

# PH.D IN BIOMEDICAL SCIENCE - NEUROSCIENCE & NEUROLOGICAL DISORDERS TRACK

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The combination of molecular biology and genetics with modern neuroanatomical techniques is transforming both our ability to examine and to understand the nervous system. Ongoing research by the faculty in the Neurosciences and Neurological Disorders graduate program is providing insights into neurotransmission, sensory system function, development and plasticity of the nervous system, regeneration and repair following neural damage, the basis of neural disease, and behavior. As one of five biomedical science degree programs in the University of Toledo, College of Medicine & Life Sciences, the Neurosciences and Neurological Disorders program is an interdisciplinary course of studies whose primary goal is to train students for independent, creative careers in biomedical research and/or teaching. The program currently awards PhD in biomedical sciences degree and participates in the MD/PhD combined degree programs. Nationally-recognized, NIH-funded Neuroscience faculty who serve as research mentors are drawn from a number of departments including: Neurosciences, Neurology, Physiology and Pharmacology, Otolaryngology, Psychiatry and Radiation Therapy.

Modern, state-of-the-art research laboratory and core facilities are available through the program and these participating departments.

The Neurosciences and Neurological Disorders training program at the University of Toledo on the Health Science Campus offers the PhD, or MD/PhD degrees through the interdisciplinary degree programs in Biomedical Sciences. The primary goal of the doctoral program in Neurosciences and Neurological Disorders is to train students for independent, creative careers in research and/or teaching. The curriculum for the PhD degree consists of a core of concentrated course work in the first year, followed by specialized elective courses and an emphasis on laboratory research. Elective courses are offered in developmental and systems neuroscience, as well as ion channel function, sensory physiology, and neuropharmacology. During the first two semesters, each student rotates through three research laboratories, conducting short-term projects, gaining exposure to techniques and identifying potential areas for further investigation. During the second semester, each student selects a major advisor who directs the student's doctoral research. A faculty committee is also jointly chosen by the student and advisor to supervise academic progress toward completion of the PhD degree. In addition to 90 credit hours in didactic and other courses, PhD students are required to successfully pass a qualifying exam that consists of independently writing and defending a research dissertation.

**\* MSBS in Neuroscience and Neurological Disorders is not currently offered**

The minimum number of credits required for PhD is 90, with a minimum of 20 credits of didactic coursework (letter grade), and a minimum of

30 credits of dissertation research. The rest of the credits are approved electives and research in the NND track.

Code	Title	Hours
FIRST TERM		
		9 credits
Introduction to Biomedical Research <sup>1</sup>		
		0
Current Problems and Research Approaches (CPRA) in:		
BMSP 6330	Current Problems and Research Approaches in Proteins	2
BMSP 6340	Curr Prob Res App Genes/Genom	2
BMSP 6360	Current Problems and Research Approaches in Cell Membranes	2
BMSP 6380	Methods in Biomedical Sciences	2
BMSP 6390	Mentored Research	1
SECOND TERM		
		9 credits
BMSP 6350	Cell Biology & Signaling	3
BMSP 6390	Mentored Research	1
BMSP 6470	System Pathophysiology	4
NNDP 6500	Seminar in Neuroscience	1
THIRD TERM		
		6 credits
BMSP 5320	Statistical Methods I	3
INDI 6020	On Being a Scientist	1
NNDP 6730	Research in NNDP	1-3
FOURTH TERM		
		9 credits
NNDP 6560	Readings in Neuroscience	1-4
NNDP 6720	Current Topics in Neuroscience	1-4
BIOE 5620	Cellular Electrophysiology	3
NNDP 6730	Research in NNDP	1-4
FIFTH TERM		
		9 credits
NNDP 8500	Seminar in Neuroscience	1
NNDP 8540	Jrnl Paper Review Neuroscience (if offered) <sup>1</sup>	0 or 2
NNDP 8720	Current Topics in Neuroscience	1-4
INDI 8790	Basic and Adv Light Microscopy (elective)	0 or 4
INDI 8860	Electron Microscopy (elective)	0 or 4

BMSP 8250	Grant Writing Workshop (elective)	0
		or
		2
NNDP 9990	Dissertation Research in NNDP	1-5
<b>Code</b>	<b>Title</b>	<b>Hours</b>
SIXTH TERM		6
		credits
NNDP 9990	Dissertation Research in NNDP	6
<b>Code</b>	<b>Title</b>	<b>Hours</b>
SEVENTH TERM		9
		credits
NNDP 9990	Dissertation Research in NNDP	9
<b>Code</b>	<b>Title</b>	<b>Hours</b>
EIGHTH TERM		9
		credits
NNDP 8500	Seminar in Neuroscience	1
NNDP 9990	Dissertation Research in NNDP	8
<b>Code</b>	<b>Title</b>	<b>Hours</b>
NINTH TERM		6
		credits
NNDP 9990	Dissertation Research in NNDP	6

<sup>1</sup> Required**PhD Program Students: Year 4 and Beyond**

Code	Title	Hours
	Fall/Spring Term (9 credits each, Summer (6 credits)	
NNDP 9990	Dissertation Research in NNDP	6-9

**PhD Program Students: Year 5 and Beyond**

Code	Title	Hours
	Fall, Spring and Summer Semesters (1 credit all semesters)	
NNDP 9990	Dissertation Research in NNDP	1

The minimum number of credits required for PhD is 90, with a minimum of 20 credits of didactic coursework (letter grade), and a minimum of 30 credits of dissertation research. The rest of the credits are approved electives and research in the NND track.

Code	Title	Hours
FIRST TERM		9
		credits
	Introduction to Biomedical Research <sup>1</sup>	0
	Current Problems and Research Approaches (CPRA) in:	
BMSP 6330	Current Problems and Research Approaches in Proteins	2
BMSP 6340	Curr Prob Res App Genes/Genom	2
BMSP 6360	Current Problems and Research Approaches in Cell Membranes	2

BMSP 6380	Methods in Biomedical Sciences	2
BMSP 6390	Mentored Research	1

Code	Title	Hours
	SECOND TERM	9
		credits

BMSP 6350	Cell Biology & Signaling	3
BMSP 6390	Mentored Research	1
BMSP 6470	System Pathophysiology	4
NNDP 6500	Seminar in Neuroscience	1

Code	Title	Hours
	THIRD TERM	6
		credits

BMSP 5320	Statistical Methods I	3
INDI 6020	On Being a Scientist	1
NNDP 6730	Research in NNDP	1-3

Code	Title	Hours
	FOURTH TERM	9
		credits

NNDP 6560	Readings in Neuroscience	1-4
NNDP 6720	Current Topics in Neuroscience	1-4
BIOE 5620	Cellular Electrophysiology	3
NNDP 6730	Research in NNDP	1-4

Code	Title	Hours
	FIFTH TERM	9
		credits

NNDP 8500	Seminar in Neuroscience	1
NNDP 8540	Jrnl Paper Review Neuroscience (if offered) <sup>1</sup>	0
		or
		2

NNDP 8720	Current Topics in Neuroscience	1-4
INDI 8790	Basic and Adv Light Microscopy (elective)	0
		or
		4

INDI 8860	Electron Microscopy (elective)	0
		or
		4
BMSP 8250	Grant Writing Workshop (elective)	0
		or
		2

NNDP 9990	Dissertation Research in NNDP	1-5
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Code	Title	Hours
	SIXTH TERM	6
		credits
NNDP 9990	Dissertation Research in NNDP	6

Code	Title	Hours
SEVENTH TERM		
		9 credits
NNDP 9990	Dissertation Research in NNDP	9

Code	Title	Hours
EIGHTH TERM		
		9 credits
NNDP 8500	Seminar in Neuroscience	1
NNDP 9990	Dissertation Research in NNDP	8

Code	Title	Hours
NINTH TERM		
		6 credits
NNDP 9990	Dissertation Research in NNDP	6

<sup>1</sup> Required

### PhD Program Students: Year 4 and Beyond

Code	Title	Hours
Fall/Spring Term (9 credits each, Summer (6 credits)		
NNDP 9990	Dissertation Research in NNDP	6-9

### PhD Program Students: Year 5 and Beyond

Code	Title	Hours
Fall, Spring and Summer Semesters (1 credit all semesters)		
NNDP 9990	Dissertation Research in NNDP	1

#### First-Year Core Curriculum SLOs

1. Identify and summarize the structure and function of cells, tissues, and organs.

2. Describe the molecular, biochemical, and cellular mechanisms that maintain the normal function, development, and plasticity of cells, tissues, and organs.

3. Summarize basic disease causes and processes that affect the structure and function of cells, tissues, and organs.

4. Assess and critically analyze relevant basic science and clinical literature.

5. Design and conduct applicable biomedical sciences experiments.

6. Organize, interpret and summarize results of applicable biomedical sciences experiments.

7. Demonstrate ethical and responsible conduct in research and all other scholarly activities consistent with the University of Toledo, Health Science Campus, Standards of Conduct (Policy 01-027).

Part I: A NND graduate of Ph.D. will be knowledgeable

K1 Knowledge of normal structure and function of the body and its major organ systems, with emphasis on the peripheral and central nervous system.

K2 Knowledge of molecular, biochemical, and cellular mechanisms which are important in homeostatic maintenance of normal nervous system function.

K3 Knowledge of the basic neurophysiology of excitable membranes.

K4 Knowledge of neurophysiological basis of behavior in health and disease.

K5 Knowledge of classical and contemporary models of changes in nervous system function in response to changes in intrinsic or extrinsic environmental stimuli throughout the lifespan.

K6 Knowledge of nervous system structure and function in normal and disease states as studied with contemporary techniques and related translational research approaches.

K7 Knowledge of pathophysiology of prominent neurological disorders (e.g., cognitive disorders, movement disorders, neurodevelopmental disorders, seizure disorder, substance use disorders).

K8 Knowledge of basic principles of pharmacology (drug action) and pharmacology of specific drugs and toxins used in basic neuroscience research, in vivo and in vitro, and in the treatment of prominent neurological disorders.

K9 Knowledge of the use of statistical methods in the appropriate design, analysis and interpretation of research projects.

K10 Knowledge of tech principles that govern ethical and legal decision making in the design and conduct of research projects, and the accurate reporting of the results.

K11 Knowledge of the various approaches to the organization and financing of biomedical research projects.

Part II: A NND graduate Ph.D. will be skilled

S1 The ability to perform selected basic laboratory procedures that are commonly used in the laboratories of most track faculty.

S2 The ability to perform advanced/specialized procedures that are necessary for the completion of the student's assigned dissertation research projects (s).

S3 The ability to design and complete independent research projects, and the ability to perform productively as a member of a research team.

S4 The ability to communicate effectively, both orally and in writing, with colleagues, faculty, scientific journal editors/reviewers, and research granting agencies.

S5 The ability to retrieve (from electronic databases and other sources), manage, and utilize biomedical information for solving problems that are relevant to the appropriate completion of a research project, and the accurate reporting of the results.

Part III: A NND graduate Ph.D. will be professional

P1 Ethical, responsible, reliable, and dependable behavior in all aspects of their professional lives, and a commitment to the profession and to society.

P2 Honesty and integrity in all interactions with colleagues, research subjects, and others with whom students may interact in their professional lives.

P3 Professionalism in dress and grooming related to compliance with health and safety rules applicable to research laboratories, and other research sites.

P4 Compassionate treatment of patients as subjects of research, and respect for their privacy and dignity.

P5 Compassionate treatment of experimental animals, and respect for all laws and regulations applicable to the use of animals in biomedical research.