



# NEUROSCIENCE

## COURSE CATALOG

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**Required Courses**

**Profiles in Neuroscience Research**

**NS 601 Credit 1**

**Van Bockstaele**

This course introduces first year doctoral students to the research and faculty within the multiple departments of the neuroscience program. Each week the students engage in an hour long research presentation by one or two members of the neuroscience faculty and may subsequently tour their laboratories. The students then write a summary of the faculty member's research and/or a summary of an assigned research paper from that laboratory. At the conclusion of this course, the students have enhanced their scope of neuroscience research-related knowledge and are better equipped to choose their laboratory rotations.



**Research Rotation**

**NS 610, 620, 630 Credits 3**

**Oshinsky**

Prior to the selection of a research advisor for the thesis project, students spend time in laboratories of program faculty, discussing the ongoing research projects and conducting experiments. Student will become familiar with the background literature for the research area and acquire expertise in laboratory techniques.

**Cellular Neurophysiology**

**NS 700 Credits 3**

**O'Leary**

This graduate survey course is designed to introduce students to neurons, the basis of their excitability, and how they interact with one another. The course provides students with an understanding of the molecular players that underlie the generation and modulation of electrical signals, including the basic principles of neurophysiology and neuropharmacology. This is obtained through didactic lectures during two two-hour class sessions per week.

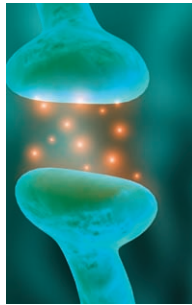
## Required Courses

### Neuroanatomy

NS 530 Credits 4

Grunwald

This graduate level course incorporates lectures, laboratories and case discussions that are designed to introduce students to the organization and function of the human nervous system. The course objective is to provide students with an overall appreciation of human functional neuroanatomy. The course utilizes a regional approach that includes overviews of the organization of the structure and function of human central nervous system components including the spinal cord, brainstem, diencephalon, basal ganglia, cerebellum, and cortex, as well as sensory and motor systems and higher integration.



### Cellular and Molecular Neuroscience

NS 715 Credits 3

Merry

The objective of this course is to provide a detailed analysis of molecular and cellular neuroscience through the combination of didactic lectures and journal article-based discussions. An emphasis will be placed on approaches used to investigate questions in several general areas, including developmental neuroscience, cellular signaling, second messengers and the molecular genetic basis of behavior and disease. The format of this course is one in which lectures and discussion of primary literature expand on and deepen understanding in particular areas of molecular and cellular neuroscience introduced in Cellular Neurophysiology. In addition, a section on molecular genetic control of neurologic function and behavior will introduce new concepts and approaches to the study of neuronal dysfunction and disease. The inclusion of primary literature in the course promotes an understanding of analytical approaches to questions in neuroscience as well as critical scientific thinking. The primary literature also makes more accessible to students many of the techniques used in molecular and cellular neuroscience. Moreover, the combination of didactic and discussion sessions for each topic allows the integration of knowledge acquisition with an analytical assessment of experimental molecular and cellular neuroscience.

### Seminar Series

NS 710, 720, 730 Credit 1

Van Bockstaele

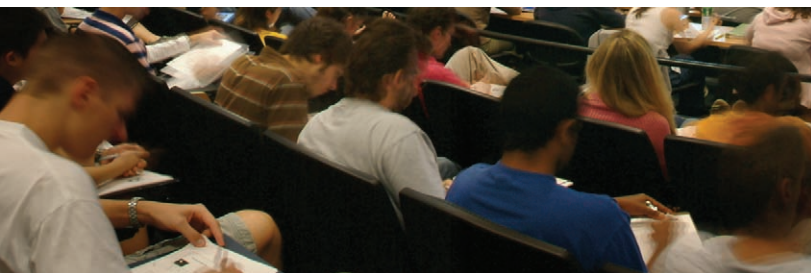
The purpose of this course is to expose graduate students to current topics in neuroscience with oral presentations from faculty from within or outside of the University. Students matriculated into the Neuroscience Graduate Program are required to register for the Neuroscience Seminar. However, the seminar is open to all TJU students, faculty and staff. This seminar series is an excellent forum for students with interest in Neuroscience to get exposed to a diverse range of topics, to observe experienced presenters, and network with TJU neuroscientists as well as invited speakers.

### Journal Club

NS 616, 626, 636 Credit 1

Trotti

The Neuroscience Journal Club is designed to provide a forum for a structured review of extramural research ongoing in the field of Neuroscience. The current format allows for presentations from all members of the TJU neuroscience community, from Professor to technician, from Clinical Neurologist to Neurosurgeon. Students officially registered for the Neuroscience Journal Club, a requirement of the Neuroscience Graduate Program curriculum but open to all TJU students, will be required to present once each semester and will review feedback, collected from the faculty at each presentation, one on one with a faculty member afterwards. This journal club is an excellent forum for students with interest in Neuroscience to get exposed to a diverse range of topics, to observe experienced presenters, and finally to get valuable constructive criticism to help improve their presentation skills.



## Required Courses

### Topics in Translational Neuroscience

NS 725 Credits 2

Van Bockstaele

The objective of this course is to familiarize students with current topics in clinical neuroscience and to provide students with fundamental knowledge of the neurobiology underlying central nervous system diseases. A detailed presentation of the current clinical approaches to treating specific nervous system disorders will be presented. Faculty will discuss basic neuroscience studies that have been successfully implemented in the clinical setting. At the conclusion of the course, students will be poised to more clearly formulate novel hypotheses for the improvement, treatment and prevention of central nervous system disorders. Research papers with a clinical focus or research topics pertaining to “translational” types of approaches will be discussed. The course presumes that students have already taken Cellular Neurophysiology (NS 700) and Neuroanatomy (NS 530).

### Applied Statistics in Neuroscience

NS 740 Credits 2

Sterling

This course serves as a graduate level introduction into applied data analytic strategies focused in the neurosciences. An understanding of hypothesis testing, the relationship of design and analysis, and the interpretation of statistical tests of significance are strongly emphasized. Methods for collecting and organizing study data, including an introduction to data analytic software such as SPSS and SAS, are discussed. The ultimate objective of this course is to provide graduate level neuroscience students with sufficient skill to independently enact various forms of data analysis and become facile in data analytic strategies that range from descriptive to multivariate statistics.

### Research

NS 910, 920, 930

Van Bockstaele

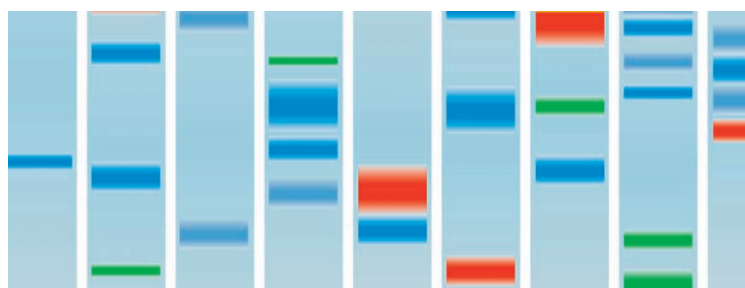
With the guidance and supervision of a member of the neuroscience graduate program faculty and a thesis research committee, the student will develop a research project and acquire the necessary technical expertise to conduct the research project. Research time towards the completion of a doctoral thesis will occupy a dominant part of the student’s time in more advanced years of study.

### Foundations in Biomedical Sciences

GC 550 Credits 10

Ellingson

This course is an entry level course for PhD candidates in the College of Graduate Studies. The course is designed to build on a basic knowledge of biochemistry, genetics, molecular biology and cellular biology. The primary objective of the course is to convey knowledge of the molecular and cellular mechanisms controlling cell, tissue and organ function. This will be accomplished through a longitudinally integrated presentation of material drawn from biochemistry, cell biology, genetics, pharmacology and physiology. A second major objective is to familiarize students with the powerful technologies that are available to today’s research laboratory and currently utilized at Thomas Jefferson University. A final objective is training in the communication of science through informal sessions on evaluation of published literature, scientific writing, oral presentations, and information retrieval.



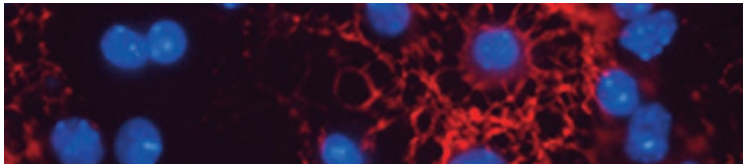
## Required Courses

### Biochemistry and Molecular Biology

BI 525 Credits 3

Hou

This course is the second part of a general course in biochemistry, which covers the basic principles of both prokaryotic and eukaryotic molecular biology. The course focuses on how genetic information is transmitted and expressed on the molecular level. The subject matter includes chromosome structure, DNA replication, repair and recombination, prokaryotic and eukaryotic transcription, RNA splicing, protein synthesis, translation apparatus and mitochondrial genomes.



### Research Ethics

GC 640 Credit 1

Flynn

This graduate seminar course is designed to familiarize students with the ethical dilemmas inherent to the conduct of research. Topics to be discussed include codes of ethical behavior, research design, conflicts of interest, informed consent and the appropriate use of animals. The student will be required to prepare a paper on the analysis of one or more case studies.

## Recommended Electives

### Category 1: Cell and Molecular Biology

#### Advanced Human Genetics

GE 637 Credits 3

Siracusa

This course is focused on the elucidation of molecular principles of human diseases with special emphasis on the diseases that are currently under active investigation utilizing the technologies of molecular biology. It includes a general review of the principles of human diseases and how the major problems posed by these diseases can be experimentally examined. Among the diseases to be covered will be mutations in hemoglobin genes that produce heritable anemias; mutations in the phenylalanine hydroxylase gene that produce phenylketonuria; mutations in the LDL receptor that produce familial hypercholesterolemia; mutations that produce deficiencies of lysosomal enzymes in syndromes such as Krabbe disease; mutations that produce muscular dystrophy; and mutations that produce cystic fibrosis. In addition, there will be an in-depth discussion of the total mapping the human genome and the potentials for gene therapy. Topics will be covered primarily in a seminar format in which students first review original articles from the literature with the faculty and then have a chance to discuss the articles with a visiting scientist who authored one or more of these articles. GC550 is a prerequisite; GE612 is recommended but not required.

#### Advanced Topics in Cell Biology

CB 611 Credits 3

Covarrubias/Joseph

The objective of this course is to teach advanced concepts in topical areas of molecular cell biology. Emphasis is placed on novel and controversial topics. Teaching is based on didactic lectures by several faculty members and presentation / discussion of original literature by the students. Recent topics have included: structure of membrane proteins, signaling complexes, visual signal transduction, membrane trafficking, calcium signaling, systems biology, transcriptional regulation and cell death/apoptosis. Successful completion of GC550 is a pre-requisite for this course. Minimum registration: 5 students

#### Advanced Topics in Virology and Neurovirology

IMP 685 Credits 3

Schnell

This is an advanced course presenting new research findings in the areas of Molecular Virology and Neurovirology and requires basic course work in Microbiology, Immunology, Genetics, and Biochemistry. Topics include important human viral pathogens such as HIV, influenza -, rabies, and measles virus. The purpose of this course is to highlight recent insights into the mechanisms of viral infection and resulting pathology

## Recommended Electives

### Category 1 continued

#### Developmental Biology - Embryology

CB 615 Credits 3

Grunwald

Embryogenesis encompasses development of an organism from fertilization to birth. DB615 will describe the fundamental and historical concepts of morphogenesis and cell differentiation as they pertain to the early embryo, body axis formation, and development and maturation of the major organ systems, including the placenta. Emphasis will be placed on comprehensive descriptions of developmental systems.

#### Fundamentals of Immunology

IMP 505 Credits 4

Korngold

A comprehensive course encompassing the major areas of Immunology: 1) the cells and organs of the immune system; 2) nature of antigens, antibodies, and receptors; 3) lymphocyte activation, proliferation, and differentiation; 4) the major histocompatibility complex; 5) regulation of the immune response; 6) effector mechanisms of immunity; and 7) immunologic mechanisms in disease. The format will involve both

lecture and discussion of specific topics, and students will be encouraged to acquire an understanding of classical and modern immunological concepts through analysis of their experimental bases. Discussion of critical techniques in Immunology will be incorporated throughout the course.

#### Introduction to Molecular Genetics, Part II

GE 612 Credits 3

Landel

This course explores the molecular genetics and functional genomics of the mouse as a model mammalian system. Section I focuses on a brief review of the principles of Mendelian genetics, including equal segregation and independent assortment. Principles governing non-Mendelian inheritance patterns are investigated. Mapping strategies for single gene and polygenic traits in the mouse are also covered. Section II focuses on the development and applications of transgenic and gene targeting technologies to manipulate the mouse genome. This section also focuses on mutagenesis strategies, genomic imprinting and X-inactivation. Section III focuses on selected topics in mouse genetics. The course concludes with summations of different mouse models of a variety of human diseases.

#### Principles of Molecular and Cellular Development

CB 625 Credits 3

Menko

This course will examine specific developmental events in detail, emphasizing contemporary concepts in cellular regulation, growth and pattern formation, differential gene expression, and cell death. Lectures and problem-based discussion groups will explore the rationale behind experimental design as it pertains to investigating principal mechanisms directing normal embryogenesis. This course places particular emphasis on gaining grantsmanship skills.

#### Special Topics in Signal Transduction

PS 650 Credits 2

This course is based on a seminar series to elucidate and integrate various aspects of contemporary knowledge of specific physiological phenomena and their underlying signal transduction mechanisms (offered on demand, minimum registration: three students).

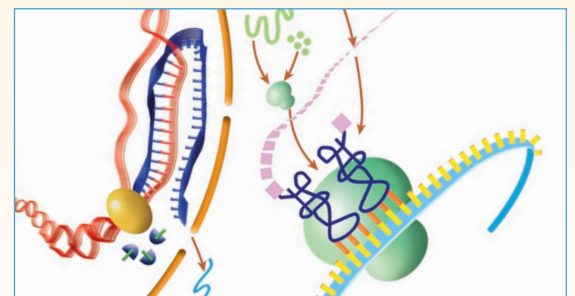
### Category 2: Neuroscience and Physiology

#### Advanced Neurophysiology

PS 634 Credits 2

Horn

This course will examine the function and structure of ion channels found in the plasma membrane of excitable cells (nerves and muscles). Functional studies will stress patch clamp, single channel recording, and heterologous expression of cloned and mutated channel proteins. Structural research will also be discussed. A theoretical introduction to the biophysics of ion channels will be presented, and selected research papers will be presented by the students.



## Recommended Electives

### Category 2 continued

#### Fundamentals of Integrative Physiology

PS 655 Credits 3

Scalia

This three-credit-hour course surveys major mammalian and human physiological systems. Contact time includes three fifty-minute lecture sessions each week. The course introduces major physiological concepts through a systems approach. The human organism is the major topic. However the course will discuss current vertebrate animal models including recent knockout mouse technology, because of their relevance in studying physiology. In addition to classical physiological approaches, frequent references will be made to experimental data from scientific investigations. The aim of the course is not to simply memorize facts, but to also understand and apply concepts. Success in this course involves mastery of the essential concepts presented in lecture or learned in laboratory experimentation as well as the ability to integrate those ideas when problem solving in new situations. Since physiologic phenomena are open to interpretation, various perspectives on the topic under discussion are often presented, e.g. the instructor may present alternative approaches and explanations to the ones found in the course textbook.

#### Neurobiology and Endocrinology

ID 515 Credits 3

McEachron

Advances the student's knowledge of the functional organization of the nervous system and the physiological mechanisms by which the nervous system promotes individual survival. Includes such topics as how sensory information is perceived and transmitted, pattern recognition and central processing of information, learning and memory, and how behavior is generated and organized. Combines this information with basic neurochemistry and neuropharmacology and applies it to an understanding of selected neurological disorders.

#### Neuropharmacology

NS 690 Credits 3

Zhang

This course, in conjunction with "Principles of Clinical Pharmacology", is to provide graduate students with basic knowledge in pharmacology and an understanding of how therapeutic and non-therapeutic drugs affect functions of the central nervous system (CNS). The neuropharmacology course will provide (1) a general overview of the biochemical and electrical properties of CNS; (2) in-depth information on neurotransmitters and their effector systems; and (3) clinical implications of the neurotransmitter systems. Emphasis will be placed on how neurons function and communicate at the molecular and system levels.

### Category 3: Pharmacology

#### General Pharmacology

PR 522 Credits 3

Waldman

This course is an introduction to the basic principles of drug action, including molecular mechanisms, time and dose dependency of drug actions, pharmacokinetics, toxicity, resistance and tolerance, pharmacogenetics, mutagenesis, carcinogenesis, and drug development and evaluation.

#### Introduction to Pharmacology

ID 517 Credits 3

Peterson

Presents an overview and synthesis of the basic mechanisms of drug action and the way in which drugs interact with biological tissue. It emphasizes drug receptors, agonists, and antagonists and the predictability of many drug actions and side effects. It covers areas such as: routes of administration, absorption, distribution and elimination, receptor theory, the nervous system, and each major class of drugs.

#### Molecular Pharmacology

PR 680 Credits 3

Wedegaertner

This course focuses on regulation of cell function through an understanding of hormone, neurotransmitter and drug action at the molecular level. Specific emphasis will be placed on the mechanisms by which cell surface receptors, GTP binding proteins, effector enzymes and ion channels mediate signal transduction in the cell.

#### Principles of Clinical Pharmacology

PR 525 Credits 3

Waldman

The objectives of this course are to present the principles of clinical pharmacology and practical therapeutics, including understanding and application of basic pharmacokinetic principles, basic pharmacodynamic principles, drug regimen design, therapeutic drug monitoring, adverse drug reactions, drug discovery and drug developments, principles of clinical study designs, biostatistics and pharmacology analysis.

#### Special Topics in Ion Channel Biophysics

PS 652 Credits 2

Horn

This course will involve the discussion of current literature on ion channels, primarily those found in excitable cells. Students will critique and present papers to the 'journal club', and will also participate in the presentations of others.

## Recommended Electives

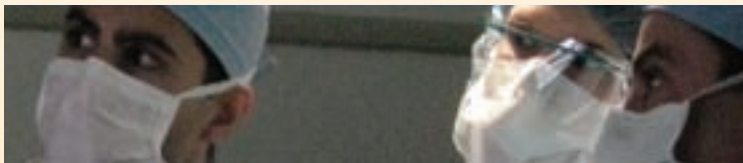
### Category 4: Pathology and Clinical Sciences

#### Clinical Mentorship in the Neurosciences

NS 735 Credits 2

Van Bockstaele

This individualized tutorial will combine Thomas Jefferson University's strength in clinical neuroscience by giving doctoral level graduate students engaged in basic neuroscience research access to the experience and perspective of clinical neuroscience faculty mentors. Each student will meet on a weekly basis with a member of TJU's clinical faculty (e.g., Psychiatry, Neurology or Neurosurgery) to discuss current topics and emerging ideas in clinical neuroscience. The schedule will be determined by the clinical mentor and the graduate student. Where possible, the student will be offered opportunities to observe the clinical activities of the mentor.



#### Fundamentals of Viral Infectious Diseases in the CNS

NS 625 Credits 2

Harshyne

The course will provide students with an introduction to the field of viral infections in the central nervous system. This course is designed to be introductory with a small laboratory component that provides exposure to fundamental experimental approaches in the field of neuroscience and virology. At the conclusion of the course, students will acquire knowledge of a variety of CNS infections, pathobiology of disease and experimental methods in neurovirology.

#### Basic Neuropathology

NS 712 Credits 3

Lopez

This is a graduate lecture course that is designed to introduce students to concepts in pathogenesis, etiology pathology and clinical features of disease affecting the human nervous system. The course will cover the most common diseases affecting the brain and peripheral nervous system, providing an overview of human neuropathology. The emphasis will be on active acquisition of knowledge through independent study of the course textbook and full participation in class and course activities. Case Studies are included to provide clinico-pathological correlations and stimulate visual learning using gross and microscopic examples of disease. In addition, these programs will provide an understanding of the clinical relevance of the major topics under discussion.

#### Pathological Aspects of Disease

CB 570 Credits 3

Fenderson

The course will cover topics in general and systemic pathology, providing an overview of major aspects of human pathology and the pathophysiology of major diseases. Lectures supplemented with computer module containing case studies, clinical correlations and self-assessment components.

#### Pathogenesis

IMP 530 Credits 2

Pellini

Provides students with a framework of understanding of the complex set of interactions between bacteria and the hosts they colonize and infect. After completing this course, the students should be familiar with the myriad of mechanisms, physical and biochemical, that bacteria employ and the effects of these factors on their human hosts. This course should serve as the foundation for understanding the process of infectious diseases.

### Category 5: Additional Electives

#### Planning and Writing a Research Grant

GC 730 Credit 1

Grunwald

This course is designed to provide students with instruction and practical experience in the art of planning and writing a research grant proposal. Students will become familiar with the structure of a research grant, including the development of the major sections of a grant proposal such as specific aims, background and significance, and experimental design. Development of the experimental design section will include approaches to discussion of experimental rationale, detailed research methods, expected results and interpretations, and potential pitfalls and alternatives. Students will also learn about the peer review process and how to critique a grant proposal. NIH-style grants will serve as the model for this course, although the general principles of grant organization and writing will be applicable to all research grants. Students will gain practical experience by sequential production of three written documents: (1) an NIH-style Specific Aims Page, (2) a Research Plan based upon expansion and development of one specific aim, and (3) an NIH-style critique of a grant proposal.

## Program of Study

Fall/Year 1		
GC 550	Foundations in Biomedical Sciences	10
NS 601	Profiles in NS Research Class	1
NS 710	Seminar Series	1
NS 616	Journal Club	1
NS 610	Research Rotation	3
NS 910	Research	var
Spring I/Year 1		
NS 700	Cellular Neurophysiology	3
BI 525	Biochemistry and Molecular Biology	3
NS 720	Seminar Series	1
NS 626	Journal Club	1
NS 620	Research Rotation	3
NS 920	Research	var
Spring II/Year 1		
NS 715	Cell and Molecular Neuroscience	3
NS 530	Neuroanatomy	3
NS 730	Seminar Series	1
NS 636	Journal Club	1
NS 630	Research Rotation	3
NS 920	Research	var
Summer/Year 1		
NS 930	Research	var

Fall/Year 2		
NS 725	Topics in Translational Neuroscience	2
—	Elective	2-3
NS 710	Seminar Series	1
NS 616	Journal Club	1
NS 910	Research	var
Spring I/Year 2		
GC 640	Research Ethics	1
—	Elective	2-3
NS 720	Seminar Series	1
NS 626	Journal Club	1
NS 920	Research	var
Spring II/Year 2		
NS 690	Neuropharmacology	3
NS 740	Applied Statistics in Neuroscience	3
NS 730	Seminar Series	1
NS 636	Journal Club	1
NS 920	Research	var
Summer/Year 2		
NS 930	Research	var
Comprehensive Examination		

## Recommended Electives

### Category 1: Cell and Molecular Biology

Advance Human Genetics  
Advanced Topics in Cell Biology  
Advanced Topics in Virology and Neurovirology  
Developmental Biology – Embryology  
Fundamentals of Immunology  
Introduction to Molecular Genetics, Part II  
Principles of Molecular and Cellular Development  
Special Topics in Signal Transduction

### Category 2: Neuroscience and Physiology

Advance Neurophysiology  
Fundamental of Integrative Physiology  
Neurobiology and Endocrinology  
Special Topics in Ion Channel Biophysics

### Category 3: Pharmacology

General Pharmacology  
Introduction to Pharmacology  
Molecular Pharmacology  
Principles of Clinical Pharmacology

### Category 4: Pharmacology

Clinical Mentorship in the Neuroscience  
Fundamentals of Viral Infectious Diseases in the CNS  
Basic Neuropathology  
Pathological Aspects of Disease  
Pathogenesis

### Category 5: Additional Electives

Planning and Writing a Research Grant

## Checklist: 4 Year Overview

### Year One

- Choose a Research Advisor (by June 30th)

### Year Two

- Form Research Committee (by beginning of 3rd Year)
  - \_\_\_ Research advisor
  - \_\_\_ Two other members of the Neuroscience Graduate Program
  - \_\_\_ One representative from another degree program or university
- Submit names of Research Committee members to the Director of the Graduate Program
- Following formation of Research Committee, must meet a minimum of two times yearly
- Complete Comprehensive Examination (by start of fall semester of Third Year)

### Year Three

- Submit Thesis Proposal during fall semester (no later than 12/01)
- Credits: A total of 180 credits including research are required to obtain a Ph.D.
  - \_\_\_ Must have 54 credits of formal graduate course work.
  - \_\_\_ 18 credits must be outside of the primary discipline.

### Year Four

- May occur no less than 12 months after formal approval (in writing) of Research Proposal by student's Research Committee
- Must submit Research Committee-approved dissertation to the Dean of the College of Graduate Studies and each member of the Final Defense of Thesis Committee no less than three weeks in advance of Thesis Defense
- Must make public announcement of Thesis Defense no less than one week prior to scheduled date of defense
- Following successful defense of dissertation, must submit original bound dissertation, an additional bound copy, and one unbound copy to the office of the Dean of the College of Graduate Studies

### For further information, please contact:

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