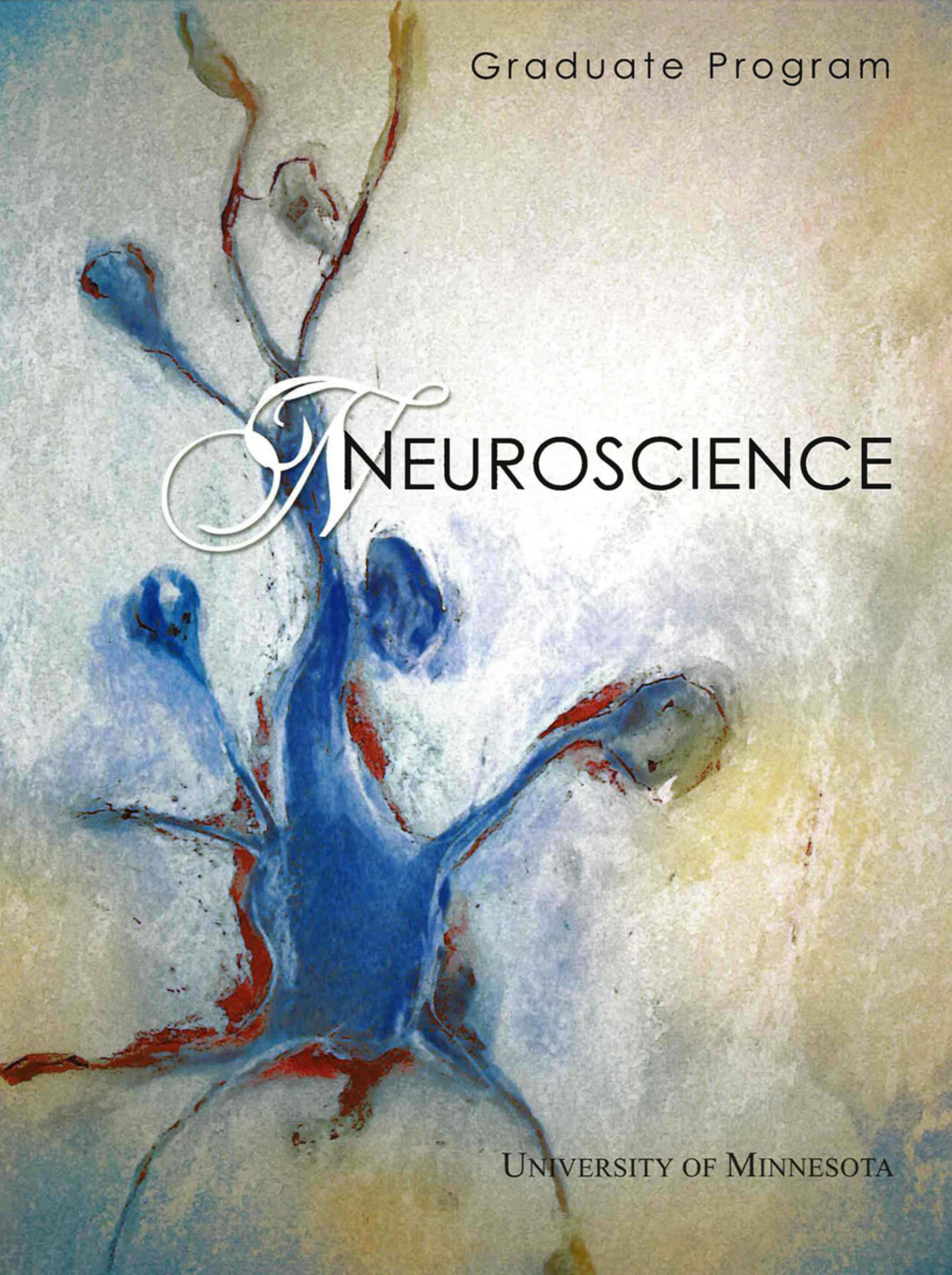
Graduate Program

Neuroscience



University of Minnesota


www.neuroscience.umn.edu

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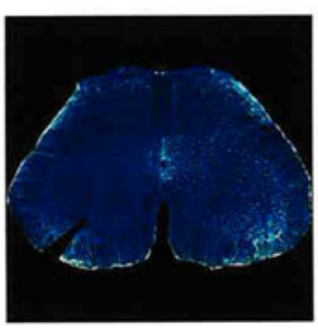
Ph.D. Program Overview

The Graduate Program in Neuroscience at the University of Minnesota includes over 100 faculty members from all parts of the University. One of our many strengths is the multidisciplinary nature of our program. Often the most noteworthy advances in our understanding of the nervous system come from bringing together two or more perspectives, and this approach is supported by the collaborative environment at the University of Minnesota.

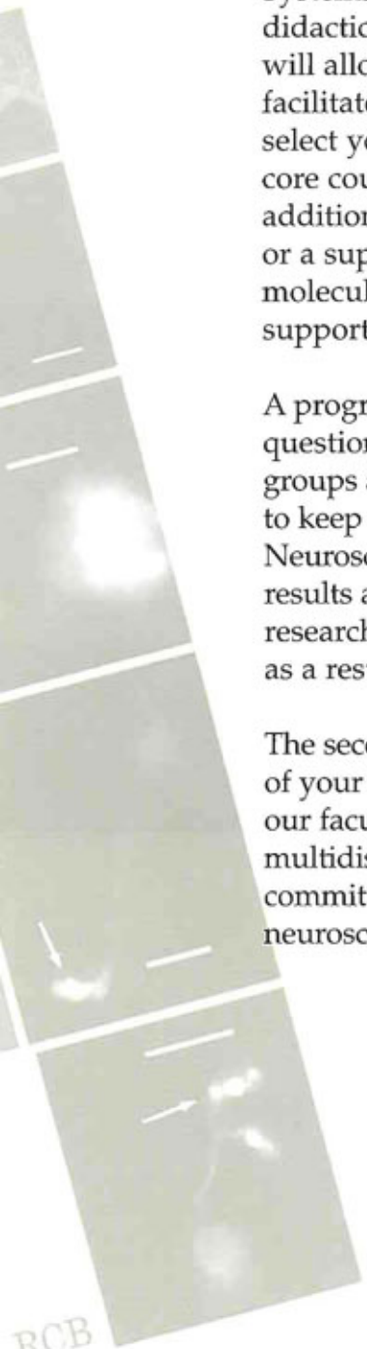
Your Ph.D. graduate training will begin in July with a five-week laboratory course covering a range of topics in molecular, cellular and systems neuroscience. Held at the Lake Itasca Biological Field Station at the Itasca State Park, this intensive course is a completely "hands-on" experience. You will perform both classical and cutting edge experiments in a modern, well-equipped laboratory. This internationally recognized course will give you an unparalleled introduction to the thrill of neuroscience.



Formal classes begin in September and cover all the areas of Neuroscience, from molecular neurobiology and genetics to systems and computational neuroscience. The first-year core curriculum includes four courses: Cellular and Molecular Neuroscience, Systems Neuroscience, Developmental Neuroscience and Behavioral Neuroscience. Your didactic experience will be complemented with four laboratory rotations. These rotations will allow you to experience potential fields of study for your doctoral work and will facilitate the selection of an appropriate advisor and thesis topic. You will be expected to select your Ph.D. thesis advisor by the end of the first year. Following completion of the core courses, all students take a written preliminary examination. You will also take an additional 12 course credits, constituting a minor defined by another graduate program or a supporting program. Typical supporting programs include courses in cell or molecular biology, physiology, statistics, psychology, medicine and computation. The supporting program coursework is usually finished by the end of the second year.

A program-sponsored course, entitled "Career Skills," offers the opportunity to ask questions about graduate school and careers in science. Journal clubs organized by research groups and weekly seminars offered by various departments provide many opportunities to keep up-to-date on developments and issues in neuroscience. We also offer a weekly Neuroscience Colloquium, where faculty and students have an opportunity to share research results as well as lunch in a friendly, collaborative atmosphere. This showcases the diverse research opportunities here at the University of Minnesota. New collaborations often start as a result of these weekly research presentations.

The second and subsequent years are filled with the most exciting and challenging aspects of your graduate study: defining a thesis topic and establishing a research program. Because our faculty have diverse research programs, you will find that the opportunities are vast and multidisciplinary. During this time, you will work closely with your advisor and thesis committee. Your ideas and hard work will produce not only a doctoral thesis, but also the neuroscience of tomorrow.



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Neuroscience At Lake Itasca

Students in the Graduate Program in Neuroscience begin their studies in mid-July at the University of Minnesota Biological Field Station at Lake Itasca. In this beautiful Minnesota northwoods setting, incoming students receive a sophisticated, intensive introduction to molecular, cellular and systems neuroscience. Students work in groups of two, and use state-of-the-art equipment, to perform experiments that cover a wide range of Neuroscience disciplines. These include single cell, synaptic and network physiology, neuropharmacology and molecular neurobiology. Students also receive experience in public speaking with weekly presentations of experimental results to their peers.

There are multiple goals in starting all our graduate students with this hands-on laboratory experience. First, it gives our diverse student body a common set of laboratory skills before they begin their laboratory rotations in the fall. Second, the course rotates in new faculty members each week, to expose students to an array of faculty interests and expertise. Third, as students live and work together throughout the course, it provides a unique opportunity for them to get to know one another. At Itasca, strong bonds are formed between students and faculty both inside and outside the lab. Indeed, sometimes the best discussions occur at the breakfast table or during canoe excursions on the lake.

Nowhere else can you walk along the shores of a pristine lake, take in a startling view of a pileated woodpecker, listen to the alluring call of a loon, smell the fragrance of the Minnesota ladyslipper, and then sit down at an experimental station to evaluate the generation of memory traces in a hippocampal slice, explore the synaptic organization of the leech ganglion or monitor single channel currents in cultured neurons. In the evenings, the 6:00 dinner bell at the field station signals the end of the day's experiments, although many students choose to return to the laboratory after dinner to continue their scientific explorations. The days often end with hiking and biking excursions in the spectacular park or relaxation and conversation at gatherings around the bonfire.

Unique Aspects of the Program

Facilities

Because Minnesota is one of the largest research universities in the country, our students have access to world class laboratories. It is impossible to describe all of our exceptional facilities. However, the list includes the Center for Magnetic Resonance Research, an imaging facility with some of the strongest research magnets for MRI in the world and our magneto-encephalography (MEG) system to detect the very small magnetic fields that result from neural activity. Other shared resources include the transgenic mouse facility, the Stem Cell Institute, Biomedical Imaging and Electron Microscopic facilities, a microchemical facility that provides overnight DNA sequencing, the Biomedical Genomics Center, a supercomputer institute and other core facilities funded by the National Institutes of Health. These shared resources foster collaboration between our many research groups and make the University of Minnesota a great place to do research.

Outreach

The Graduate Program in Neuroscience is committed to serving the greater world community. We sponsor three major programs that reach out into different segments of the community. The first is part of a National program sponsored by the Society for Neuroscience and is called Brain Awareness Week. In this program, we send over 100 faculty, students and staff into elementary schools in Minnesota equipped with human brains and activities to help explain neuroscience to grade school students. This outreach brings Neuroscience and neuroscientists to thousands of school-aged children every year. Our Graduate Program also participates in the National Brain Bee program. This program is similar to a spelling bee, but is based on demonstrating knowledge of neuroscience. The focus is on high school students, and the state winner is flown to Washington DC for the National Brain Bee. The third major initiative is a joint program with the Science Museum of Minnesota that supports a new neuroscience curriculum in participating middle schools. These programs give the neuroscience faculty and students an opportunity to give back to the community as well as to raise awareness and understanding of the brain in health and disease.





Points of Interaction

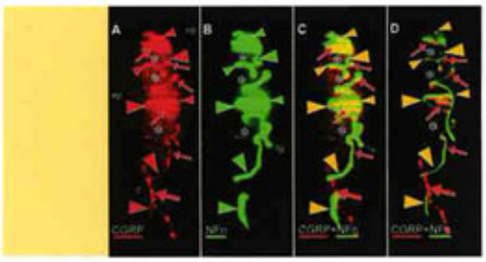
Science is by its very nature a collaborative venture. These collaborations are supported and enhanced by regular interactions between faculty and students. One example is the weekly Colloquium sponsored by the Graduate Program in Neuroscience. Over a boxed lunch, members of the Neuroscience community share their latest research in an informal seminar format. In the fall, faculty present their most recent laboratory findings, and in the spring, graduate students have the opportunity to share their research results to a friendly audience. Seminars from visiting faculty are sponsored by many departments including Neuroscience, Pharmacology, Genetics, Cell Biology and Development, Immunology, Laboratory Medicine and Pathology, and Neurology to name a few, and also are sponsored by centers, including the Institute of Human Genetics, the Stem Cell Institute and the Institute of Child Development. These seminars allow the faculty and students to stay connected to the world of neuroscience both within and outside of the University of Minnesota.

Almost every research group sponsors a journal club. This format allows students and faculty to sit and discuss, usually over coffee (and cookies), primary literature in their field. Indeed, many new experiments have come out of these informal discussions of the literature. Journal clubs give students an opportunity to keep up with the current literature and to learn the critical thinking skills that are so important for scientists.

The students of the Graduate Program in Neuroscience organize a yearly retreat for all members of the program. The purpose of the retreat is to provide a venue for interactions between students and program faculty in a relaxed atmosphere off campus. New faculty are invited to give short research talks, and the graduate students present their work in a poster format. The retreat also gives the faculty and students another opportunity to spend the day together, and this helps to keep the vision of the program in line with that of the current faculty and students.

Areas Of Research

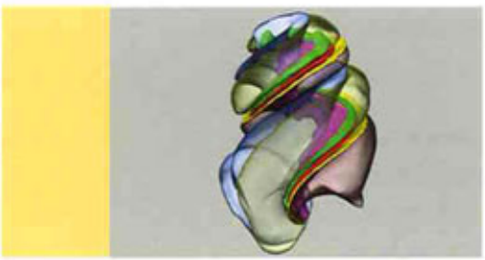
Addictive Disease



Relationship between peptidergic C-fiber (arrows) and A-fiber (arrowheads) Meissner corpuscle innervation.

Addictive disease is a pervasive and growing problem in US society. It contributes to the dissemination of AIDS and other diseases, and costs the nation more than $116 billion per year for health care, lost work productivity and early death. While it has always been considered to be an insidious social problem, addictive disease is now known to have strong biological underpinnings. Within the Graduate Program in Neuroscience one-fourth of faculty members are actively engaged in the basic and clinical aspects of addictive disease research. Their work investigates the effects of alcohol, cocaine, nicotine and opiates on the immune and nervous systems, and the neurobiological underpinnings of drug addiction, overeating and obsessive-compulsive disorders. Graduate students receive research experience and coursework through individual research grants and NIH-sponsored training programs, including Neuroscience Training in Drug Abuse and Pharmaconeuroimmunology and Substance Abuse Training. Through these initiatives, students receive training in addictive disease biology at molecular, cellular, organismal, behavioral and clinical levels.

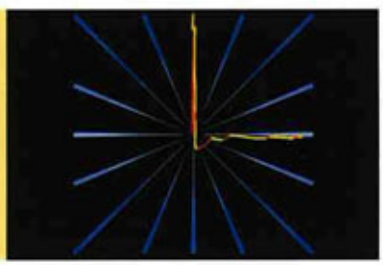
Auditory/Vestibular Neurosciences



Mouse cochlea database 3D reconstruction of a cochlea using orthogonal-plane fluorescence optical sectioning microscopy.

Research performed by the Auditory and Vestibular Neurosciences group seeks to understand neural and perceptual mechanisms of hearing and balance in both normal and pathological ears. The research effort is multidisciplinary and involves faculty in the Departments of Otolaryngology, Psychology and Communication Disorders. Group members' research interests include: molecular composition of the inner ear, neurophysiological studies of excitatory processes and functional electrical stimulation of the inner ear, quantitative studies of the vestibulo-ocular reflex and perceptual processing of time-varying auditory signals. Group members also collaborate with other faculty on research involving auditory perception with cochlear implants, intensity coding, speech perception and electrophysiological and biochemical studies of middle and inner ear function. Fully-equipped research laboratories provide students with specific training in anatomy/immunohistochemistry, single-unit and evoked-potential electrophysiology, psychophysical procedures and computer-based data acquisition and analysis.

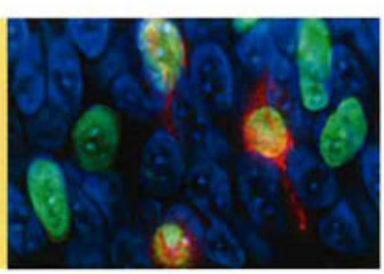
Behavioral and Cognitive Neurosciences



Oculomotor tracking in two dimensions (smooth pursuit: yellow, saccades: orange).

How do we learn and remember? Which neural networks are active during seeing or hearing? How is thought translated into movement? What has happened in the brain when things go wrong, and we can no longer remember, think clearly, see or grasp objects? These are some of the central questions of Behavioral and Cognitive Neuroscience. It is the study of how the brain enables the acquisition, storage and utilization of knowledge. The University of Minnesota has an extraordinary academic environment in Cognitive Neuroscience with faculty research and collaborations. Students participate and benefit from major research groups including the Brain Sciences Center, the Cognitive Sciences Center and the Center for Magnetic Resonance Research.

Developmental Neuroscience

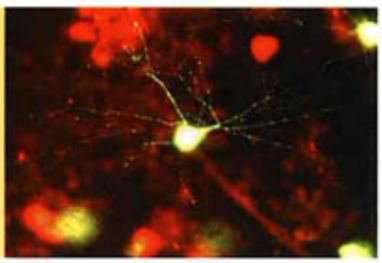


Blocking Notch signaling re-initiated ganglion cell genesis in the developing retina.

The developmental biology community is one of the most rapidly expanding at the University of Minnesota, with over a dozen laboratories representing a diverse array of vertebrate and invertebrate systems. Studies include: defining the molecular and cellular events leading to the emergence of neurons underlying behavior in the developing moth, Manduca sexta; determining the molecular signals involved in growth cone guidance and cell-cell interactions in the developing nervous system; identifying the molecular cues governing the organization of the retina in the developing eye and its connections to the rest of the brain using chick and rodent models; examining gene function, using human genetic approaches and studies in mice, as precursor cells differentiate into neurons and move during brain formation; assessing human brain development using methods drawn from cognitive neuroscience; using genetic approaches to monitor the development of sensory maps in the mammalian neocortex; investigating the gene cascade regulating differentiation and fate determination of vertebrate neurons; and examining activity-dependent development, specialization and survival of neurons using the auditory system of the mouse and chick. Investigators, students and fellows interact regularly through the Center for Developmental Biology in a rich collegial environment.

Areas Of Research

Ion Channels



On-off amacrine cell of the vertebrate retina.

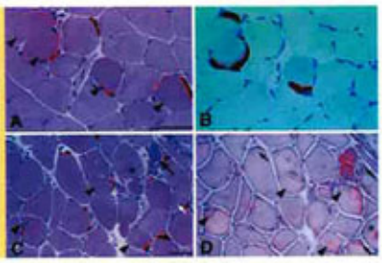
Brain function is critically dependent on the properties of neurons and glial cells. Members of the Ion Channels group study the properties and functions of ligand- and voltage-gated ion channels in both cell types. Ongoing investigations explore the molecular structure of ion channels, their regulation by intracellular signals, their interactions with scaffolding proteins and their role in information processing in the central nervous system. A variety of techniques are employed, including the cloning and expression of ion channels in heterologous systems such as Xenopus oocytes or transfected mammalian cells, single-channel and whole cell voltage-clamp studies and recording of synaptic events in brain slices and cultured neurons.

Motor Control

Cyberglove renderings of fingerspell letters I, O and U.

The University of Minnesota has one of the largest and most highly regarded motor control groups in the world. Research deals primarily with the control of arm and hand movement and hand-eye coordination, including the functions of the motor cortex, basal ganglia and the nature of the sensorimotor transformations controlling movement. The Motor Control group uses a variety of approaches ranging from a biomechanical description of movement kinematics and kinetics to single unit recording from alert animals and encompassing human psychophysics, functional magnetic resonance imaging and neural network models. The group studying normal movement is complemented by a large group of researchers studying cerebellar ataxia and other diseases of the motor system. This latter group uses cellular and molecular approaches including genetics and transgenic mouse models to understand diseases of the motor system.

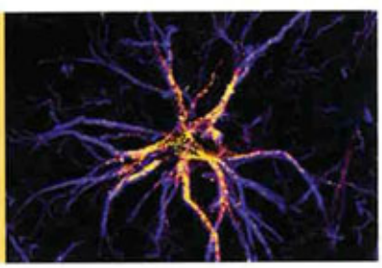
Muscle and Muscle Diseases



Fura-2 imaging of calcium at the neuromuscular synapses of normal (upper) and slow-channel transgenic (lower) muscle fibers while applying acetylcholine "puffs".

Skeletal muscle is the most prominent effector of the peripheral nervous system and the basis for production of movement and maintenance of posture. There are over 40 diseases that are either myogenic or neurogenic in origin that affect the structure and function of skeletal muscle, and many of these are currently under investigation by the Muscle and Muscle Diseases faculty members. These faculty members study skeletal muscle structure, function and disease. They work in many different disciplines and are part of a large group of scientists doing muscle research at the University of Minnesota. They all are active participants in the Center for Muscle and Muscle Research and Muscular Dystrophy Center. Their work spans the gamut from molecular genetics and cell biology to whole muscle systems in both health and disease. These include studies of myotonic dystrophy, muscular dystrophy, eye movement disorders including strabismus, channelopathies and malignant hyperthermia.

Neurodegenerative Diseases and Regeneration

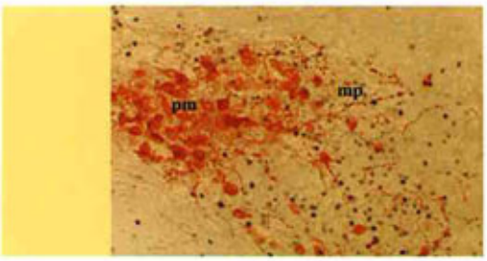


Astrocytes in the injured spinal cord up-regulate expression of endothelin A receptors.

Many laboratories at the University of Minnesota study neurodegenerative diseases. Minnesota researchers have developed a transgenic mouse model of Alzheimer's disease, one that expresses the human amyloid precursor protein and exhibits some of the neuropathological hallmarks seen in Alzheimer's patients. Others have discovered an intranasal method to deliver therapeutic agents to the brain to treat Alzheimer's disease, stroke and other brain disorders. Researchers in Multiple Sclerosis (MS) investigate the antigens responsible for the destruction of myelin by the immune system and seek ways to control inflammation by studying patient material and animals with experimental allergic encephalomyelitis, a model of MS. Transgenic mice with a variant of cerebellar ataxia called spinocerebellar ataxia have been developed and are used to study the neuropathological basis of this disease. In the study of Parkinson's disease, animals with a loss of dopaminergic neurons in the substantia nigra are used to evaluate the efficacy of neuronal transplants and stem cells to restore function. Investigators interested in spinal cord injury study intrinsic mechanisms of axonal regeneration, such as the control of the activity of growing nerve tips and neuronal surface molecules that mediate nerve cell adhesion to intrinsic nervous system tissue and connective tissue.

Areas Of Research

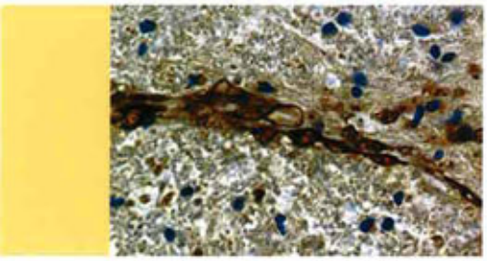
Neuroendocrine, Autonomic and Other Homeostatic Systems



Hypothalamic paraventricular neurons labeled for vasopressin and Fos.

The integration of endocrine and autonomic systems with behavior is required to keep physiological systems in balance and to maintain homeostasis. The impairment of homeostatic mechanisms results in a variety of disorders including obesity, hypertension, gastric ulceration and depression. Molecular, cellular, systems and behavioral approaches are used to understand how the nervous system maintains whole body function in the face of an ever-changing environment. Research questions include: how do different brain regions interact to influence food intake and energy expenditure; what areas of the brain subserve opiate control of food preference; what is the neuroendocrine circuitry that controls secretion of stress hormones; what behavioral conditions are responsible for stress-induced ulceration; how do endocrine and sympathetic systems interact to control blood pressure. The methodology used in these studies includes molecular biology, electrophysiology, animal behavior, radiotelemetry for cardiovascular monitoring, radioimmunoassay, immunohistochemistry and confocal microscopy. There is extensive collaboration and interaction between laboratories, including journal clubs and a graduate course in neuroendocrine and autonomic control.

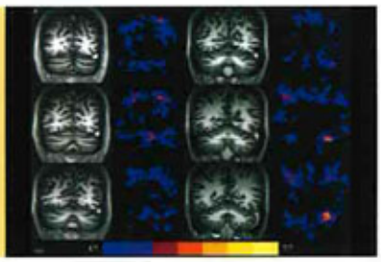
Neurogenetics



Aggregates of mutant SOD I (G37R) protein in the neurites of lumbar spinal cord motor neurons accumulate even in the complete absence of copper chaperone for superoxide dismutase CCS.

The Neurogenetics group investigates three major areas: genetic approaches to neurodevelopment, isolation and characterization of genes involved in human neurological diseases and development of transgenic mouse models of neurological disorders. A major focus of attention in all three of these areas is the cerebellum. Researchers study transgenic mouse models of spinocerebellar ataxia type 1, a disease due to the expansion of an unstable trinucleotide repeat, of Alzheimer's disease and aging and of slow channel syndrome. Genes involved in human neurological disease are isolated using molecular approaches. Investigations also include neurogenetic studies to identify possible genes involved in Parkinson's disease. The molecular genetics of neurodevelopment is also an active area of investigation, including the use of genetics to study the development of sensory maps in cerebral cortex.

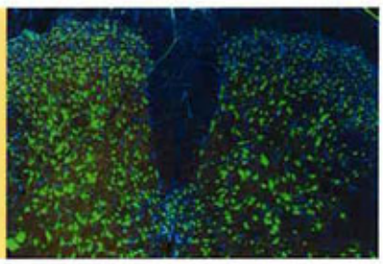
Neuroimaging



Activation of cerebellum and parietal cortex during object-based switching of attention between color and shape.

Understanding human brain function requires non-invasive and rapid visualization of human brain activity. The University of Minnesota has state-of-the-art, centralized resources that support this research. The Center of Magnetic Resonance Research (CMRR) is an interdisciplinary MR research center where several groups work together to develop novel imaging and spectroscopic applications for the neurosciences. The CMRR was one of two laboratories that introduced functional brain mapping with MRI, and Minnesota remains a world leader in high and ultrahigh field MR methodology. The magneto-encephalography (MEG) system, housed in the Brain Sciences Center at the Veterans Administration Medical Center, uses an array of over 200 axial gradiometers to detect the very small magnetic fields that result from neural activity. Diverse research interests include neural function in schizophrenia, neural activity during spatial navigation, and algorithm development to remove signal artifacts such as cardiac activity. Finally, many electrophysiological (EEG) laboratories exist on campus, including a number of both low- and high-density event-related potential laboratories. Collaboration between researchers using these different neuroimaging methodologies combines the spatial resolution of fMRI with the temporal resolution of EEG and MEG to provide superior neuroimaging capabilities.

Neuropharmaceutics

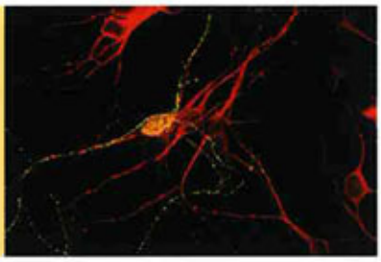


The spinal cord is one important research focus in Neuropharmaceutics. Neurons are shown in green and astroglia in blue.

The central nervous system (CNS) is highly enriched in therapeutic targets (e.g., protein receptors, enzymes, ion channels), the activation or inhibition of which provides therapeutic benefit for many neurological diseases. Delivery of drugs that act at those targets can be challenging due to unique anatomical and physiological properties of the CNS environment, such as the blood-brain barrier. Features of the blood-brain barrier can either diminish entry from the systemic circulation to the CNS or prevent retention of neuroactive drugs in the CNS. Although the vast majority of drugs are delivered by systemic routes of administration, delivery of neuroactive compounds directly to the CNS can sometimes be a more efficient therapeutic approach. The faculty of the Neuropharmaceutics group has an internationally recognized expertise in the areas of neuropharmacokinetics, blood-brain barrier transport proteins, direct CNS delivery techniques (intrathecal and intranasal delivery of neuroactive agents) and neuropharmacology. Through formal coursework, seminars and laboratory training, the Neuropharmaceutics faculty seek to offer students an understanding of the issues specific to the delivery of drugs to the CNS, the process of distribution of the drug in the CNS environment and the drug activity at the target site within the CNS.

Areas of Research

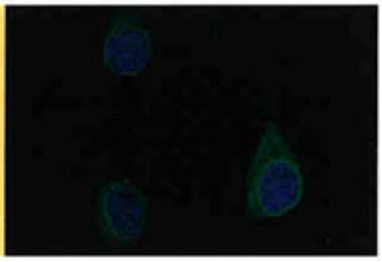
Pain



Internalization of neurokinin-1 receptors in spinal cord neurons involved in the ascending conduction of pain.

The University of Minnesota is one of the leading centers for pain research in the world. The Pain group includes neuroscientists whose research is focused on pain transmission, hyperalgesia and endogenous pain inhibitory systems. Studies of pain transmission include mapping sensory pathways in the spinal cord and brain, anatomically and physiologically. In studies of hyperalgesia, effects of injury and inflammation on the physiology and biochemistry of nociceptive neurons located in the peripheral and central nervous system are being determined. The anatomical organization of endogenous analgesic systems that originate in the brain and control nociceptive transmission in the spinal cord, and regulation of their receptors, are also being studied. A wide variety of techniques are used by the group, including molecular biology, electrophysiology, immunohistochemistry, animal behavior, human psychophysics and neuroimaging. In addition, many of the basic scientists interact with clinical faculty who specialize in pain management and are actively involved in clinical studies that help bridge the gap between basic and clinical sciences.

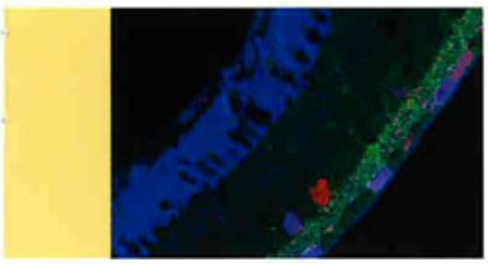
Synaptic Plasticity and Learning



Application of the steroid hormone estradiol activates the transcription factor CREB (shown in purple) leading to the remodeling of the neuronal cytoskeleton (green).

In order to accommodate the changing world, an animal must be able to learn about and remember aspects of its environment. Learning and memory require adaptive changes in the strength of communication between neurons, a property known as synaptic plasticity. Members of the Synaptic Plasticity and Learning group study the mechanisms of activity-dependent changes in synaptic communication as well as behavioral aspects of learning and memory. This research area includes the function of brain regions involved in learning and memory, changes in the activity of neurons as animals learn, alterations in synaptic plasticity in animal models of neurodegenerative diseases, the plastic responses of the nervous system in injury, disease and development and investigations of the molecular mechanisms of long-term changes in synaptic protein structure and function. A variety of techniques and approaches are used in these studies, including imaging, electrophysiology, behavioral analyses, molecular genetics, pharmacology and developmental studies.

Vision Neuroscience



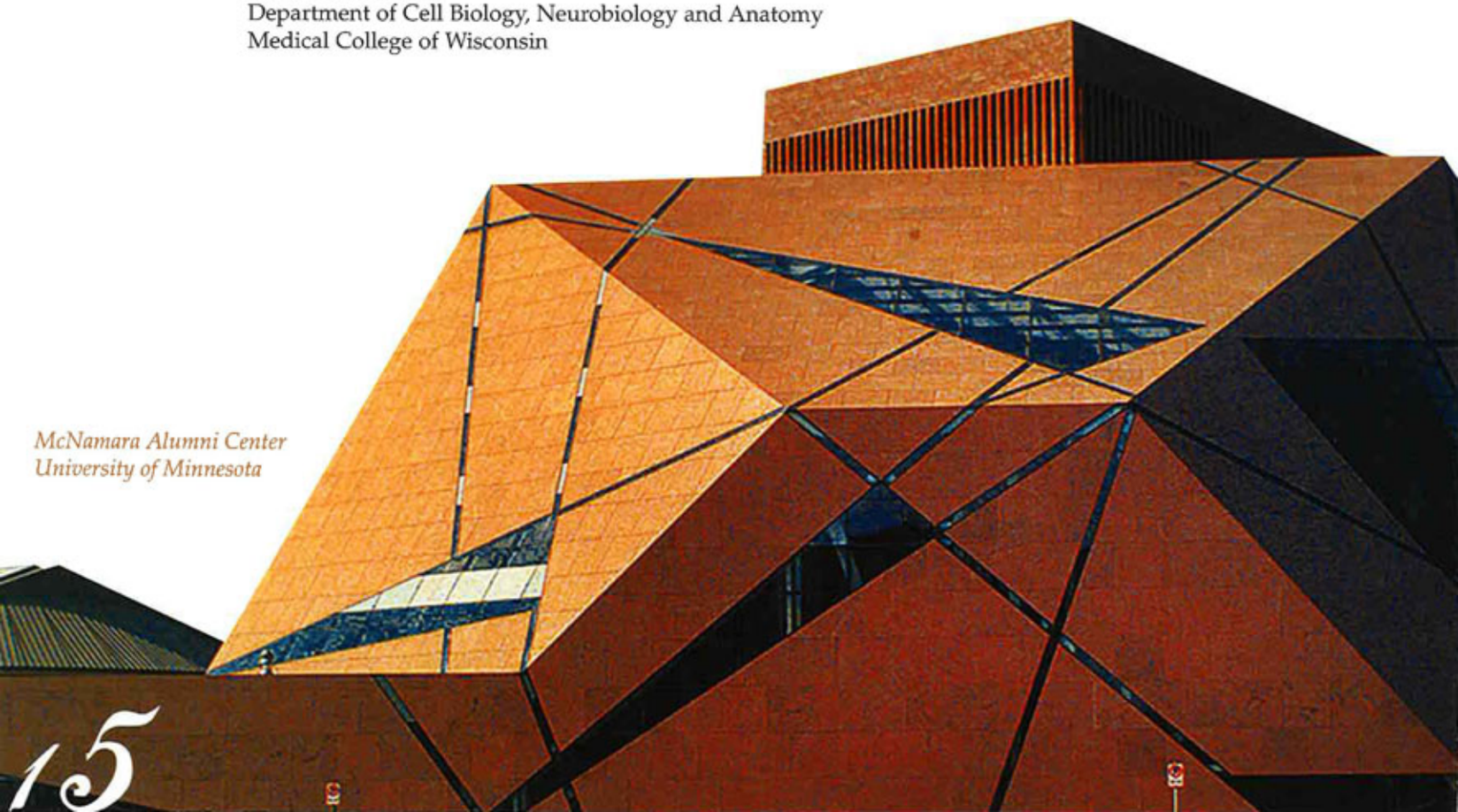
Multiple functions of the retina (transmitters/gap junctions) revealed by immunostaining techniques.

The University of Minnesota has a large, diverse vision research community, with a strong representation in the cutting-edge issues of vision research. The Vision Neuroscience faculty are a very active group whose research emphasis in the retina includes retinal neurocircuitry, ion channel function, synaptic transmission, glial cell physiology, glial-neuronal interactions, development of the retina, dendritic physiology, retina-brain connections and how they develop, and correlates between retinal function and human psychophysics. Studies of ocular muscle function and organization are also part of our experimental repertoire as well as studies of the mechanisms by which our eyes follow objects in two-dimensional space. Computational neuroscience is also carried out in several of our vision research laboratories. A new research emphasis has been initiated to explore the possibility that stem cells can be used to replace lost or deficient cell types in the retina. This research complements a large University commitment to stem cell research at the clinical and basic science levels with the formation of the Stem Cell Institute.

Comments From Alumni

I feel extremely fortunate to have received my Ph.D. training in the Graduate Program in Neuroscience at the University of Minnesota for a number of reasons. The beginning course at Lake Itasca gave me my first hands-on experience with an oscilloscope. At that time, I found electrophysiological recordings to be completely intimidating, but through this experience, I became fascinated by the sophisticated techniques we have available to study the function of single neurons in vitro and in vivo. Since the Itasca course, I continued developing a strong interest in studying the function of neurons by using electrophysiological approaches. . . Since my first year in graduate school, I have been intensely interested in mechanisms that drive and maintain pain, and I continued studying pain mechanisms throughout my postdoctoral training and now as an independent investigator. One of the major reasons I believe I have been successful in establishing my own laboratory for pain research in an academic institute is that I had fantastic, broad and in-depth training from a tremendous number of pain-focused investigators at the University of Minnesota. . . Even though the Neuroscience program is highly diverse and included (at the time) over 80 faculty members, I had a very strong sense that the faculty members in the Neuroscience program really knew who we graduate students were and how we were progressing, and genuinely cared about the success of each of us. My experience is that the contacts between faculty and students continue long after the graduate students move on.

Cheryl Stucky, Ph.D. 1995
Current Position:
Assistant Professor
Department of Cell Biology, Neurobiology and Anatomy
Medical College of Wisconsin



McNamara Alumni Center
University of Minnesota

As the time since my graduation from the Program in Neuroscience continues to elapse, I grow to appreciate the many benefits of my education more and more. These benefits can best be divided into two categories: the breadth and depth of the education I received; the relationships and the contacts I made with the faculty. During my training, I received a broad but thorough education in some of the core areas of neuroscience, from the cellular to the systems levels. This education has provided me with a sound foundation upon which I have been able to continue learning throughout my career. Obviously, a key component to successful education lies in the hands of the teachers. The Program's faculty are truly one of its greatest assets. They successfully made a large university feel familiar and comfortable, enabling the formation of positive relationships between faculty and students. The relationships that I established with the faculty have continued to grow, and have proven to be very valuable assets for my career.

James Pomonis, Ph.D. 1998
Current Position:
Research Investigator
Purdue Pharma, New Jersey

Unlike many first year graduate students that I meet today, when I entered the Neuroscience Program at the University of Minnesota in 1989, I was not wedded to a particular research area. . . For my third rotation I went to Paul Letourneau's lab where he was studying nerve growth cones. Paul was using several forms of microscopy to image growing axons in culture. I can still recall seeing my first time-lapse movie of a growth cone migrating randomly across a culture dish. At that moment I became fascinated, like Paul, in how these sensory-motor specializations worked. In fact, I consider this to be the most pivotal point in my career. I became preoccupied with my studies and never considered what I was doing as work. . . As a faculty member less time can be spent at the bench, as more time is required in writing and reviewing grants and papers, consulting with students, and giving lectures. However, I was fortunate to have several talented graduate students join my lab and can now witness their emerging fascination with growth cones. Although my responsibilities have changed, my days are still spent thinking, learning, and teaching, which I trust I will never consider work. I am extremely thankful for my five years as a graduate student at the University of Minnesota, as I believe the Neuroscience program, its faculty, and of course my advisor provided me with the strong foundation I needed to succeed.

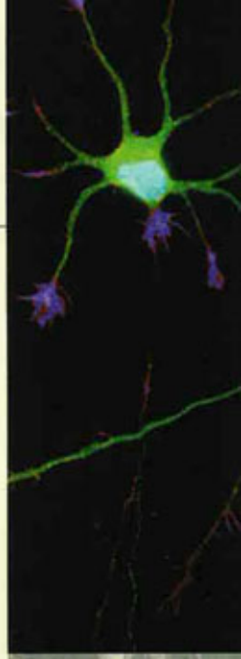
Timothy Gomez, Ph.D. 1995
Current Position:
Assistant Professor
Department of Anatomy
University of Wisconsin, Madison

The Admissions Process

Our graduate students come from a variety of backgrounds and have diverse scientific interests. Therefore, we do not have specific coursework prerequisites for admission. However, experience tells us that the most appropriate background includes coursework in biology, chemistry (including biochemistry), psychology, mathematics and physics.

We require all students to take the general GRE. Students whose native language is not English are also required to take the TOEFL with a minimum score of 625 (or 263 on the computer-based test) or to obtain a score of 6.5 or better on the IELTS (International English Language Testing System) examination. While we have no minimum GPA or GRE score requirements, a GPA of 3.5 and a GRE score reaching at least the 80th percentile (for all three sections) are typical of students accepted into our program. All prospective students are required to fill out an application, and as part of the application, we require three letters of recommendation and a personal statement about your ambitions and motivations for a research career.

Our admissions committee looks for students who have shown strong initiative, creativity, productivity and a passion for discovery. The majority of our students have had research experience during their undergraduate or post-undergraduate education, experience that has often helped them clarify their research interests. We have found that previous research experience outside of regular coursework is the greatest indicator of success in our graduate program, and we encourage all students to work in a research environment prior to graduate school.



In late February or early March, we invite our top candidates to the Twin Cities and introduce them to our program, faculty and students. These prospective students are provided an opportunity to sample the research environment by visiting labs of interest. This trip also allows prospective students the chance to explore the campus and the Twin Cities area. Candidates accepted into the program are notified shortly after the campus visit. Once accepted into our program, we provide each student a considerable stipend, full tuition benefits, health care benefits and funds to travel to a national neuroscience conference during the first year in the program. Once a student has selected a Ph.D. advisor, the advisor provides financial support until completion of the Ph.D.

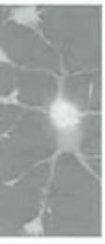
The program is strongly committed to training students of diverse backgrounds and welcomes all applications. In fact, the program considers an applicant's contribution to diversity as a positive factor in the admissions process. Further information and application materials can be obtained at our web site found at http://www.neuroscience.umn.edu/.

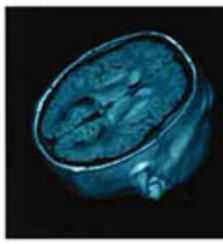
University Of Minnesota

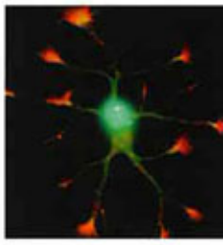
TWIN CITIES CAMPUS

Founded in 1851, the University of Minnesota is one of the most comprehensive universities in the United States and ranks among the most prestigious. It is both a state land-grant university, with a strong tradition of education and public service, and a major research institution, with scholars of national and international reputation. Through its library system, the 17th largest in North America, faculty and students have access to over 45,000 periodical subscriptions and 6 million volumes. More than 15 University programs rank among the top 10 nationally. In 2001 and 2002, the University's Twin Cities campus was ranked as being among the top three public research universities in the nation.

The University of Minnesota-Twin Cities is a classic Big Ten campus in the heart of the Minneapolis-St. Paul metropolitan area, just minutes from downtown. The largest of the four campuses, with its state-of-the-art facilities and stately historic buildings, it is set along the banks of the Mississippi River and in the rolling hills of St. Paul. With the most comprehensive academic programs of any institution in Minnesota, as well as the widest range of graduate and professional programs, the University offers unlimited academic and experiential opportunities for students and faculty alike.

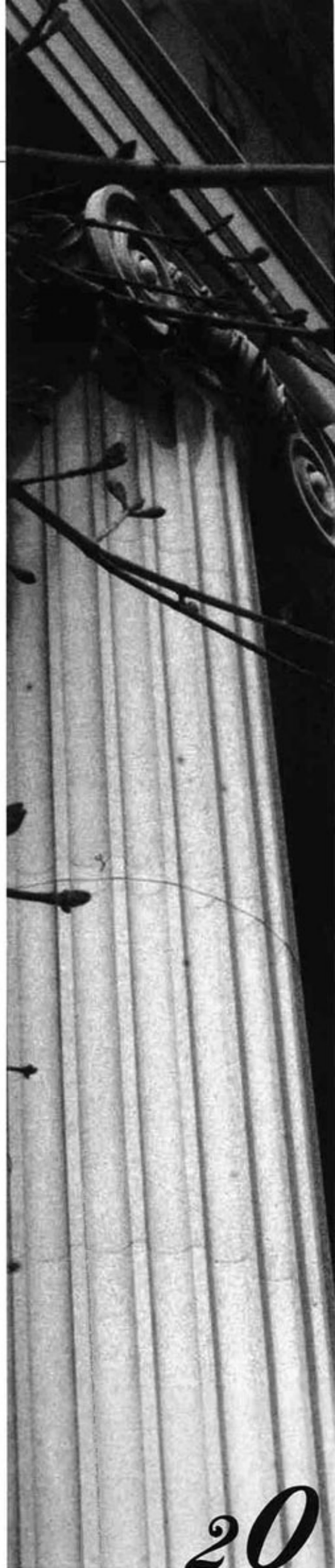






Pioneering research has given the University an international reputation, leading to successes such as the world's leading kidney transplant center, the development and release of over eighty crop varieties that have increased grain production worldwide, eradication of many types of livestock diseases, the invention of the heart-lung machine and the first heart pacemaker. Honors and awards such as McKnight, Fulbright, Guggenheim, Pulitzer, Rhodes, MacArthur and Bush also attest to the quality of the University's researchers and scholars.

The University received nearly $455 million in contract and grant awards in fiscal year 2000. Private gifts have financed such improvements as the Weisman Art Museum, the Ted Mann Concert Hall, the University Cancer Center, the Molecular and Cellular Biology Building, the Cargill Building and the Translational Research Facility. The University of Minnesota continues to expand activities that move its discoveries and technology to the marketplace for public benefit. Thus, work done by faculty, staff and students at the University has improved the lives of people throughout the world.



About The Twin Cities

Minneapolis – St. Paul

The Mississippi river, the river of literature, folklore, commerce, jazz and music, flows through Minneapolis and St. Paul on its way to New Orleans. This great American river begins its journey as a stream bed among the towering red pines flowing out of Lake Itasca in northern Minnesota, winding past farms and small towns, until it reaches Minneapolis and St. Paul, as a major inland waterway. Ships travel the river from the Twin Cities carrying agricultural goods, raw materials and industrial products to the Gulf of Mexico. In the Twin Cities, the river winds its way past the University of Minnesota, parks and walkways, ethnic neighborhoods, thriving downtowns, theaters and museums, for this is one of the most lively, thriving metropolitan communities in the United States.

Over 136,000 acres have been set aside for parks in the metropolitan area. In the evenings and on the weekends, parks are the meeting places for whole neighborhoods. More than 500 lakes are in the metro area, mostly in the public park system. Lush green trees and grassy knolls border more than 100 miles of walking paths, jogging and biking trails.

These are friendly cities, both cosmopolitan and warm to newcomers. World renowned theater, distinguished music groups like the Minnesota Orchestra and the St. Paul Chamber Orchestra, and sophisticated art galleries set the pace for many experimental theaters, galleries and music groups.

Weisman Art Museum
University of Minnesota – Twin Cities Campus

Minneapolis was crowned "The Most Fun City in America" by the makers of Cranium, Inc. The cities were ranked on their number of sports teams, restaurants, dance performances, toy stores, and the amount of city budget spent on recreation, among other factors. Minneapolis, the survey shows, has more theaters than Boston, more parks than Denver, more golfers per capita than any other city in America, and with 10,000 lakes in the state, Minnesota has more coastline than California, Florida and Hawaii combined.

Citizens here have a strong sense of community. There are more than 600 ethnic organizations operating in the state, mainly in Minneapolis and St. Paul. Both cities have preserved their historic neighborhoods, downtowns and quality of life through rigorous community initiatives. Intent on preserving city life at its best, both Minneapolis and St. Paul are known for their personal warmth and dedication to their communities. Thus, Minnesotans have developed and preserved one of the most beautiful metropolitan areas in the country. The area is known for the creative partnership between business, public sectors, communities and citizens working to change and improve the quality of life.

Brochure design and cover illustration by Colin Kulow

Cover illustration is adapted from a microphotograph of a cultured pyramidal neuron with growth cones, taken by Dr. Lorene M. Lanier.

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UNIVERSITY OF MINNESOTA

Application Checklist

GRADUATE PROGRAM IN NEUROSCIENCE

Domestic Applicants	APPLICATION DEADLINES	International Applicants
December 5		December 5

We strongly encourage candidates to submit their applications one month prior to the deadline.

Submit via: **ApplyYourself Application System (Preferred)**

Or

By mail:

Graduate Program in Neuroscience
University of Minnesota
6-145 Jackson Hall
321 Church Street SE
Minneapolis, MN 55455

☐ **Transcript from all post-secondary institutions attended** (Original or photocopy are acceptable)

☐ **GRE scores** (Initially, a photocopy of an official report is acceptable. However, we must receive an official ETS report before acceptance into the program. Institution Code 6874, Department Code 0213)

☐ **TOEFL or IELTS scores** (Only for applicants whose native language is not English. Initially, a photocopy of an official report is acceptable. However, we must receive an official report before acceptance into the program.) (TOEFL: Institution Code 6874, Dept. Code 99 for Not Listed)

☐ **Three (3) Letters of Recommendation** (Letters should be uploaded through ApplyYourself, but they will also be accepted if addressed to the Admissions Committee at the above address. The envelope should be sealed and signed on the flap.)

☐ **Current Registration Information** (If currently enrolled at an academic institution, you must provide a separate listing of all courses you expect to complete in your present program)

Submit via: **ApplyYourself Application System (Required)**

☐ **Graduate School Application, which is available online at:**
http://www.grad.umn.edu/admissions/index.html
(The "Major Code" is **059060208**. "Term of Admission" is **Summer** and fill in the appropriate year)

☐ **Application Fee: $75.00 U.S. Citizens / Permanent Residents; $95.00 International Applicants**

☐ **Statement of Purpose** (State your immediate and long-range career objectives)


www.neuroscience.umn.edu