

DEPARTMENT OF NEUROSCIENCE, DEVELOPMENTAL AND REGENERATIVE BIOLOGY

Mission Statement

The mission of the Department of Neuroscience, Developmental and Regenerative Biology is to conduct high impact, internationally recognized research and to educate and train the next generation of leaders in biological sciences. As a department of neuroscientists, and developmental and regenerative biologists, we focus on understanding organismal, tissue and cellular function from molecules to behavior in health and disease.

General Information

The Department of Neuroscience, Developmental and Regenerative Biology study key questions relating to how the brain works in normal and disease states (neuroscience) and how cells and tissues are formed, maintained, and repaired (developmental and regenerative). Collectively and collaboratively, we seek to learn, investigate, and communicate knowledge in these fields. Our diverse and recognized faculty and state-of-the-art laboratory facilities provide students with opportunities for personal interaction, mentorship, and undergraduate research projects.

Neuroscience

Neuroscience research at UTSA is interdisciplinary and explores neural function from molecules to cells to neural networks to behavior. Students will find a highly collaborative atmosphere across the department. Our neuroscience laboratories employ behavioral, cellular, computational, developmental, and molecular approaches to answer questions associated with neural function. Many of our faculty are leading investigators attempting to understand debilitating brain diseases, including Alzheimer's Disease, Parkinson's Disease, and Epilepsy. Students also can participate in various neuroscience-related activities supported by the UTSA Neurosciences Institute and UTSA's Brain Health Consortium, including weekly seminar and special seminar programs. Undergraduate study in the neurosciences is directly supported through a Bachelor of Science (B.S.) in Neuroscience degree and a Minor in Neuroscience.

Developmental and Regenerative Biology

Faculty and students in the areas of **Developmental and Regenerative Biology** study a wide range of questions relating to stem cells, cancer and cell cycle regulation, tissue regeneration, epigenetic regulation of cell fate and function, gene expression, fertility, and "Disease-in-a-Dish" models, including "organoid" systems. State-of-the-art technologies include genomics, epigenomics, proteomics, cell sorting, and cell imaging. A wide range of lecture courses are available to undergraduate students in Developmental and Regenerative Biology, along with opportunities for seminar classes, independent study, and directed research. Many of our faculty and students are associated with UTSA's Institute of Regenerative Medicine, a joint collaborative initiative between UTSA's Colleges of Engineering and Sciences, and multiple research institutions in San Antonio. Undergraduate students with interests in Developmental and Regenerative Biology are encouraged to attend a weekly Cell and

Molecular Biology seminar series that frequently highlights research in this area.

Degrees

Neuroscience is the interdisciplinary study of the nervous system across various levels – from molecules, to cells, through circuits, and behavior. Neuroscience represents a unique academic field, requiring students to understand and utilize a diverse knowledge base across multiple disciplines. The Department of Neuroscience, Developmental and Regenerative Biology offers a B.S. degree in Neuroscience and a Minor in Neuroscience for an interdisciplinary undergraduate experience for students interested in how the brain works.

The B.S. in Neuroscience curriculum is conceptually structured around i) an interdisciplinary foundation in the biological, psychological, and computational sciences, ii) a broad scope of electives for students to individualize their degree or pursue one of three neuroscience concentrations (Behavioral, Molecular, and Pre-medical), and iii) opportunities for research/practical experience. At its foundation, all students will take an introductory course in Neuroscience (Introduction to Neuroscience), Biology (Biosciences I), and Psychology (Introduction to Psychology). In subsequent years all students will take an upper-division class and laboratory in Neurobiology. Their first two years will also include a strong set of required courses in the sciences, math, and statistics. The remaining two years of the program is designed for the student to explore neuroscience across a wide range of disciplines, along with free electives, allowing for maximum flexibility in their chosen program of study. The B.S. in Neuroscience degree prepares students for careers in neuroscience-related fields, graduate-level study in masters and doctoral-level programs, and medical and dental school. Because of the broad training afforded by this program, graduates may find employment in many industries, including companies or government agencies associated with public health, biomedical engineering, education, psychology, and research.

The Minor in Neuroscience provides formal recognition for students who have focused a significant portion of their academic work in the interdisciplinary area of neuroscience. The minor can accommodate majors from all other departments.

Studies in Developmental and Regenerative Biology

The department offers several classes with a focus on biological principles of mammalian/human development, maintenance, and repair, from fertilized egg throughout adulthood. Students wishing to earn an undergraduate degree specializing in these fundamental questions can seek a B.S. in Biology with a Concentration in Cell and Molecular Biology from the Department of Integrative Biology, including courses in this area within the concentration's program of study.

Student Success

The Department and Faculty supporting the B.S. in Neuroscience and Minor in Neuroscience, and B.S. in Biology with a Concentration in Cell and Molecular Biology, are committed to championing and developing the next generation of Neuroscience, Developmental and Regenerative Biology students at UTSA through multiple avenues of engagement and academic support. In addition to an innovative academic program, opportunities for participation in cutting-edge research, a vibrant "student-life", and strong priorities of inclusion will foster student accomplishment within prestigious programs of study.

Health Careers Pathways

The Department of Neuroscience, Developmental and Regenerative Biology offers programs that supports students interested in pursuing professional or graduate programs (e.g., medical, dental, pharmacy and veterinarian) in health-related professions. See the Degrees (p. 2) page for more information. Students can also visit the UTSA Health Professions office (<https://www.utsa.edu/healthprofessions/>) for more information.

Sophomore Biology Research Initiative (SBRI)

The Sophomore Biology Research Initiative offers eligible second-year students to engage in authentic research with faculty and graduate students while earning academic credit. The opportunity to be part of the SBRI is limited, students should register early. See the Degrees (p. 2) page for more information about SBRI.

- B.S. degree in Neuroscience (p. 2)
 - Concentration in Behavioral Neuroscience (p. 3)
 - Concentration in Molecular Neuroscience (p. 3)
 - Concentration in Pre-Medical Neuroscience (p. 3)

Bachelor of Science Degree in Neuroscience

The B.S. in Neuroscience is an interdisciplinary degree that will provide students the opportunity to pursue an integrated course of study in Neuroscience. Neuroscience represents a unique academic field in that it requires students to understand and utilize a set of diverse knowledge from multiple disciplines. Neuroscience impacts almost all areas of science and business, and this degree is intended to prepare students for a wide range of careers in this area.

A minimum number of 120 semester credit hours is required for the B.S. in Neuroscience, including 42 hours of Core Curriculum requirements. Thirty-nine of the total semester credit hours required for the degree must be at the upper-division level. All major and support work courses, and required prerequisites, must be completed with a grade of "C-" or better.

Program Outcomes

Graduates of the B.S. in Neuroscience program will be able to:

- Communicate across the biological, psychological, and computational sciences.
- Identify and explain fundamental concepts in molecular neuroscience, cellular neurophysiology and signaling, neuroanatomy, neural information processing, and behavior.
- Develop and conduct appropriate experimentation, analyze and interpret data, and use judgment to draw conclusions.

Sophomore Biology Research Initiative

Students may apply to participate in the Sophomore Biology Research Initiative. After acceptance, students will take NDRB 2953 Special Topics in two consecutive semesters during their sophomore year after completing their first 30 hours. Students should apply after their first semester. A total of six hours will be completed. Several different research topics will be available to choose from. There will be approximately two hours of lecture/lab meeting and six hours of lab work per week. Students will present their final data in poster format at an

organized symposium. The opportunity to be part of the SBRI is limited, so students should register early.

Core Curriculum Requirements (42 semester credit hours)

Students seeking the B.S. degree in Neuroscience must fulfill University Core Curriculum requirements in the same manner as other students. The courses listed below satisfy both degree requirements and Core Curriculum requirements; however, if these courses are taken to satisfy both requirements, then students may need to take additional courses in order to meet the minimum number of semester credit hours required for this degree.

- MAT 1193 may be used to satisfy the core requirement in Mathematics as well as a major requirement.
- PSY 1013 may be used to satisfy the core requirement in Social and Behavioral Sciences as well as a major requirement.
- BIO 1203 & PHY 1943 may be used to satisfy the core requirement in Life and Physical Sciences, as well as major requirements.
- CS 1173 may be used to satisfy the core requirement in Component Area Option as well as a major requirement.

Core Curriculum Component Area Requirements (<http://catalog.utsa.edu/undergraduate/bachelorsdegreeregulations/degreerequirements/corecurriculumcomponentarearequirements/>)

First Year Experience Requirement	3
Communication	6
Mathematics	3
Life and Physical Sciences	6
Language, Philosophy and Culture	3
Creative Arts	3
American History	6
Government-Political Science	6
Social and Behavioral Sciences	3
Component Area Option	3
Total Credit Hours	42

Degree Requirements

Code	Title	Credit Hours
A. Foundation Courses		
1. Required Biology Courses		
BIO 1203	Biosciences I for Science Majors	3
BIO 1201	Biosciences I Laboratory for Science Majors	1
BIO 2313	Genetics	3
2. Neuroscience required courses		
NDRB 2113	Introduction to Neuroscience	3
NDRB 3433	Neurobiology	3
NDRB 3442	Neurobiology Laboratory	2
PSY 1013	Introduction to Psychology	3
3. Math requirement		
MAT 1193	Calculus for the Biosciences	3
4. Data Analysis - pick one of the following		
CS 1063	Introduction to Computer Programming I	3
CS 1173	Data Analysis and Visualization	

DS 4003	Introduction to Data Science	
DS 4013	Programming for Data Science	
5. Chemistry Requirements		
CHE 1103	General Chemistry I	3
CHE 1121	General Chemistry I Laboratory	1
CHE 1113	General Chemistry II	3
CHE 1131	General Chemistry II Laboratory	1
6. Statistics		
STA 1403	Probability and Statistics for the Biosciences	
or PSY 2073	Statistics for Psychology	
7. Physics. Select from one of the following options:		
Option 1		
PHY 1603	Algebra-based Physics I	
PHY 1611	Algebra-based Physics I Laboratory	
Option 2		
PHY 1943	Physics for Scientists and Engineers I	
PHY 1951	Physics for Scientists and Engineers I Laboratory	
B. Support Courses		
1. Neuroscience. Select eight of the following:		24
NDRB 3213	Animal Behavior	
NDRB 3453	Neuroscience and Our Future	
NDRB 3463	Brain Diseases	
NDRB 3623	Neuropsychopharmacology	
NDRB 4483	Developmental Neuroscience: From Zygote to Brain Circuits	
NDRB 4583	Emergent Properties of Neural Circuits	
NDRB 4683	Neural Data Science	
NDRB 4783	Computational Neuroscience	
NDRB 4813	Brain and Behavior	
NDRB 4823	Cognitive Neuroscience	
or PSY 4343	Cognitive Neuroscience	
NDRB 4913	Independent Study	
NDRB 4923	Laboratory Research	
NDRB 4953	Special Studies	
2. Additional Electives. Select four of the following:		12
Courses not taken in B.1 (above) can be taken as Additional Electives		
NDRB 3813	Cell Biology	
BIO 3513	Biochemistry	
or CHE 3313	Biochemistry I	
NDRB 3913	Molecular Biology	
PSY 2503	Developmental Psychology	
PSY 2513	Abnormal Psychology	
PSY 2563	Cognitive Psychology	
PSY 3153	Sensation and Perception	
PSY 3403	Experimental Psychology	
PSY 4253	Psychology of Health	
STA 3003	Applied Statistics	
STA 3013	Multivariate Analysis for the Life and Social Sciences	
PHI 3033	Philosophy of Science	
PHI 3083	Philosophy of Mind	

PHI 3203	Biomedical Ethics	
C. Free Electives		
Select 12-18 semester credit hours of free electives, depending on the student's choice of Core Courses, to complete 120 hours, including a minimum requirement of 39 upper-division semester credit hours.	12-18	
Total Credit Hours		87-93

Concentrations

The Department of Neuroscience, Developmental and Regenerative Biology, within the B.S. in Neuroscience degree, offers three areas of concentration. To declare a concentration or obtain advice, students should consult an undergraduate academic advisor in the Life and Health Sciences Advising Center. To receive credit for a concentration, students must successfully complete all requirements for the B.S. degree, along with the requirements for the respective concentration. Students who do not successfully complete all courses of a given concentration area will receive a standard B.S. degree in Neuroscience.

Concentration in Behavioral Neuroscience

The coursework within the Behavioral Neuroscience concentration must be completed with a minimum cumulative grade point average of 3.0 or better. Students are also encouraged to enroll in NDRB 4923 Laboratory Research as part of their program of study.

Code	Title	Credit Hours
Select four of the following:		
NDRB 3213	Animal Behavior	
NDRB 4823	Cognitive Neuroscience	
NDRB 4923	Laboratory Research	
PSY 3153	Sensation and Perception	
PSY 3403	Experimental Psychology	
PSY 2563	Cognitive Psychology	
Total Credit Hours		12

Concentration in Molecular Neuroscience

The coursework within the Molecular Neuroscience concentration must be completed with a minimum cumulative grade point average of 3.0 or better. Students are also encouraged to enroll in NDRB 4923 Laboratory Research as part of their program of study.

Code	Title	Credit Hours
NDRB 3913	Molecular Biology	3
Select three of the following:		
NDRB 3813	Cell Biology	
NDRB 4143	Developmental Biology	
NDRB 4453	Endocrinology	
NDRB 4923	Laboratory Research	
BIO 3413	General Physiology	
BIO 3513	Biochemistry	
Total Credit Hours		12

Concentration in Pre-Medical Neuroscience

The B.S. degree in Neuroscience with a concentration in Pre-Medical Neuroscience is designed to prepare students for professional programs in medicine. This concentration has a recommended curriculum that is designed to meet the requirements for entry medical school and to

prepare students for the MCAT examination. For completion of the Pre-Medical Neuroscience Concentration students must have both an overall math/science GPA of 3.5 or higher, and complete all required coursework within the concentration with a minimum GPA of 3.5 or higher. All candidates for the concentration in Pre-Medical Neuroscience must complete the following:

Code	Title	Credit Hours
CHE 2603	Organic Chemistry I	3
CHE 2612	Organic Chemistry I Laboratory	2
CHE 3643	Organic Chemistry II	3
Biochemistry - Select one of the following:		3
BIO 3513	Biochemistry	
CHE 3313	Biochemistry I	
Select one of the two Physics options:		4
Option 1		
PHY 1623	Algebra-based Physics II	
PHY 1631	Algebra-based Physics II Laboratory	
Option 2		
PHY 1963	Physics for Scientists and Engineers II	
PHY 1971	Physics for Scientists and Engineers II Laboratory	
Total Credit Hours		15

Course Sequence Guide for the B.S. in Neuroscience Degree

First Year

Fall		Credit Hours
AIS 1263	AIS: Life and Health Sciences	3
BIO 1203 & BIO 1201	Biosciences I for Science Majors and Biosciences I Laboratory for Science Majors (core and major)	4
WRC 1013	Freshman Composition I (core)	3
MAT 1193	Calculus for the Biosciences	3
Credit Hours		13

Spring

PSY 1013	Introduction to Psychology (core and major)	3
NDRB 2113	Introduction to Neuroscience	3
CHE 1103	General Chemistry I	3
CHE 1121	General Chemistry I Laboratory	1
WRC 1023	Freshman Composition II (core)	3
STA 1403	Probability and Statistics for the Biosciences	3
Credit Hours		16

Second Year

Fall		Credit Hours
BIO 2313	Genetics	3
PHY 1943	Physics for Scientists and Engineers I (core)	3
PHY 1951	Physics for Scientists and Engineers I Laboratory	1
POL 1013	Introduction to American Politics (core)	3

CHE 1113	General Chemistry II	3
CHE 1131	General Chemistry II Laboratory	1
Credit Hours		14

Spring

CS 1173	Data Analysis and Visualization	3
NDRB 3433	Neurobiology	3
NDRB 3442	Neurobiology Laboratory	2
American History (core)		3
Language, Philosophy & Culture (core)		3
Additional Neuroscience Elective (B.2)		3
Credit Hours		17

Third Year

Fall

POL 1133	Texas Politics and Society (core)	3
Neuroscience Support Course (B.1)		3
Neuroscience Support Course (B.1)		3
Additional Neuroscience Elective (B.2)		3
Elective		3
Credit Hours		15

Spring

American History (core)		3
Neuroscience Support Course (B.1)		3
Neuroscience Support Course (B.1)		3
Additional Neuroscience Elective (B.2)		3
Elective		3
Credit Hours		15

Fourth Year

Fall

Creative Arts (core)		3
Neuroscience Support Course (B.1)		3
Neuroscience Support Course (B.1)		3
Additional Neuroscience Elective (B.2)		3
Elective		3
Credit Hours		15

Spring

Neuroscience Support Course (B.1)		3
Neuroscience Support Course (B.1)		3
Elective		3
Elective		3
Elective		3
Credit Hours		15

Total Credit Hours		120
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Minor in Neuroscience

The Minor in Neuroscience is open to all majors in the University. To declare a Minor in Neuroscience or obtain advice, students should consult with their academic advisor. All students pursuing the minor must complete a minimum of 18 semester credit hours of neuroscience courses. It should be noted that students seeking a minor must also complete applicable support coursework in biology, chemistry, computer science, physics, mathematics and statistics, as needed to fulfill the normal prerequisites for any course listed below. All neuroscience courses and their prerequisites must be completed with

a grade of "C-" or better, and students must achieve a grade point average of at least 2.0 on all work used to satisfy the requirements of the minor.

Code	Title	Credit Hours
A. Required Courses		12
BIO 1203	Biosciences I for Science Majors	
BIO 1201	Biosciences I Laboratory for Science Majors	
NDRB 2113	Introduction to Neuroscience	
NDRB 3433	Neurobiology	
NDRB 3442	Neurobiology Laboratory	
B. Organized Neuroscience Courses (Select 6 credit hours from the following)		6
NDRB 3213	Animal Behavior	
NDRB 3453	Neuroscience and Our Future	
NDRB 3463	Brain Diseases	
NDRB 3623	Neuropsychopharmacology	
NDRB 4483	Developmental Neuroscience: From Zygote to Brain Circuits	
NDRB 4583	Emergent Properties of Neural Circuits	
NDRB 4683	Neural Data Science	
NDRB 4783	Computational Neuroscience	
NDRB 4823	Cognitive Neuroscience	
NDRB 4923	Laboratory Research	
Total Credit Hours		18

Neuroscience, Developmental and Regenerative Biology (NDRB) Courses

NDRB 1033. Drugs and Society. (3-0) 3 Credit Hours.

An examination of licit and illicit drugs and their biosocial effects. Topics include pharmacology of alcohol, stimulants, hallucinogens, addiction, and abuse. May be applied toward the Core Curriculum requirement in Social and Behavioral Sciences. (Same as BIO 1033. Credit cannot be earned for both NDRB 1033 and BIO 1033.) Generally offered: Fall, Spring. Course Fees: LRC1 \$12; LRS1 \$46.20; STSI \$21.60.

NDRB 2113. Introduction to Neuroscience. (3-0) 3 Credit Hours.

Prerequisite: BIO 1203 (formerly BIO 1404). An introduction to the interdisciplinary field of Neuroscience, including understanding of the foundations of brain function, behavior, and neurological diseases from molecular, neuroanatomical, neurophysiological, neurochemical, and behavioral points of view. Generally offered: Fall, Spring. Course Fees: LRS1 \$46.20, STSI \$21.60.

NDRB 2953. Special Topics. (3-0) 3 Credit Hours.

An organized course offering the opportunity for specialized study not normally or not often available as part of the regular course offerings. Special Topics may be repeated for credit when the topics vary, but no more than 6 semester credit hours will apply to a bachelor's degree, regardless of discipline. No more than 6 semester credit hours of NDRB 2953, NDRB 4951, or NDRB 4953 can be applied to a Bachelor of Science degree in Neuroscience. Course Fees: LRS1 \$46.20; STSI \$21.60.

NDRB 3213. Animal Behavior. (3-0) 3 Credit Hours.

Prerequisites: BIO 1203 (formerly BIO 1404); prior completion of BIO 1223 (formerly BIO 1414) recommended. This course will introduce various approaches to the study of animals and their behavior in natural habitats. The course will examine basic principles derived from studying the evolution, ecology, and development of animals, and use these principles to explain how and why animals behave as they do in particular situations. (Formerly BIO 3213. Credit cannot be earned for both NDRB 3213 and BIO 3213.) Generally offered: Fall, Spring, Summer. Differential Tuition \$150. Course fee: IUB1 \$10.

NDRB 3362. Molecular Biochemistry Laboratory. (1-4) 2 Credit Hours.

Prerequisites: BIO 2362, CHE 1103, and completion or concurrent enrollment in MAT 1093 or higher. A study of the microscopic, biochemical and molecular techniques used to investigate biochemical reactions and the structure and function of proteins in cells and tissues. Techniques will include protein extraction, protein characterization, enzyme kinetics, chromatography, western blotting, Immunofluorescence, and bioinformatics. (Formerly BIO 3522, BIO 3822, and BME 3114. Same as BIO 3362. Credit cannot be earned for both NDRB 3362 and BIO 3362 or NRDB 3362 and any of the following: BIO 3522, BIO 3822, or BME 3114.) Generally offered: Fall, Spring, Summer. Differential tuition: \$100, Course Fees: IUB1 \$10; L001 \$30.

NDRB 3433. Neurobiology. (3-0) 3 Credit Hours.

Prerequisite: NDRB 2113. Anatomy and physiology of nervous systems and the mechanisms of neuronal functions. Formerly BIO 3433. Credit cannot be earned for both NDRB 3433 and BIO 3433. Generally offered: Fall, Spring. Differential Tuition: \$150. Course fee: IUB1 \$10.

NDRB 3442. Neurobiology Laboratory. (0-4) 2 Credit Hours.

Prerequisites: NDRB 2113 and completion of or concurrent enrollment in NDRB 3433. A laboratory course emphasizing principles presented in NDRB 3433. (Formerly BIO 3442. Credit cannot be earned for both NDRB 3442 and BIO 3442.) Generally offered: Fall, Spring. Differential Tuition: \$100. Course Fees: IUB1 \$10; L001 \$30.

NDRB 3453. Neuroscience and Our Future. (3-0) 3 Credit Hours.

Prerequisite: NDRB 2113. A discussion of the implications of recent Neuroscience discoveries. Students will use available literature and their own powers of reason to separate fact from fantasy and determine what future applications of Neuroscience may be possible. (Formerly BIO 3453. Credit cannot be earned for both NDRB 3453 and BIO 3453.) Generally offered: Spring. Differential Tuition: \$150. Course fee: IUB1 \$10.

NDRB 3463. Brain Diseases. (3-0) 3 Credit Hours.

Prerequisite: NDRB 3433. A study of selected major brain diseases and neurological disorders, their underlying causes and treatments, and an emphasis on molecular mechanisms. Generally offered: Fall. Differential Tuition: \$150. Course fee: IUB1 \$10.

NDRB 3623. Neuropsychopharmacology. (3-0) 3 Credit Hours.

Prerequisite: NDRB 3433. A study of the pharmacology of drugs that affect the function of the central nervous system. Topics include drug-receptor interactions, drugs of abuse, and drugs used to treat mental illness. (Formerly BIO 3623. Credit cannot be earned for both NDRB 3623 and BIO 3623.) Generally offered: Fall. Differential Tuition: \$150. Course fee: IUB1 \$10.

NDRB 3663. Human Embryology. (3-0) 3 Credit Hours.

Prerequisite: BIO 2313. Development of the human embryo from fertilization to the birth of the fetus. The origin of various tissues and organs will be followed during development. Environmental and genetic factors that can alter development will be discussed. (Formerly BIO 3663. Credit cannot be earned for both NDRB 3663 and BIO 3663.) Generally offered: Fall. Differential Tuition: \$150. Course fee: IUB1 \$10.

NDRB 3813. Cell Biology. (3-0) 3 Credit Hours.

Prerequisites: BIO 2313; prior completion of BIO 3513 is recommended. A study of cellular molecules and metabolic processes, synthesis and regulation of macromolecules, differential gene expression, membranes and organelles, cytoskeleton, cell cycle, and growth of normal and neoplastic cells. Credit cannot be earned for both NDRB 3813 and BME 3114. (Formerly BIO 3813, credit also cannot be earned for both NDRB 3813 and BIO 3813.) Generally offered: Fall, Spring, Summer. Differential Tuition: \$150. Course fee: IUB1 \$10.

NDRB 3913. Molecular Biology. (3-0) 3 Credit Hours.

Prerequisite: BIO 2313; prior completion of BIO 3513 is recommended. A study of nucleotides, DNA, replication, recombination, RNA, transcription, genetic code, translation, genomes, and chromosomes. (Formerly BIO 3913. Credit cannot be earned for both NDRB 3913 and BIO 3913.) Generally offered: Fall, Spring. Differential Tuition: \$150. Course fee: IUB1 \$10.

NDRB 3993. Principles of Cancer Biology. (3-0) 3 Credit Hours.

Prerequisite: BIO 1203 (formerly BIO 1404). A broad introduction to mechanisms that produce oncogenes and tumor suppressor genes. Methodologies of cancer assessment and prevention will be reviewed. (Formerly BIO 3933. Credit cannot be earned for both NDRB 3993 and BIO 3933.) Generally offered: Fall, Spring. Differential Tuition: \$150. Course fee: IUB1 \$10.

NDRB 4143. Developmental Biology. (3-0) 3 Credit Hours.

Prerequisite: BIO 2313; prior completion of BIO 3813 is recommended. Overview of developmental biology focusing on the origins of classical concepts as well as modern molecular approaches. Emphasis will be placed on the mechanisms underlying developmental processes using both invertebrate and vertebrate examples. Subjects include axis formation, induction, morphogenesis, embryonic pattern formation, cell differentiation, and organogenesis. (Formerly BIO 4143. Credit cannot be earned for both NDRB 4143 and BIO 4143.) Generally offered: Fall. Differential Tuition: \$150. Course fee: IUB1 \$10.

NDRB 4153. Frontiers in Pluripotent Stem Cells. (3-0) 3 Credit Hours.

Prerequisite: BIO 2313; prior completion of NDRB 3813 is recommended. The course covers interrelated topics such as pluripotency, cell fate specification, differentiation, patterning, organogenesis, morphogenesis, regeneration, and tissue engineering with an emphasis on human pluripotent stem cells and translational applications/emerging technologies related to regenerative medicine such as CRISPR/Cas9 gene editing and 3D organoids. Generally offered: Spring. Differential Tuition: \$150. Course fee: IUB1 \$10.

NDRB 4453. Endocrinology. (3-0) 3 Credit Hours.

Prerequisite: BIO 2313. Molecular, cellular, and physiological effects of hormones in health and disease. Topics include molecular mechanisms of hormone action in reproductive physiology, growth and development, and defects in hormonal regulation underlying clinically important syndromes (e.g., diabetes, hypertension, osteoporosis, and cancer). (Formerly BIO 4453. Credit cannot be earned for both NDRB 4453 and BIO 4453.) Generally offered: Fall. Differential Tuition: \$150. Course fee: IUB1 \$10.

NDRB 4483. Developmental Neuroscience: From Zygote to Brain Circuits. (3-0) 3 Credit Hours.

Prerequisites: BIO 2313, NDRB 3813, and NDRB 3433. A comparative developmental approach will be used to understand patterning mechanisms that control formation of the nervous system along the major axes of the body. Other topics include epigenetic mechanisms regulating neuronal plasticity and disease. Generally offered: Fall. Differential Tuition: \$150. Course fee: IUB1 \$10.

NDRB 4583. Emergent Properties of Neural Circuits. (3-0) 3 Credit Hours.

Prerequisite: NDRB 3433. An exploration of how interesting and useful functions arise in networks of neurons based on fundamental principles of cellular neurophysiology, neuroanatomy, and neurochemistry. (Formerly BIO 4583. Credit cannot be earned for both NDRB 4583 and BIO 4583.) Generally offered: Spring. Differential Tuition: \$150. Course fee: IUB1 \$10.

NDRB 4683. Neural Data Science. (3-0) 3 Credit Hours.

Prerequisites: MAT 1193, CS 1063 or DS 4013, STA 1403 or PSY 2073, and NDRB 2113. Analysis and interpretation of neurophysiological data, such as spike trains and EEG traces recorded from behaving animals or human subjects. While gaining hands-on computer-programming experience, this course will examine how neuroscientists use data analysis to investigate open questions. Lastly, more advanced "data science" techniques will tackle the complex data sets that arise from innovative brain-machine interfaces. Generally offered: Spring. Differential Tuition: \$150. Course fee: IUB1 \$10.

NDRB 4783. Computational Neuroscience. (3-0) 3 Credit Hours.

Prerequisites: MAT 1193, CS 1063 or DS 4013, STA 1403 or PSY 2073, and NDRB 2113, or consent of the instructor. An introduction to brain modeling and computational approaches to brain function. Topics include neural coding and the computational properties of neurons and neuronal networks. Generally offered: Fall. Differential Tuition: \$150. Course fee: IUB1 \$10.

NDRB 4813. Brain and Behavior. (3-0) 3 Credit Hours.

Prerequisite: NDRB 2113. This course explores the brain basis of behavior with a focus on understanding the neurophysiological, neurochemical, and neuroanatomical underpinnings for a variety of simple and complex behaviors. Students will explore topics such as sensation and perception, pain, movement, sleep, biological rhythms, emotions, addiction, learning and memory, and neurodevelopment. The topics are grounded with examples of typical human behavior and disorders such as Parkinson's disease, Autism, Schizophrenia, and psychopathology. (Formerly BIO 4813. Credit cannot be earned for both NDRB 4813 and BIO 4813, nor PSY 4183.) Generally offered: Fall. Differential Tuition: \$150. Course fee: IUB1 \$10.

NDRB 4823. Cognitive Neuroscience. (3-0) 3 Credit Hours.

Prerequisite: NDRB 3433, or NDRB 4813, or PSY 4183, or consent of instructor. The biological basis of cognition including perception, attention, learning, memory, emotion, language, and executive function. The course introduces students to the use of human neuroimaging experiments and clinical population, and research with other species, to study the brain basis of complex behavior and cognitive disorders, such as memory loss, language impairment, and developmental disorders. (Formerly BIO 4823. Credit cannot be earned for both NDRB 4823 and BIO 4823.) Generally offered: Spring. Differential Tuition: \$150. Course fee: IUB1 \$10.

NDRB 4911. Independent Study. (0-0) 1 Credit Hour.

Independent reading, research, discussion, and/or writing under the direction of a faculty member. May be repeated for credit, but no more than 6 semester credit hours will apply to a bachelor's degree, regardless of discipline. Only 6 semester credit hours of NDRB 4911-3, NDRB 4923, and NDRB 4993, in any combination, can be taken as NDRB electives. Additional research hours of these courses (excluding Independent Study) may be taken as free electives, for a maximum of 12 research hours being applied to the bachelor's degree. Generally offered: Fall, Spring, Summer. Differential Tuition: \$50.

NDRB 4912. Independent Study. (0-0) 2 Credit Hours.

Independent reading, research, discussion, and/or writing under the direction of a faculty member. May be repeated for credit, but no more than 6 semester credit hours will apply to a bachelor's degree, regardless of discipline. Only 6 semester credit hours of NDRB 4911-3, NDRB 4923, and NDRB 4993, in any combination, can be taken as NDRB electives. Additional research hours of these courses (excluding Independent Study) may be taken as free electives, for a maximum of 12 research hours being applied to the bachelor's degree. Generally offered: Fall, Spring, Summer. Differential Tuition: \$100.

NDRB 4913. Independent Study. (0-0) 3 Credit Hours.

Independent reading, research, discussion, and/or writing under the direction of a faculty member. May be repeated for credit, but no more than 6 semester credit hours will apply to a bachelor's degree, regardless of discipline. Only 6 semester credit hours of NDRB 4911-3, NDRB 4923, and NDRB 4993, in any combination, can be taken as NDRB electives. Additional research hours of these courses (excluding Independent Study) may be taken as free electives, for a maximum of 12 research hours being applied to the bachelor's degree. Generally offered: Fall, Spring, Summer. Differential Tuition: \$150.

NDRB 4923. Laboratory Research. (0-0) 3 Credit Hours.

Supervised laboratory research mentored by a faculty member engaged in active research within the student's designated area of concentration. May be repeated for credit, but no more than 6 semester credit hours will apply to a bachelor's degree. Only 6 semester credit hours of NDRB 4911-3, NDRB 4923, and NDRB 4993, in any combination, can be taken as NDRB electives. Additional research hours of these courses (excluding Independent Study) may be taken as free electives, for a maximum of 12 research hours being applied to the bachelor's degree. Generally offered: Fall, Spring, Summer. Differential Tuition: \$150. Course fee: IUB1 \$10.

NDRB 4951. Special Studies. (1-0) 1 Credit Hour.

An organized course offering the opportunity for specialized study not normally or not often available as part of the regular course offerings. Special Studies may be repeated for credit when the topics vary, but no more than 6 semester credit hours will apply to a bachelor's degree, regardless of discipline. No more than 6 semester credit hours of NDRB 2953, NDRB 4951, or NDRB 4953 can be applied to a B.S. degree in Neuroscience. Generally offered: Fall, Spring, Summer. Differential Tuition: \$50.

NDRB 4953. Special Studies. (3-0) 3 Credit Hours.

An organized course offering the opportunity for specialized study not normally or not often available as part of the regular course offerings. Special Studies may be repeated for credit when the topics vary, but no more than 6 semester credit hours will apply to a bachelor's degree, regardless of discipline. No more than 6 semester credit hours of NDRB 2953, NDRB 4951, or NDRB 4953 can be applied to a B.S. degree in Neuroscience. Generally offered: Fall, Spring, Summer. Differential Tuition: \$150. Course fee: IUB1 \$10.

NDRB 4993. Honors Research. (0-0) 3 Credit Hours.

Prerequisites: Enrollment limited to biology majors who are members of the Honors College, or who are pursuing College of Sciences Honors, and who are in their last two semesters of study; approval by the Honors College or College Honors Committee is required. Supervised research and preparation of an Honors Thesis. May be repeated for credit with approval, but no more than 6 semester credit hours will apply to a bachelor's degree, regardless of discipline. Only 6 semester credit hours of NDRB 4911-3, NDRB 4923, and NDRB 4993, in any combination, can be taken as NDRB electives. Additional research hours of these courses (excluding Independent Study) may be taken as free electives, for a maximum of 12 research hours being applied to the bachelor's degree. Generally offered: Fall, Spring. Generally offered: Fall, Spring. Differential Tuition: \$150.