edu/ggeb/

Genomics and Computational Biology
215.746.2807
210 Richards Building
www.med.upenn.edu/gcb

Immunology
215.573.4394
357 Biomedical Research Building II/III
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Neuroscience
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