MD-PhD Scholars Program

Training the physician-scientists of tomorrow
# Table of Contents

- Goals and Welcome ................................................................. 1
- Contact information ................................................................. 1
- Application and Admission Information .................................... 2
- Financial Support ................................................................. 3
- Timeline ................................................................. 3
- Activities ................................................................. 3
- Medical School Curriculum .................................................... 4
- Medical School Facilities ....................................................... 4
- Graduate Programs Overview .................................................. 5
- Research Facilities .............................................................. 6
- Research Core Facilities .......................................................... 7
- College of Medicine Graduate Programs: IGPBS ....................... 8
- Biochemistry and Molecular Biology ........................................ 9
- Cancer Research ................................................................. 10
- Immunology, Pathology and Infectious Disease ......................... 11
- Integrative Physiology and Molecular Medicine ....................... 12
- Molecular Genetics and Cell Biology ....................................... 13
- Neuroscience ................................................................. 14
- Medical Sciences Interdisciplinary Area (MSIA). ....................... 15
- College of Pharmacy ........................................................... 16
- College of Public Health ......................................................... 17
- Munroe-Meyer Institute for Genetics and Rehabilitation ............... 18
- Summer Undergraduate Research Program ............................. 19
- Participating Faculty ............................................................. 20
The MD-PhD Scholars Program at UNMC

Goals
The goal of the MD-PhD Scholars Program at the University of Nebraska Medical Center is to provide an integrated program of training in clinical medicine and biomedical research to prepare scholars for successful careers as physician scientists.

Welcome
Progress in healthcare in our future depends upon excellent clinicians who provide state-of-the-art patient care and treatment, and upon dedicated biomedical researchers who discover revolutionary ways to improve diagnosis, treatment, and healthcare delivery. The physician-scientist has an intimate understanding of this whole process, contributing to the advancement of healthcare anywhere along the spectrum from bench to bedside to community to public policy.

The University of Nebraska Medical Center has developed a dynamic program to train physician scientists and prepare them for a variety of careers. Our Medical School has a systems-based curriculum that integrates normal function, clinical abnormalities, and relevant research. The facilities for learning include a building for meetings and student interaction, and a center for the most advanced simulation and virtual reality training. In combination with the clinical enterprise, Nebraska Medicine, the medical training at UNMC provides a foundation for outstanding clinical care.

The MD-PhD program also takes advantage of a biomedical campus that emphasizes innovative approaches to major research questions. As a Scholar in our program, you can choose from seven interdisciplinary programs in the basic sciences in the College of Medicine and Eppley Cancer Institute, or drug discovery and development programs in the College of Pharmacy, or public health and policy programs in the College of Public Health. Through partnerships with the University of Nebraska-Lincoln, students have also done PhDs in Biomedical Engineering, Psychology, and Imaging. The facilities for research are outstanding, with new buildings designed to facilitate interaction between researchers and clinicians.

A critical part of our MD-PhD program is to provide a structure that encompasses, extends, and integrates the clinical and research training. Our Scholars support each other and contribute to the growth and development of our program. Through their leadership activities, they also contribute to the UNMC community and to the national community of physician-scholars.

We encourage you to take a look at UNMC. We are confident you will be as enthusiastic as we are about the future awaiting UNMC MD-PhD Scholars!

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Qualifications
We encourage applications from individuals with exceptional academic qualifications, research experience, and significant clinical exposure who will have graduated from an accredited college or university prior to matriculation in the MD-PhD program. Applicants must be US citizens or permanent residents. There is no Nebraska residency requirement for MD-PhD students.

Nondiscrimination statement
The University of Nebraska does not discriminate based on race, color, ethnicity, national origin, sex, pregnancy, sexual orientation, gender identity, religion, disability, age, genetic information, veteran status, marital status, and/or political affiliation in its programs, activities, or employment.

Application Process
Applications are made through the online AMCAS process that handles applications to US medical schools: https://students-residents.aamc.org/applying-medical-school/applying-medical-school-process/applying-medical-school-amcas/how-apply-med-school-amcas/ MCAT test results and complete official undergraduate transcripts are required. When completing the AMCAS form, applicants should indicate that they are applying to a Combined Medical Degree/PhD Program. This will ensure that the appropriate essays are included and that the applications will be forwarded to the MD/PhD Scholars Program office. In addition to the online applications, two letters of recommendation should be submitted from individuals qualified to evaluate the applicant’s research performance and potential. The deadline for submission of applications is November 1.

Interviews
Based on the AMCAS application and letters of recommendation, candidates will be selected for interviews by the MD-PhD program and the Medical School. The interviews are conducted on several Thursdays and Fridays in October, November, and/or December. On Thursday, applicants will meet with seven to eight faculty members and will also have the opportunity to meet with current students and will have their Medical School interviews on Friday.

Acceptances
Candidates must be accepted by both the MD-PhD Admissions Committee and the Medical School. Most acceptances are issued in January and February, and candidates are invited for a second visit to meet with faculty members who are conducting research in their area of interest and to look at housing. UNMC follows the AMCAS regulations (“Traffic Rules”) for the timing of acceptances and student decisions.

Alternative Pathway
Students who are in medical school at UNMC may apply for admission to the MD-PhD program in the fall of their first or second year through the Alternative Pathway. Interested students supply their original AMCAS applications, Medical School transcript, and the two additional essays and letters of reference covering their research experiences. They go through the same interview and selection process as other applicants. Students accepted in the second year of medical school must have identified a mentor for their Ph.D. studies, since there will not be an opportunity for research rotations before starting graduate school in the spring.
Overview of the Program

Financial Support
Tuition and fees are waived for MD-PhD Scholars for Medical School and Graduate school, and they receive annual stipends based on the pre-doctoral stipend levels established by the National Institutes of Health. Stipends are funded by the MD-PhD program during Medical School and by the Graduate program or mentor for Graduate School. Health insurance is also provided for the student, and they can purchase additional coverage for their family.

MD-PhD Activities and Timeline
The MD-PhD Scholars program provides a continually integrated curriculum of training in medicine and biomedical research. This integration allows compression of the total time to graduation as some course work can be applied to both degrees, and prepares the students for a career as a physician scientist.

The program begins the summer prior to the first year of medical school with participation in two six-week laboratory rotations designed to help the students select a mentor for their Ph.D. research. Two more rotations are done in the summer between the first and second year of medical school.

After the second year of medical school (Phase I), students take the USMLE Step 1 examination and enter graduate school as a full-time Ph.D. student. Most students take four years to complete course work in the graduate program, pass the comprehensive examination for candidacy for the Ph.D., and conduct original research leading to their dissertation, oral defense, and graduation with their Ph.D. Some students complete the requirements in three years.

When the Ph.D. requirements have been completed, students re-enter medical school for their last two years of clinical training (Phases II and III).

Clinical Activities during Graduate School
During graduate school, scholars are also required to participate in clinics at the medical center as well as community-based service clinics. This is designed to maintain a clinical perspective while they are engaged in research, and also gives them an opportunity to explore multiple clinical specialties in preparation for selecting a residency.

Additional Activities
In addition to the work of medical school and graduate school, MD-PhD Scholars have additional requirements. They attend special research and clinical seminars and interact with faculty and outside speakers at informal discussions. There is a two-day off-campus annual retreat with student-led workshops, outside speakers who discuss issues of importance to physician scientists, a poster session for students in graduate school, and time for recreation. Other activities during the year include a summer picnic, recruitment dinners with applicants, and an annual graduation banquet. Students also participate in other teams and activities including student government and national physician-scientist organizations. Our goal is to foster a cohesive group of students who support each other throughout their training.
Medical School at UNMC

Curriculum
The medical curriculum and training at UNMC is designed to enhance the student’s ability to acquire enduring knowledge and skills while integrating emerging concepts and approaches critical to physician practice in the 21st century. Throughout all aspects of the curriculum, six scientific domains will be considered: biomedical science; population science and public health; social and behavioral science; clinical science, health systems science, and educational science. It is organized into three phases:

Phase I: Foundations of Medicine
Phase II: Clinical Applications
Phase III: Career Preparations

The Foundations of Medicine phase presents the basic medical sciences necessary for diagnosis and treatment as well as issues that are crucial to the practice of medicine in a complex health care system. The curriculum is arranged by organ system, integrating normal development, disease processes, health maintenance, and public health aspects. Clinical training is started early in this phase in small group and one-on-one settings including patient contact. Students take the USMLE Step 1 at the end of Phase I in March of the second year. At this point, MD-PhD Scholars enter graduate school.

At the completion of the Ph.D. in March of their third or fourth year of graduate school, scholars re-enter medical school for the Clinical Applications phase. Over the 12 months of this phase, students have clinical rotations in internal medicine, surgery, pediatrics, psychiatry, family medicine, and obstetrics/gynecology, with proficiency examinations after each rotation.

Phase III is 13 months long, allowing students to take elective rotations in other medical specialties to explore additional medical specialties and prepare for residency applications and interviews in the fall. Toward the end of the year, the focus changes to preparation for the transition to residency.

Facilities
The activities in Phase I of medical school are centered around the Michael F. Sorrell Center for Health Science Education which opened in 2008. The Sorrell Center features auditoriums, conferences rooms, small-group interaction rooms, clinical skills laboratories, the Truhlsen Events Center for large programs, and a convenience store and lunch area. The overall design is geared toward fostering interactions among students and between students and faculty.

Learning is further enhanced by realistic simulations in the Sorrell Clinical Simulation Lab and electronic reconstructions and virtual reality presentations. The electronic resources will move across the street to the iExcel Global Center for Advanced Interprofessional Learning in 2018, which will further expand the resources available to students.

Clinical training takes place in a variety of settings in Omaha depending upon the specialty. These include UNMC and the Nebraska Medical Center, Childrens Hospital Medical Center, the Omaha Veterans Administration Hospital, Nebraska Methodist Hospital the Munroe-Meyer Institute for Genetics and Rehabilitation, Lasting Hope Recovery Center inpatient psychiatric hospital, Immanuel Hospital, and private practice clinics. There are also several community-based clinics for volunteer service, such as the student-run SHARING clinic.

For more details, please see the UNMC College of Medicine brochure “Admissions Information” or go to unmc.edu/com
MD-PhD Scholars have wide range of options for their Ph.D. work. They may work with faculty members in all of the Colleges and Institutes at UNMC and in joint programs with other University of Nebraska campuses. These include:

- College of Medicine
- Eppley Cancer Institute
- College of Public Health
- College of Pharmacy
- Munroe-Meyer Institute for Genetics and Rehabilitation

We also have joint programs in Bioinformatics with the University of Nebraska-Omaha, Bioengineering with the College of Engineering at the University of Nebraska-Lincoln, Developmental Psychology with the Psychology Department at the University of Nebraska-Lincoln, and Neurobehavioral Imaging with Boys Town National Research Hospital. The flexibility of our program allows us to continue to add new areas of research as needed.

The core curriculum for the Ph.D. is set by the individual graduate program, although many programs will give credit for medical school courses that overlap with their curriculum. This can help shorten the time to completion. In most programs, MD-PhD students generally spend their first year of graduate school taking courses and learning about the research and techniques in their mentor’s laboratory. The second year focuses on developing a research project, submission of fellowship applications, and preparing for their comprehensive examination for admission to candidacy to the Ph.D. at the end of their second year. The next two years are spent doing research and publishing papers, culminating in a doctoral thesis that is defended before returning to medical school.

In addition to their coursework and research, students in graduate school are required to do the equivalent of one day per month with a clinician attending clinics, and they are also required to attend evening community clinics at least four times per year. This assures that they maintain their clinical skills and reinforces a clinical perspective on research, and also allows the students to gain experience in different clinical specialties in an ungraded setting.
Research Facilities

The UNMC campus boasts state-of-the-art research facilities in a well-defined area that encourages interdisciplinary collaboration. These facilities include:

**Fred & Pamela Buffett Cancer Center**
The Fred & Pamela Buffett Cancer Center, which opened in 2017, is shaping cancer care, research and education in Nebraska, the region and the world. Through collaboration between the University of Nebraska Medical Center and its hospital partner, Nebraska Medicine, patients experience personalized care – based on the latest scientific research – in one facility. It includes a 10-story, 98-laboratory research tower named the Suzanne and Walter Scott Cancer Research Tower; and an eight-story, 108-bed inpatient treatment center named the C.L. Werner Cancer Hospital, as well as multidisciplinary outpatient center.

**Durham Research Centers**
The original Durham Research Center (DRC) opened in 2003. It contains 117 research laboratories, a 319-seat auditorium, 3 classrooms and 15 conference/seminar rooms. The laboratories are arranged in an open format, which facilitates communication and shared equipment. There are also smaller utility rooms for each laboratory for tissue culture and other scientific equipment.

The second tower, DRC II, opened in 2009 and has 95 laboratories in the same configuration as the first DRC. It is home to more than 250 staff members, including 35 principal investigators.

Together, the twin 10-story research towers enable UNMC to enhance research in a number of areas, including cancer, cardiovascular diseases, neurosciences, transplantation biology, genetics, and eye research. The two towers contain a combined total of more than 550,000 square feet of space dedicated to research.

**Harold and Beverly Maurer Center for Public Health**
The 52,500-square-foot, three-level facility was completed in 2010 and provides a home for the newly established College of Public Health.

**UNMC Center for Drug Discovery/Lozier Center for Pharmacy Sciences and Education**
Completed in 2016, this building is 85,000 square feet and provides contemporary education space, equipped with the advanced technology needed to deliver pharmacy education and active learning in the 21st century. It also includes laboratory and research support space designed to accommodate the specific technical needs of pharmaceutical research in three areas: drug discovery and development, drug delivery, and clinical and translational research.
Core Facilities

Core facilities provide specialized resources for researchers. A partial list includes:

**Advanced Microscope Core Facility**
Confocal laser scanning microscopy, Super Resolution microscopy, live cell imaging

**Mass Spectrometry and Proteomics**
Mass Spectrometry including MALDI/TOF/TOF, LC-MS/MS such as LTQ Orbitrap, QTRAP and TripleTOF protein identification and quantification.

**Bioinformatics and Systems Biology Facility**
Biological data analysis, development of database/application/web interfaces, pathway analysis, Next Generation whole genome and exome mapping, RNAseq mapping.

**Molecular Interactions Core Facility**
Surface plasmon resonance for real-time monitoring of macromolecular interactions Affinity measurements, binding kinetics, active concentrations, binding specificity and epitope mapping. Target-ligand interactions

**Biologics Production Facility**
GMP Facility for the manufacturing, production and modification of cells, tissues, cellular and tissue-derived products

**Mouse Genome Engineering Core**
DNA constructs, genotyping, knockout and conditional knockouts, transgenics, CRISPR-Cas9 editing, mouse strain rederivation

**Electron Microscopy Facility**
Transmission and scanning electron microscopy

**Nanomaterials Characterization Core Facility**
AFM/Raman for nanomanipulations and characterization of mechanical, electrical, and magnetic properties of samples.

**Electronic Health Record Data Access Core**
Electronic health record access; feasibility, cross-sectional, health-outcomes, retrospective data analysis, quality improvement, registry creation, subject recruitment, public health

**Nebraska Biobank**
Deidentified serum/plasma or DNA samples for clinical/translational research projects

**Molecular Biology and HTS Facility**
High-throughput chemical, small molecule, and small interfering RNA screening, high-content cell imaging and analysis, Luminex xMAP technologies

**Nebraska Nanomedicine Production Plant**
Resources to transition nanomedicines from preclinical screening to human clinical trials, i

**Genomics Core**
Next Generation sequencing, whole genome and exome sequencing, gene expression.

**Structural Biology Facility**
Protein expression and purification for static and dynamic light scattering, small angle X-ray scattering, crystallization screening and optimization; X-Ray crystallography.

**Holland Computing Center**
High Performance Computing
The IGPBS includes faculty members from the College of Medicine, the College of Pharmacy, the College of Dentistry, the College of Nursing, the Munroe-Meyer Institute, and the Eppley Cancer Institute, encompassing an umbrella program with six component programs:

- Biochemistry and Molecular Biology
- Cancer Research
- Immunology, Pathology and Infectious Disease
- Integrative Physiology and Molecular Medicine
- Molecular Genetics and Cell Biology
- Neuroscience

These programs are structured around our basic science departments, but faculty members can belong to more than one program, providing students with a greater choice of mentors and supervisory committee members and giving them more broad-based training in multidisciplinary research.

In addition to the IGPBS programs, the Medical Sciences Interdisciplinary Area (MSIA) provides a novel mechanism for individualized training in translational research.
IGPBS: Biochemistry and Molecular Biology

The Biochemistry and Molecular Biology program trains students for careers in experimental biology. The research goals range from defining basic biochemical and biophysical functions to translational research in cancer, genetic diseases, and overall human health. Areas of research include:

**Molecular Biology of Cancers**
- Mechanisms of neoplastic transformation in pancreatic, ovarian, and prostate cancers
- Gene expression in hematopoiesis and leukemia
- Altered signaling pathways in pancreatic cancer
- Apoptosis and microRNA signaling in liver cancer
- Aberrant glycosylation and golgi apparatus alteration in prostate cancer
- Role of the VEGF-C/Neuropilin-2 axis in metastasis
- Intestinal mucosal barrier function and inflammation in colon cancer

**Cellular Signaling and Communication**
- Insulin-like growth factors in cell growth and tumor development
- Epithelial cell-cell adhesion dysfunction in cancers
- Role of gap junctions in tumor suppression and in heart failure
- Tyrosine phosphorylation and redox signal transduction in androgen regulation of cell proliferation and carcinogenesis
- EGFR and cell-cell adhesion communication in renal epithelial cancer

**Endocytosis and Trafficking**
- Mechanisms for movement of receptors, proteins and lipids

**Tumor Glycobiology**
- Regulation of mucin glycan biosynthesis in lung diseases and cancer metastasis
- Role of mucin proteins in cancer progression and metastasis, including breast and ovarian cancers

**Cancer Therapies**
- Vaccines and monoclonal antibodies
- Serum assays for early diagnosis of pancreatic cancer
- Multi-antigen radioimmunology based targeted therapies
- Reactive oxygen species in radiation treatment of prostate cancer

**Tumor Microenvironment**
- Effects of microenvironment on progression of pancreatic cancer
- Interactions between tumor cells and stromal fibroblasts in promoting an oxidative microenvironment in breast cancer
IGPBS: Cancer Research

The Cancer Research umbrella program is based in the Eppley Cancer Institute, which is affiliated with the Fred & Pamela Buffett Cancer Center which opened in 2017. The goals of this NCI-supported Center are to perform basic and translational research into the causes, detection, and treatment of cancers. Research areas are centered around:

**Causes of Cancer:** genomics, DNA damage and repair, nutrition and environmental causes
- Molecular mechanisms of DNA interstrand crosslinks in cancers and drug resistance
- Tumor suppressor genes in breast cancer
- Protein modifications by environmental agents
- Mechanisms of cell death and survival
- DNA polymerase defects
- Dysregulation of the DNA damage response in cancer

**Molecular and Cellular Characteristics of Cancer:** gene expression, signal transduction, structural biochemistry
- Molecular control of tyrosine kinase signaling
- Structural biology of DNA post-translational modification
- Signaling pathways in mitosis and cancer development
- Regulation of post-translational gycosylation in pancreatic cancer
- DNA methylation changes in cancers
- KSR1 and KSR2 signaling pathways in tumorigenesis and metabolism
- Gene expression in normal mammary gland development and cancer

**Diagnostics and Therapeutics:** drug identification, biomarker identification, and immunotherapy.
- Protein kinase C signaling in colon cancer transformation, diagnosis and treatment
- High throughput screening for small molecule inhibitors for breast, ovarian, and pancreatic cancers
- Gene therapy for breast cancer
- T-cell mediated immunotherapies
- Therapeutic targets associated with metastasis and drug resistance in colon cancer

Pancreatic cancer research is particularly aided by NCI funding for a Specialized Program of Research Excellence (SPORE) grant. This includes funding to:
- Develop and test novel diagnostic reagents and assays that will improve our ability to detect pancreatic cancer in its early stages
- Develop and test novel diagnostic strategies including immunotherapy, chemotherapy, and chemoradiation therapy for patients with early and advanced pancreatic cancer
- Undertake basic research studies in conjunction with clinical trials that will provide insight at the molecular level into the reasons for success and failure of the different strategies.

These functions are aided by funding for two important resources:
- Pancreatic Cancer Detection Consortium
- Pancreas Tumor SPORE Tissue Bank
IGPBS: Immunology, Pathology and Infectious Disease

This program encompasses microbiology, pathology, immunology, neuroimmunology, and host-pathogen interactions, including basic, clinical, and applied research. These can be grouped into research areas of Immunology and Disease, Molecular Pathogenesis, and Infectious Disease.

Immunology and Disease
- Mechanisms of immune impairment
- Host-pathogen interaction
- Immune aspects of genetic disorders
- Vaccine therapy for cancers
- Cytokine therapies for autoimmune disorders
- Inflammation in neurodegenerative disorders

Infectious Disease
- Host/pathogen interaction and pathogenesis
- Bacterial biofilms
- Microbial metabolism and antimicrobial development
- Mechanisms of HIV pathology
- Enterovirus receptor interactions

Molecular Pathogenesis
- Functional genomics, pathogenesis, and therapies for lymphoma, leukemia, and myeloma
- Epigenetics in malignant lymphoma
- Signal transduction in lymphomagenesis
IGPBS: Integrative Physiology and Molecular Medicine

This umbrella area emphasizes cellular and molecular processes involved in the coordination of organ systems. Research areas fall into several themes:

**Cell Transport and Signaling**
- Transport activities, including ion transport, receptors, and second messenger systems
- Redox signaling
- Ciliary activity

**Mechanisms of Cellular Injury and Fibrogenesis**
- Cellular injury, death, repair, and regeneration
- Ischemia-reperfusion injury
- Nephropathy and cardiomyopathy in diabetes
- Peripheral artery disease
- Alcohol-induced liver disease

**Inflammatory and Autoimmune Processes**
- Lupus nephritis
- Hypertension, obesity, and diabetes
- Inflammatory respiratory disease
- Aortic aneurysm

**Cardiovascular Function**
- Intracellular, neural, and humoral regulation of the heart and vasculature
- Ca+ signaling, stretch receptors, and chemosensitive receptor signaling
- Effects of ischemia on cellular, vascular, and organ function
- Central nervous system mechanisms impacting cardiovascular and renal function

**Therapeutic Strategies**
- Nanoparticle or miRNA delivery
- Contrast microbubble therapeutic ultrasound
- Regeneration of adult skeletal muscle in peripheral artery disease
- Stem cell therapies in cardiomyopathy and neurodegenerative disease
IGPBS: Molecular Genetics and Cell Biology

The focus of this program is on the cellular, molecular, and genetic basis for normal development and disease pathogenesis. The goal of the program is to prepare students for independent careers in research and education. Research in the program falls into four general areas:

**Cancer Cell Biology and Genetics**
- Bioinformatic and genomic analysis, epigenetics, and transcriptomic changes associated with cancer
- Cancer driver genes and mutations

**Developmental Biology**
- Skeletal and neurosensory development
- Hematopoiesis and immune system development
- Mammary gland and ovarian follicle development

**Stem Cells in Disease and Development**
- Cancer stem cells
- Tissue regeneration and induced pluripotent stem cells
- Regulation of hematopoietic and other normal stem cells

**Fundamental Cellular Processes**
- DNA replication and repair, epigenesis, and endocytosis
IGPBS: Neuroscience

At UNMC, neuroscience research falls into four general areas:

**Neurodevelopment and neurosignaling**
This research recognizes the genetic and environmental interactions in brain development and dysfunction at the molecular, cellular, structural, and functional levels. Examples are:
- Cell signaling pathways in brain development
- Molecular mechanisms of developmental disorders
- Regulation of synapse development and neurotransmitter function
- Functional brain imaging in neuropsychiatric disorders

**Behavioral and Cognitive Neuroscience**
Researchers in this area examine brain function in neurological and neuropsychiatric disorders. Examples of research in this area include:
- Role of the immune system in behavior and brain aging
- Motor performance and rehabilitative outcomes of children and adults with neurological disorders
- Molecular, cellular, and electroencephalographic mechanisms of epilepsy and other neurologic disorders

**Biology of Neurological Disorders**
This research focuses on the role of the immune system in neurodegenerative disorders due to infectious or traumatic insults to the brain or genetic disorders, and the development of strategies of treatment. Examples include:
- Nanoparticle therapeutics for HIV infection
- Cytokine and chemokine signaling pathways for neuronal damage and protection
- Role of microRNAs, exosomes, and macrophages in neurodegenerative diseases
- Neurotransmitter receptors and ion channels in AIDS dementia
- Mechanisms of interaction of drug abuse with neurological disorders
- Use of mouse models with humanized tissues to study development and disorders

**Autonomic Neuroscience**
Researchers in this area study the mechanisms through which the brain regulates the function of other systems. Examples of research include:
- Redox modulation in CNS control of cardiovascular disease
- Optogenetic modulation of hypothalamic neuronal function
- CNS dysregulation in renal disease

**Developmental Neuroscience**
Projects focus on the molecular mechanisms regulating the development and function of the brain, particularly with regard to autism, cognitive and neurodevelopmental delays, and communication disorders. Examples include:
- Genetic and molecular regulation of neuronal formation and maintenance of synaptic connections in learning and memory
- Development of neuronal circuits and their alterations in learning
- Influence gene-environment interactions on brain development and function, such as the role of Maternal Immune Activation on autism and neuropsychiatric disorders
- Neurosensory development and regeneration, particularly of the cochlear cells of the inner ear
- Cellular and molecular mechanisms of early brain development
- Development of novel gene-editing tools, such as refinement of CRISPR-Cas methods, to produce precise models for the study of genetic alterations on development.
Medical Sciences Interdisciplinary Area (MSIA)

The MSIA program in the College of Medicine is designed to meet the specific needs of a student who wants to do research that cuts across the usual institutional boundaries, often with a focus on translational research. Students can select advisory committee members from different programs across the University of Nebraska system to develop a curriculum tailored to their interests. There are 5 sub-plans within MSIA:

- Clinically Relevant Basic Research
- Patient-Oriented Research
- Health Practice and Medical Education Research
- Applied Behavior Analysis
- Oral Biology and Cancer
The UNMC College of Pharmacy is ranked #25 nationally according to U.S. News and World Report (2017). Research in the College is focused around drug delivery and targeting, with training in:

- Biophysical chemistry
- Biomaterials nanotechnology
- Nanomedicine
- Biopharmaceuticals
- Pharmacokinetics
- Pharmacodynamics.

Translational aspects are also covered, including the steps needed for drug testing, manufacture, and utilization.

Research in nanomedicine in the College of Pharmacy is driven by the NIH-funded Center for Drug Delivery and Nanomedicine, a Center for Biomedical Research Excellence (COBRE) which coordinates research, mentoring, and shared core facilities.

Research topics of faculty in the College of Pharmacy include:

- *in vitro* and *in vivo* animal models to support ADMET (absorption, distribution, metabolism, excretion, and toxicity) and pharmacokinetic (PK) studies.
- Discovery of biomarkers for hepato-biliary diseases
- Self-assembling polymer materials for drug delivery and gene therapy
- Design of complex multifunctional biomaterials and bioactive small molecules for medicinal applications.
- Molecular imaging and radiotherapeutic agent design
- Novel positive allosteric modulators related to CNS-related therapies
- Molecular mechanisms Alzheimer’s, Parkinson’s and similar protein misfolding diseases
- Micelle and nanoparticulate drug delivery
- Oligonucleotides, siRNA, miRNA and gene delivery
- Fluorescent imaging contrast agents to guide surgical removal of tumors
- Multifunctional nanoparticles for treatment of metastatic cancer and inflammatory conditions
- Antiparasitic drug discovery, particularly antimalarial drug design and synthesis
The Dean’s introduction to the College of Public Health states their mission: “At the UNMC College of Public Health, we are putting knowledge into practice and implementing a new era of public health grounded in social justice, community engagement, innovative public health practices, and public health policies that support community health efforts.” The College offers Ph.D. degrees in five areas:

**Biostatistics**
Collaboration with scientists, clinicians, physicians and clinical investigators in the development of methodological procedures for clinical trials, study design, survival analysis, generalized linear models, longitudinal analysis, survey methodology, and analysis of microarray gene-expression data and other high-dimensional data.

**Environmental Health, Occupational Health, and Toxicity**
Research with emphasis in environmental, agricultural and occupational health involves multi-disciplinary collaborations within and outside the College of Public Health, the UNMC campus, and NU system. This broad approach enables us to tackle difficult issues in order to improve the health of our community, especially rural, agriculture-based communities, both in Nebraska and around the world.

**Epidemiology**
Research in this area covers occupational and environmental hazards, cancer, infectious diseases, perinatal conditions, injuries, mental health, substance abuse, global health and epidemiologic methods.

**Health Promotion and Disease Prevention**
Research in this area of emphasis includes basic and translational research in adolescent risk behaviors, tobacco and substance use, nutrition, physical activity and inactivity, obesity prevention and control, environmental sustainability and health, cross-cultural health and health inequities, maternal and child health, school health, sexual health, social marketing, behavioral economics, consumer behavior, clinical and public health ethics and law, and aesthetic and humanistic influences on health.

**Health Services Research and Administration**
This research focuses on how health care and public health services are financed, organized, and delivered and how public policies affect the health and well-being of both rural and urban populations. The department’s research improves the fairness of payment systems to both providers and consumers, helps health care providers find more cost-effective means of completing their work, contributes to improvement in care by studying the outcomes of care in the “real world” of practice, and translates research into practice and policy to ensure adequate access to quality health care services for all.
Munroe-Meyer Institute for Genetics and Rehabilitation (MMI)

The mission of MMI is to transform the lives of individuals with intellectual and developmental disabilities, and to provide support and education to their families and their community. Faculty members are involved in clinical service, teaching, and research, including basic investigations in developmental neurosciences, such as the genetics of autism and other neurodevelopmental disorders, to applied studies of treatments for disorders of movement, severe behavior, feeding, communication, sleep, pediatric pain and learning. Research leading to the Ph.D. is primarily in three areas:

Center for Autism Spectrum Disorders (CASD)
The CASD and the Psychology Division collaborate to offer a Ph.D. in Applied Behavior Analysis for clinical research and individualized treatment of autism spectrum disorders and severe behavior disorders. Current research areas include:

- Assessment and treatment of severe behavior disorders
- Refining methods to promote skill acquisition in behavioral and feeding disorders
- Enhancing service delivery via web-based communication
- Stimulus control procedures to improve functional communication
- Prevention of relapse of destructive behavior

Physical Therapy and Sensorimotor Learning
Degree programs in Physical Therapy are coordinated with the IGPBS Neuroscience umbrella program. Areas of focus involve the relationship between motor development and the central nervous system through functional imaging such as magnetoencephalography, electroencephalography, diffusion tensor imaging, and functional near infrared spectroscopy:

- Relationship between intensive practice of a motor task and the modulation of sensorimotor cortical oscillations
- Activation of sensorimotor cortices and the fidelity of neural fibers in the thalamocortical and corticospinal tracts
- Influence of different therapy paradigms on mobility, standing postural balance, and neuroplasticity
UNMC MD-PhD Summer Undergraduate Research Program

This summer research program is for individuals that are motivated for success in careers combining medicine and research. Although we are especially interested in undergraduate students who are currently in their sophomore year of college, current freshman and juniors are also encouraged to apply. Some research background may be useful in order to maximize your laboratory experience.

This is a great opportunity for students to discover first-hand the broad spectrum of research activities being performed at the University of Nebraska Medical Center. Not only will students be doing research, but successful applicants will also have the opportunity to shadow physicians. This gives students a chance to not only experience great science but to also experience the doctor/patient relationship side of medicine. We can provide a summer of challenges and exceptional learning experiences.

A wide variety of exciting research projects are available, from studies at the molecular level to patient oriented clinical research and healthcare outcomes research.

The program is ten weeks long and begins the first week of June. Participants are supported by stipends. The benefits include:

- Explore your personal motivation for a career in medicine and biomedical research
- Understand how discoveries made in the laboratory are translated into new methods of prevention, diagnosis, and treatment of human disease
- Present your research project in a professional session
- Become familiar with UNMC and its faculty, students and programs, and let them get to know you and your potential.

The Summer Research Program, like the MD-PhD Scholars Program, is highly competitive, and candidates that are successful in securing a slot in the summer program will have outstanding academic records.

You can apply online to participate in this program. In addition to the application, the student must also submit the following information on-line:

- A one- to two-page essay describing their interest in medicine and research. Be sure to indicate your general (or specific) area of research interest in your essay.
- A current transcript (also include a high school transcript if currently a freshman).
- SAT or ACT scores (required for all applicants).
- At least two letters of reference from faculty members at your current college or university.

The goal is to place students in the areas that interest them the most.

Students in the program will be required to participate in a Summer Undergraduate Research Poster Session. Students, with the help of their faculty advisor, will develop a poster for the session.

For additional information and an on-line application go to: unmc.edu/com/prospective/pre-medical/summer

The deadline for receipt of the application and all additional materials is February 1.
Participating Faculty

This list gives an example of the faculty members who are available as graduate school mentors and/or advisory committee members in the MD-PhD Program. Primary mentors should have an active and productive research program, a record of success in obtaining external funding, and sufficient funds to support the student’s stipend and research. MD-PhD students are encouraged to have at least one clinician on their advisory committee.

- **Abdalla, Maher Y., Ph.D.**, Pathology and Microbiology, College of Medicine
- **Ahmad, Iqbal, Ph.D.**, Ophthalmology and Visual Sciences, College of Medicine
- **Alnouti, Yazen, Ph.D.**, Pharmaceutical Sciences, College of Pharmacy
- **Anderson, Daniel R., M.D., Ph.D.**, Internal Medicine–Cardiology, College of Medicine
- **Anderson, Rebecca, J.D., M.S., C.G.C.**, Health Promotion, Social and Behavioral Health, College of Public Health
- **Anderson Berry, Ann, M.D., Ph.D.**, Pediatrics–Newborn Medicine, College of Medicine
- **Arikkath, Jyothi, Ph.D.**, Developmental Neuroscience, Munroe-Meyer Institute
- **Baccaglini, Lorena, D.D.S., Ph.D.**, Epidemiology, College of Public Health
- **Bailey, Kristina L., M.D.**, Internal Medicine, College of Medicine
- **Band, Hamid, M.D., Ph.D.**, Eppley Cancer Institute
- **Band, Vimla, Ph.D.**, Genetics, Cell Biology and Anatomy, College of Medicine
- **Baranowska-Kortylewicz, Janina, Ph.D.**, Eppley Cancer Institute
- **Batra, Surinder K., Ph.D.**, Biochemistry and Molecular Biology, College of Medicine
- **Baxter, B. Timothy, M.D.**, Surgery, College of Medicine
- **Bayles, Kenneth W., Ph.D.**, Pathology and Microbiology, College of Medicine
- **Bennett, Robert G., Ph.D.**, Internal Medicine–Diabetes, Endocrinology and Metabolism, College of Medicine
- **Bessho, Tadayoshi, Ph.D.**, Eppley Cancer Institute
- **Bevins, Rick, Ph.D.**, Psychology, University of Nebraska-Lincoln
- **Bhakat, Kishor K., Ph.D.**, Genetics, Cell Biology and Anatomy, College of Medicine
- **Bidasee, Keshore R., Ph.D.**, Pharmacology and Experimental Neuroscience, College of Medicine
- **Bierman, Philip, M.D.**, Internal Medicine–Hematology and Oncology, College of Medicine
- **Black, Adrian, Ph.D.**, Eppley Cancer Institute
- **Black, Jennifer D., Ph.D.**, Eppley Cancer Institute
- **Blair, James R, Ph.D.**, Center for Neurobehavioral Research, Boys Town National Research Hospital
- **Boesen, Erika I., Ph.D.**, Cellular and Integrative Physiology, College of Medicine
- **Bonasera, Stephen, M.D., Ph.D.**, Internal Medicine, College of Medicine
- **Borgstahl, Gloria, Ph.D.**, Eppley Cancer Institute
- **Bronich, Tatiana K., Ph.D.**, Pharmaceutical Sciences, College of Pharmacy
- **Buch, Shilpa J., Ph.D.**, Pharmacology and Experimental Neuroscience, College of Medicine
- **Buckley, Shannon, Ph.D.**, Genetics, Cell Biology and Anatomy, College of Medicine
- **Buesing, Keely, M.D.**, Surgery, College of Medicine
- **Byrareddy, Siddappa N., Ph.D.**, Pharmacology and Experimental Neuroscience, College of Medicine
- **Campbell, W. Scott, MBA, Ph.D.**, Pathology and Microbiology, College of Medicine
- **Caplan, Steven H., Ph.D.**, Biochemistry and Molecular Biology, College of Medicine
- **Carlson, Mark, M.D.**, Surgery, College of Medicine
- **Carmines, Pamela K., Ph.D.**, Cellular and Integrative Physiology, College of Medicine
Carson, Steven D., Ph.D., Pathology and Microbiology, College of Medicine

Case, Adam J., Ph.D., Cellular and Integrative Physiology, College of Medicine

Casey, Carol A., Ph.D., Internal Medicine, College of Medicine

Cavaliere, Ercole, DSc, Eppley Cancer Institute

Challagundla, Kishore, Ph.D., Biochemistry and Molecular Biology, College of Medicine

Chatterjee, Monita, Ph.D., Center for Hearing Research, Boys Town National Research Hospital

Chatzizisis, Yiannis, M.D., Ph.D., Internal Medicine-Cardiology, College of Medicine

Cheng, Pi-Wan, Ph.D., Biochemistry and Molecular Biology, College of Medicine

Chittezham Thomas, Vinai, Ph.D., Pathology and Microbiology, College of Medicine

Chowdhury, Sanjib, Ph.D., Biochemistry and Molecular Biology, College of Medicine

Clemens, Dahn, Ph.D., Internal Medicine–Gastroenterology and Hepatology, College of Medicine

Cohen, Samuel M., M.D., Ph.D., Pathology and Microbiology, College of Medicine

Conda-Sheridan, Martin, Ph.D., Pharmaceutical Sciences, College of Pharmacy

Cosgrove, Dominic, Ph.D., Center for Neurosensory Science, Boys Town National Research Hospital

Cowan, Kenneth H., M.D., Ph.D., Eppley Cancer Institute

Datta, Kaustubh, Ph.D., Biochemistry and Molecular Biology, College of Medicine

Davis, John S., Ph.D., Obstetrics and Gynecology, College of Medicine

Desouza, Cyrus, MBBS, Internal Medicine–Diabetes, Endocrinology and Metabolism, College of Medicine

Dhawan, Punita, Ph.D., Biochemistry and Molecular Biology, College of Medicine

Dodd, Michael, Ph.D., Psychology, University of Nebraska-Lincoln

Dong, Jixin, Ph.D., Eppley Cancer Institute

Donohue, Terrence Jr, Ph.D., Internal Medicine–Gastroenterology and Hepatology, College of Medicine

Duan, Bin, Ph.D., Internal Medicine–Cardiology, College of Medicine

Dudley, Andrew T., Ph.D., Genetics Cell Biology and Anatomy/Regenerative Medicine, College of Medicine

Dunaevsky, Anna, Ph.D., Neurological Sciences, College of Medicine

Fey, Paul D., Ph.D., Pathology and Microbiology, College of Medicine

Fisher, Wayne W., Ph.D., Center for Autism Spectrum Disorders, Munroe-Meyer Institute

Fletcher, Courtney V., Pharm.D., College of Pharmacy

Fox, Howard S., M.D., Ph.D., Pharmacology and Experimental Neuroscience, College of Medicine

Fu, Kai, M.D., Ph.D., Pathology and Microbiology, College of Medicine

Garrison, Jered C., Ph.D., Pharmaceutical Sciences, College of Pharmacy

Gao, Lie, M.D., Ph.D., Cellular and Integrative Physiology, College of Medicine

Gebhart, Catherine, Ph.D., Pathology and Microbiology, College of Medicine

Gendelman, Howard E., M.D., Pharmacology and Experimental Neuroscience, College of Medicine
Lutz, Richard, M.D., Pediatrics, College of Medicine
Lyubchenko, Yuri L., Ph.D., DrSc, Pharmaceutical Sciences, College of Pharmacy
MacDonald, Richard, Ph.D., Biochemistry and Molecular Biology, College of Medicine
Macha, Muzafar, Ph.D., Biochemistry and Molecular Biology, College of Medicine
Mahato, Ram I., Ph.D., Pharmaceutical Sciences, College of Pharmacy
Marky, Luis, Ph.D., Pharmaceutical Sciences, College of Pharmacy
McClay, James, M.D., Emergency Medicine/Bioinformatics, College of Medicine
McDonald, Thomas, Ph.D., Pathology and Microbiology, College of Medicine
McMillan, David, Ph.D., Pharmacology and Experimental Neuroscience, College of Medicine
McVicker, Benita, Ph.D., Internal Medicine–Gastroenterology-Hepatology, College of Medicine
Mehta, Parmender P., Ph.D., Biochemistry and Molecular Biology, College of Medicine
Meza, Jane, Ph.D., Biostatistics, College of Public Health
Mikuls, Ted R., M.D., MSPH, Internal Medicine, College of Medicine
Mirnics, Karoly, M.D., Ph.D., Munroe-Meyer Institute
Mishra, Paras Kumar, Ph.D., Cellular and Integrative Physiology, College of Medicine
Mohs, Aaron M., Ph.D., Pharmaceutical Sciences, College of Pharmacy
Monaghan, Daniel T., Ph.D., Pharmacology and Experimental Neuroscience, College of Medicine
Mosley, R. Lee, Ph.D., Pharmacology and Experimental Neuroscience, College of Medicine
Mott, Justin, M.D., Ph.D., Biochemistry Molecular Biology, College of Medicine
Naramura, Mayumi, M.D., Eppley Cancer Institute
Naslavsky, Naava, Ph.D., Biochemistry and Molecular Biology, College of Medicine
Natarajan, Amarnath, Ph.D., Eppley Cancer Institute
Nawy, Scott, Ph.D., Ophthalmology and Visual Sciences, College of Medicine

Neta, Maital, Ph.D., Psychology, University of Nebraska-Lincoln
Norgren, Robert B., Ph.D., Genetics, Cell Biology and Anatomy, College of Medicine
Obaro, Stephen, M.D., Ph.D., Pediatrics, College of Medicine
Oberley-Deegan, Rebecca E., Ph.D., Biochemistry and Molecular Biology, College of Medicine
Olney, Ann Haskins, M.D., Pediatrics, College of Medicine
Osna, Natalia, M.D., Ph.D., Internal Medicine–Gastroenterology and Hepatology, College of Medicine
Ouellette, Michel M., Ph.D., Internal Medicine, College of Medicine
Oupicky, David, Ph.D., Pharmaceutical Sciences, College of Pharmacy
Padanilam, Babu, Ph.D., Cellular and Integrative Physiology, College of Medicine
Patel, Kaushik P., Ph.D., Cellular and Integrative Physiology, College of Medicine
Pavlov, Youri, Ph.D., Eppley Cancer Institute
Pendyala, Gurudutt N., Ph.D., Anesthesiology, College of Medicine
Petrosyan, Armen, M.D., Ph.D., Biochemistry and Molecular Biology, College of Medicine
Pipinos, Iraklis Ilias, M.D., Surgery, College of Medicine
Poluektova, Larisa, M.D., Ph.D., Pharmacology and Experimental Neuroscience, College of Medicine
Ponnusamy, Moorthy P., Ph.D., Biochemistry and Molecular Biology, College of Medicine
Poole, Jill A., M.D., Internal Medicine–Allergy, Immunology, College of Medicine
Porter, Thomas, M.D., Internal Medicine–Cardiology, College of Medicine
Rachagani, Satyayanarayana, Ph.D., Biochemistry and Molecular Biology, College of Medicine
Radhakrishnan, Prakash, Ph.D., Eppley Cancer Institute
Rautiainen, Risto H., Ph.D., Environmental, Agricultural and Occupational Health, College of Public Health
Reid, St. Patrick, Ph.D., Pathology and Microbiology, College of Medicine
Rizzino, Angie A., Ph.D., Eppley Cancer Institute
Rizzo, Matthew, M.D., Neurological Sciences, College of Medicine
Rizzo, William B., M.D., Pediatrics, College of Medicine
Rodabaugh, Kerry, M.D., Obstetrics and Gynecology, College of Medicine
Rogan, Eleanor G., Ph.D., Environmental, Agricultural & Occupational Health, College of Public Health
Romberger, Debra, M.D., Internal Medicine, College of Medicine
Roy, Shyamal K., Ph.D., Obstetrics & Gynecology and Cellular & Integrative Physiology, College of Medicine
Rozanski, George J., Ph.D., Cellular and Integrative Physiology, College of Medicine
Sansom, Steven, Ph.D., Cellular and Integrative Physiology, College of Medicine
Sarvetnick, Nora E., Ph.D., Surgery/Regenerative Medicine, College of Medicine
Scarsi, Kimberly K., Pharm.D., Pharmacy Practice, College of Pharmacy
Schultz, Harold D., Ph.D., Cellular and Integrative Physiology, College of Medicine
Sharp, Graham (John), Ph.D., Genetics, Cell Biology and Anatomy, College of Medicine
Shcherbakova, Polina V., Ph.D., Eppley Cancer Institute
Sherman, Simon, Ph.D., Eppley Cancer Institute
Singh, Amar B., Ph.D., Biochemistry Molecular Biology, College of Medicine
Singh, Dhirendra P., Ph.D., Ophthalmology and Visual Sciences, College of Medicine
Singh, Pankaj Kumar, Ph.D., Eppley Cancer Institute
Singh, Rakesh K., Ph.D., Pathology and Microbiology, College of Medicine
Sisson, Joseph H., M.D., Internal Medicine–Pulmonology, College of Medicine
Smith, Shelley D., Ph.D., Neurological Sciences, College of Medicine
Solheim, Joyce, Ph.D., Eppley Cancer Institute
Sorgen, Paul L., Ph.D., Biochemistry and Molecular Biology, College of Medicine
Stuberg, Wayne, PT, Ph.D., Physical Therapy, Munroe-Meyer Institute
Su, Kaihong, Ph.D., Pathology and Microbiology, College of Medicine
Sun, Keer, Ph.D., Pathology and Microbiology, College of Medicine
Tahirov, Tahir H., Ph.D., Eppley Cancer Institute
Talmadge, James E., Ph.D., Pathology and Microbiology, College of Medicine
Teoh-Fitzgerald, Melissa Lai Tee, Ph.D., Biochemistry and Molecular Biology, College of Medicine
Thayer, Sarah P., M.D., Ph.D., Surgery, College of Medicine
Thiele, Geoffrey M., Ph.D., Internal Medicine–Rheumatology, College of Medicine
Thompson, Austin, M.D., Internal Medicine–Pulmonology, College of Medicine
Thoreson, Wallace B., Ph.D., Ophthalmology and Visual Sciences, College of Medicine
Tibbits, Melissa, Ph.D., Health Promotion, Social and Behavioral Health, College of Public Health
Van Hook, Matthew, Ph.D., Ophthalmology and Visual Sciences, College of Medicine
VanSchooneveld, Trevor, M.D., Internal Medicine–Infectious Disease, College of Medicine
Vennerstrom, Jonathan L., Ph.D., Pharmaceutical Sciences, College of Pharmacy
Vetro, Joseph A., Ph.D., Pharmaceutical Sciences, College of Pharmacy
Viswanathan, Saraswathi, Ph.D., Cellular and Integrative Physiology, College of Medicine
Wang, Cheng, Ph.D., Obstetrics and Gynecology, College of Medicine
Wang, Dong, Ph.D., Pharmaceutical Sciences, College of Pharmacy
Wang, Guangshun (Gus), Ph.D., Pathology and Microbiology, College of Medicine
Wang, Hanjun, M.D., Cellular and Integrative Physiology, College of Medicine
Warren, David, Ph.D., Neurological Sciences, College of Medicine
Watanabe-Galloway, Shinobu, Ph.D., Epidemiology, College of Public Health
Wen, Haitao, Ph.D., Pathology and Microbiology, College of Medicine
Wilson, Tony W., Ph.D., Neurological Sciences, College of Medicine
Windle, John R., M.D., Internal Medicine, College of Medicine
Woods, Nicholas, Ph.D., Eppley Cancer Institute
Xie, Jingwei, Ph.D., Surgery/Regenerative Medicine, College of Medicine
Xiong, Huangui, M.D., Ph.D., Pharmacology and Experimental Neuroscience, College of Medicine
Xiong, Wanfen, M.D., Ph.D., Surgery, College of Medicine
Yan, Ying, Ph.D., Radiation Oncology, College of Medicine
Yelamanchili, Sowmya, Ph.D., Pharmacology and Experimental Neuroscience, College of Medicine
Zheng, Hong, M.D., Cellular and Integrative Physiology, College of Medicine
Zheng, Jialin, M.D., Pharmacology and Experimental Neuroscience, College of Medicine
Zimmerman, Matthew, Ph.D., Cellular and Integrative Physiology, College of Medicine
Zucker, Irving H., Ph.D., Cellular and Integrative Physiology, College of Medicine
The University of Nebraska Medical Center is the premier health sciences training and biomedical research university for the state of Nebraska. UNMC employs almost 5000 individuals and consists of the Colleges of Allied Health, Dentistry, Medicine, Nursing, Pharmacy, and Public Health, as well as the Eppley Institute for Research in Cancer and Allied Diseases in the Fred & Pamela Buffett Cancer Center, and the Munroe-Meyer Institute for Genetics and Rehabilitation. The 148 acre UNMC campus is located in the center of Omaha within a five-minute drive of the downtown and the historic Old Market restaurant and entertainment district.

OMAHA
The Omaha metropolitan area has approximately 950,000 citizens. Omaha is located among the rolling hills along the west bank of the Missouri River and has been rated as one of the Top 10 cities of quality of living due to low living expenses and excellent education system as well as recreational and cultural opportunities such as the Omaha Symphony, Opera Omaha, Joslyn Art Museum, Lauritzen Botanical Gardens, Jazz on the Green, Shakespeare on the Green, College World Series, and the award-winning Henry Doorly Zoo. Omaha is also known for its variety and quality of restaurants and live music venues, and there are numerous free outdoor concerts throughout the summer. Near Omaha are several scenic areas such as the Loess Hills, Fontanelle Forest, DeSoto Bend Wildlife Refuge, the 60-mile Wabash Trace Nature Trail, the 27-mile Keystone Bicycle Trail, and several state parks and recreational areas with lakes and hiking trails.

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Our mission is to lead the world in transforming lives to create a healthy future for individuals and communities through premier educational programs, innovative research and extraordinary clinical care.