NEUROSCIENCE, DEVELOPMENTAL AND REGENERATIVE BIOLOGY (NDRB)

Neuroscience, Developmental and Regenerative Biology (NDRB) Courses

NDRB 5001. Ethical Conduct in Research. (1-0) 1 Credit Hour.
This course provides a basic overview of the requirements for ethical conduct within the research laboratory. The grade report for this course is either “CR” (satisfactory completion) or “NC” (unsatisfactory completion). (Same as BIO 5001. Formerly BIO 7413. Credit can only be earned for one of the following: NDRB 5001, BIO 5001, or BIO 7413.) Differential Tuition: $50. Course Fee: GS01 $30; IUB1 $10.

NDRB 5033. Biotechnology Laboratory. (0-6) 3 Credit Hours.
Prerequisite: Good Standing. An organized course offering an introduction to routine procedures employed in the modern research laboratory. (Same as BIO 5033. Credit cannot be earned for both BIO 5033 and NDRB 5033.) Differential Tuition: $150. Course Fee: GS01 $90; L001 $30; IUB1 $10.

NDRB 5123. Principles of Molecular Biology. (3-0) 3 Credit Hours.
Prerequisite: BIO 3513 or an equivalent. Molecular structure and function of genes and nucleic acids, and the processes of DNA replication, mutation and repair, as well as transcription and translation of genetic material. Genome projects, functional genomics and the genetic control of development will also be covered. (Formerly BIO 5123. Credit cannot be earned for both NDRB 5123 and BIO 5123.) Differential Tuition: $150. Course Fee: GS01 $90. NDRB 5153. Principles of Cell Biology. (3-0) 3 Credit Hours.
Prerequisite: BIO 3513 and NDRB 3913, or their equivalents. Basic structure, organization, and differentiation of cells. Cell cycle, signaling, growth, and movement of cells, as well as cellular immunology and cellular aspects of infectious disease will also be covered. (Same as BIO 5133. Credit cannot be earned for both NDRB 5133 and BIO 5133.) Differential Tuition: $150. Course Fee: GS01 $90; IUB1 $10.

NDRB 5143. Advanced Nucleic Acids Laboratory. (0-6) 3 Credit Hours.
Prerequisite: NDRB 3913 or an equivalent, NDRB 5033 recommended. An introduction to advanced techniques of molecular biology dealing with manipulations and analyses of DNA, including preparation and analysis of genomic DNA, genomic cloning, the polymerase chain reaction (PCR), Southern blotting, DNA sequencing, and computational analysis of DNA sequence data. Same as BIO 5143. Credit cannot be earned for both BIO 5143 and NDRB 5143. Differential Tuition: $150. Course Fee: GS01 $90; IUB1 $10; L001 $30.

NDRB 5163. Recombinant Protein Biotechnology Laboratory. (0-6) 3 Credit Hours.
Prerequisite: Satisfactory completion of NDRB 5033. Small- to large-scale growth of microorganisms and eukaryotic cells followed by downstream processing of supernatants and/or cell pellets, protein purification and protein analysis. Same as BIO 5163. Formerly BIO 7542 and BIO 7543. Credit can only be earned for one of the following: BIO 5163, BIO 7542, BIO 7543, or NDRB 5163. Differential Tuition: $150. Course Fee: GS01 $90; IUB1 $10; L001 $30.

NDRB 5213. Principles of Chemical Biology. (3-0) 3 Credit Hours.
Prerequisite: BIO 3513 and NDRB 3813, or equivalents. Cell- and organism-level functions viewed from a chemical perspective. Studies of molecular interactions of metabolites, pharmaceuticals, proteins, polysaccharides, lipids, and nucleic acids, including protein folding and unfolding, protein modification, ligand binding, proteomics, metabolomics, lipidomics, glycoproteins, and nucleotide modification. (Same as BIO 5213. Credit cannot be earned for both NDRB 5213 and BIO 5213.) Differential tuition: $150 Course Fee: GS01 $90.

NDRB 5223. Principles of Developmental Biology. (3-0) 3 Credit Hours.
Prerequisite: NDRB 3813 or NDRB 4143, or equivalent. Experimental models and approaches used to address the fundamental processes of multicellular development. The course will cover foundational concepts, such as cell-type specification, morphogenesis, and growth coordination, as well as the next frontiers in developmental biology, organogenesis and regenerative medicine. Differential Tuition: $150. Course Fee: GS01 $90.

NDRB 5423. Neuroanatomy. (3-0) 3 Credit Hours.
Prerequisite: Consent of instructor. The anatomy of the vertebrate nervous system. (Formerly BIO 5423. Credit cannot be earned for both NDRB 5423 and BIO 5423.) Differential Tuition: $150. Course Fee: GS01 $90.

NDRB 5433. Systems Neuroscience. (3-0) 3 Credit Hours.
Prerequisite: NDRB 3433 or equivalent. The fundamentals of neurophysiology are presented from the cellular to the systems level. (Formerly BIO 5433. Credit cannot be earned for both BIO 5433 and NDRB 5433.) Differential Tuition: $150. Course Fee: GS01 $90; IUB1 $10.

NDRB 5443. Molecular and Cellular Neurobiology. (3-0) 3 Credit Hours.
Prerequisite: NDRB 3813 or equivalent. This course is an introduction to the fundamental genetics, cell biology, development, and plasticity of the nervous system. This course uses a combination of lecture and discussion of current and foundational literature, to cover a range of topics and techniques in molecular neurobiology. (Formerly BIO 5443. Credit cannot be earned for both BIO 5443 and NDRB 5443.) Differential Tuition: $150. Course Fee: GS01 $90.

NDRB 5453. Neurophysiology. (3-0) 3 Credit Hours.
Prerequisite: NDRB 3433 or equivalent. The fundamentals of cellular and synaptic neurophysiology. Differential Tuition: $150. Course Fee: GS01 $90; IUB1 $10.

NDRB 5463. Reproductive Biology. (3-0) 3 Credit Hours.
Prerequisite: Graduate standing in Biology. This course covers mammalian reproduction including mechanisms involved in sexual differentiation, fertilization, and fetal development. Endocrine regulation and environmental influences with a focus on human reproduction. (Formerly BIO 5463. Credit cannot be earned for both BIO 5463 and NDRB 5463.) Differential Tuition: $150. Course Fee: GS01 $90; IUB1 $10.

NDRB 5473. Neurobiology of Learning and Memory. (3-0) 3 Credit Hours.
Prerequisite: NDRB 3433 or equivalent, or consent of instructor. This course focuses on the fundamental neurobiological mechanisms underlying learning and memory. Neurotransmission, synaptic plasticity, molecular events, neurophysiological correlates, and behavioral readouts are considered to describe how discrete brain regions and neural networks contribute to learning and memory. Differential Tuition: $150. Course Fee: GS01 $90.
NDRB 5483. Computational Neuroscience. (3-0) 3 Credit Hours.
Prerequisite: NDRB 3433 or equivalent. An introduction to the computational functions of the brain, including sensory coding, neural control of movement, and the computational properties of neurons and neuronal networks. (Formerly BIO 5483. Credit cannot be earned for both BIO 5483 and NDRB 5483.) Differential Tuition: $150. Course Fee: GS01 $90; IUB1 $10.

NDRB 5493. Cognitive Neuroscience. (3-0) 3 Credit Hours.
Prerequisite: NDRB 3433 or PSY 3403 recommended, or consent of instructor. This course surveys the field of cognitive neuroscience covering a variety of topic areas and methodologies. Specific topics covered may vary, and may include subjects such as perception, memory, language, motor control, emotion, development, or other related subjects. Students will have the opportunity for (1) an overview of the neural correlates of human cognition, (2) technical and inferential aspects of various human neuroimaging techniques, (3) reading primary research publications, and (4) developing and presenting a research question in the field. (Same as BIO 4823 and NDRB 4823. Formerly BIO 5493. Credit can only be earned for one of the following: BIO 4823, NDRB 4823, BIO 5493, or NDRB 5493.) Differential Tuition: $150. Course Fee: GS01 $90.

NDRB 5613. Neurodegenerative Disease. (3-0) 3 Credit Hours.
Prerequisite: NDRB 3433 and NDRB 3813, or consent of instructor; NDRB 5433 and NDRB 5443 are recommended. The pathogenesis of neurodegenerative diseases will be covered with an emphasis on the molecular mechanisms and experimental approaches. Current research progress will be covered. (Formerly BIO 5613. Credit cannot be earned for both BIO 5613 and NDRB 5613.) Differential Tuition: $150. Course Fee: GS01 $90.

NDRB 5643. Introduction to Bioinformatics. (3-0) 3 Credit Hours.
The ability to sequence and analyze genomes has transformed biology. The genomic revolution has been made possible by the development of bioinformatics tools that combine computation with principles of molecular biology. In this course, students will learn how to use some of the major bioinformatics tools and will examine a few genomes to understand the vast amount of information present in them. (Same as MMI 6643. Credit cannot be earned for both MMI 6643 and NDRB 5643.) Differential Tuition: $150. Course Fee: GS01 $90.

NDRB 5673. Space and Time in the Brain. (3-0) 3 Credit Hours.
Prerequisite: NDRB 3433 or equivalent. Specific cells in the brain appear to signal position in space as well as the passage of time, suggesting that the brain uses common mechanisms to process space and time while forming memories. In this course, students will be introduced to the concepts of place cells, grid cells, and other spatial cells found within and beyond the hippocampal formation. Differential Tuition: $150. Course Fee: GS01 $90.

NDRB 5683. Neural Data Science. (3-0) 3 Credit Hours.
Prerequisite: MAT 1193, CS 1063 or DS 4013, STA 1403 or PSY 2073, and NDRB 2113, or equivalents. 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. Differential Tuition: $150. Course Fee: GS01 $90.

NDRB 5813. Frontiers in Human Pluripotent Stem Cells. (3-0) 3 Credit Hours.
This course integrates the fundamental aspects of developmental biology with emerging concepts in embryonic and adult stem cells and regenerative medicine. A discussion of various stem cell applications in industry, military, medicine, and ethics of regenerative medicine is presented. (Formerly BIO 5813. Credit cannot be earned for both BIO 5813 and NDRB 5813.) Differential Tuition: $150. Course Fee: GS01 $90.

NDRB 5833. Membrane Structure and Function. (3-0) 3 Credit Hours.
Prerequisite: BIO 3513 or an equivalent. A study of the composition, organization, transport functions, and permeability of natural and model membranes. (Formerly BIO 5833. Credit cannot be earned for both BIO 5833 and NDRB 5833.) Differential Tuition: $150. Course Fee: GS01 $90.

NDRB 5971. Directed Research. (0-0) 1 Credit Hour.
Prerequisite: Admission to either the Biology or Biotechnology Master's program or admission as a special graduate or non-degree-seeking student, and permission in writing (form available) from the instructor and the student's Graduate Advisor of Record. The directed research course may involve either a laboratory or a theoretical problem. May be repeated for credit, but not more than 6 hours, regardless of discipline, in combination with NDRB 6951, NDRB 6952, and NDRB 6953 (Independent Study), will apply to the Master's degree. Differential Tuition: $50. Course Fee: GS01 $30.

NDRB 5972. Directed Research. (0-0) 2 Credit Hours.
Prerequisite: Admission to either the Biology or Biotechnology Master's program or admission as a special graduate or non-degree-seeking student, and permission in writing (form available) from the instructor and the student's Graduate Advisor of Record. The directed research course may involve either a laboratory or a theoretical problem. May be repeated for credit, but not more than 6 hours, regardless of discipline, in combination with NDRB 6951, NDRB 6952, and NDRB 6953 (Independent Study), will apply to the Master's degree. Differential Tuition: $50 Course Fee: GS01 $60.

NDRB 5973. Directed Research. (0-0) 3 Credit Hours.
Prerequisite: Admission to either the Biology or Biotechnology Master's program or admission as a special graduate or non-degree-seeking student, and permission in writing (form available) from the instructor and the student's Graduate Advisor of Record. The directed research course may involve either a laboratory or a theoretical problem. May be repeated for credit, but not more than 6 hours, regardless of discipline, in combination with NDRB 6951, NDRB 6952, and NDRB 6953 (Independent Study), will apply to the Master's degree. Differential Tuition: $50 Course Fee: GS01 $90.

NDRB 6233. Quantitative Biology. (3-0) 3 Credit Hours.
Prerequisite: Graduate Standing or consent of instructor. An introduction of quantitative analysis of biological data and design of experiments. Topics include probability theory and distributions, descriptive statistics, hypothesis testing and confidence intervals for means, variances, and proportions, chi-square statistic, categorical data analysis, linear correlation and regression model, analysis of variance, and nonparametric methods. (Same as BIO 6233. Credit cannot be earned for both NDRB 6233 and BIO 6233.) Differential Tuition: $150. Course Fee: GS01 $90; IUB1 $10.
NDRB 6313. Molecular Biology and Biophysics of Ion Channels. (3-0) 3 Credit Hours.
Prerequisite: NDRB 3433, or permission of instructor. A study of the molecular composition and biophysical properties of ion channels. The course emphasizes three families of ion channels: voltage-gated, ligand-gated, and metabotropically-stimulated channels. Their structure and function will be related to how ion channels mediate cellular actions in excitable cells. (Formerly BIO 6313. Credit cannot be earned for both BIO 6313 and NDRB 6313.) Differential Tuition: $150. Course Fee: GS01 $90.

NDRB 6483. Neurobiology of Animal Behavior. (3-0) 3 Credit Hours.
Prerequisite: NDRB 3433 or BIO 3413 or consent of instructor. This course is designed to develop critical thinking skills while examining current neurobiology research on the extrinsic and intrinsic factors influencing animal behavior. The class will focus on behaviors that are relevant models for human disorders. (Formerly BIO 6483. Credit cannot be earned for both BIO 6483 and NDRB 6483.) Differential Tuition: $150. Course Fee: GS01 $90; IUB1 $10.

NDRB 6643. Advanced Multicellular Bioinformatics. (3-0) 3 Credit Hours.
The ability to sequence and analyze genomes has transformed biology. The genomic revolution has been made possible by the development of bioinformatics tools that combine computation with principles of molecular biology. In this course students will learn how to use some of the major bioinformatics tools and will examine a few genomes to understand the vast amount of information present in them. Differential Tuition: $150. Course Fee: GS01 90.

NDRB 6951. Independent Study. (0-0) 1 Credit Hour.
Prerequisite: Graduate standing and permission in writing of the instructor and the student's Graduate Advisor of Record. This course includes independent reading, research, discussion, and/or writing under the direction of a faculty member. For students needing specialized work not normally or not often available as part of the regular course offerings. May be repeated for credit, but not more than 6 hours, regardless of discipline, in combination with NDRB 5971, NDRB 5972, and NDRB 5973. Directed Research will apply to the Master's degree. Differential Tuition: $50. Course Fee: GS01 $30.

NDRB 6952. Independent Study. (0-0) 2 Credit Hours.
Prerequisite: Graduate standing and permission in writing of the instructor and the student's Graduate Advisor of Record. This course includes independent reading, research, discussion, and/or writing under the direction of a faculty member. For students needing specialized work not normally or not often available as part of the regular course offerings. May be repeated for credit, but not more than 6 hours, regardless of discipline, in combination with NDRB 5971, NDRB 5972, and NDRB 5973. Directed Research will apply to the Master's degree. Differential Tuition: $50. Course Fee: GS01 $60.

NDRB 6953. Independent Study. (0-0) 3 Credit Hours.
Prerequisite: Graduate standing and permission in writing of the instructor and the student's Graduate Advisor of Record. This course includes independent reading, research, discussion, and/or writing under the direction of a faculty member. For students needing specialized work not normally or not often available as part of the regular course offerings. May be repeated for credit, but not more than 6 hours, regardless of discipline, in combination with NDRB 5971, NDRB 5972, and NDRB 5973. Directed Research will apply to the Master's degree. Differential Tuition: $50. Course Fee: GS01 $90.

NDRB 6961. Comprehensive Examination. (0-0) 1 Credit Hour.
Prerequisite: Approval of the appropriate Graduate Program Committee to take the Comprehensive Examination. This is an independent study course for the purpose of taking the Comprehensive Examination. May be repeated as many times as approved by the Graduate Program Committee. Enrollment is required each term in which the Comprehensive Examination is taken if no other courses are being taken that term. The grade report for the course is either "CR" (satisfactory performance on the Comprehensive Examination) or "NC" (unsatisfactory performance on the Comprehensive Examination). Differential Tuition: $50. Course Fee: GS01 $30.

NDRB 6973. Special Problems. (3-0) 3 Credit Hours.
Prerequisite: Consent of instructor. An organized course offering the opportunity for specialized study not normally or not often available as part of the regular course offerings. Special Problems courses may be repeated for credit when the topics vary, but not more than 6 hours, regardless of discipline, may be applied to the Master's degree. Differential Tuition: $150. Course Fee: GS01 $90.

NDRB 6981. Masters Thesis. (0-0) 1 Credit Hour.
Prerequisite: Permission of the Graduate Advisor of Record and thesis director. Corequisites: Enrollment in NDRB 6981, NDRB 6982, or NDRB 6983 is required each term in which the thesis is in progress. Thesis research and preparation. May be repeated for credit, but not more than 6 hours will apply to the Master's degree. Credit will be awarded upon completion of the thesis. Differential Tuition: $50. Course Fee: GS01 $90.

NDRB 6982. Masters Thesis. (0-0) 2 Credit Hours.
Prerequisite: Permission of the Graduate Advisor of Record and thesis director. Corequisites: Enrollment in NDRB 6981, NDRB 6982, or NDRB 6983 is required each term in which the thesis is in progress. Thesis research and preparation. May be repeated for credit, but not more than 6 hours will apply to the Master's degree. Credit will be awarded upon completion of the thesis. Differential Tuition: $100. Course Fee: GS01 $60.

NDRB 6983. Masters Thesis. (0-0) 3 Credit Hours.
Prerequisite: Permission of the Graduate Advisor of Record and thesis director. Corequisites: Enrollment in NDRB 6981, NDRB 6982, or NDRB 6983 is required each term in which the thesis is in progress. Thesis research and preparation. May be repeated for credit, but not more than 6 hours will apply to the Master's degree. Credit will be awarded upon completion of the thesis. Differential Tuition: $150. Course Fee: GS01 $90.

NDRB 7041. Colloquium. (1-0) 1 Credit Hour.
Prerequisite: Graduate standing. This course will include oral presentations, discussions, critical evaluation of students' research in progress, or discussions of current journal articles or reviews of recent scientific advances. May be repeated for credit. The grade report for this course is either "CR" (satisfactory participation in the colloquium) or "NC" (unsatisfactory participation in the colloquium). Differential Tuition: $50. Course Fee: GS01 $30; IUB1 $10.

NDRB 7051. Seminar. (1-0) 1 Credit Hour.
Prerequisite: Graduate standing. Formal presentations of research by outside authorities in the biological sciences. May be repeated for credit. The grade report for this course is either "CR" (satisfactory participation in the seminar) or "NC" (unsatisfactory participation in the seminar). Differential Tuition: $50. Course Fee: GS01 $30; IUB1 $10.
NDRB 7113. Principles of Biological Scientific Teaching. (0-0) 3 Credit Hours.
Prerequisite: Admission to candidacy for the Doctoral degree. Required course for Neuroscience or Developmental and Regenerative Sciences doctoral students. The student will be trained on strategies to be an effective teacher in the classroom. The student will also be responsible for all aspects of leading a discussion section or laboratory course. Approval by the chair of the appropriate Doctoral Studies committee is required. Differential Tuition: $150. Course Fee: GS01 $90.

NDRB 7143. Principles of Biological Scientific Writing. (3-0) 3 Credit Hours.
Prerequisite: Graduate standing. This course will provide an overview of scientific grant and manuscript preparation. The class will be directed toward producing a Ph.D. dissertation proposal and a predoctoral fellowship application. Differential Tuition: $150. Course Fee: GS01 $90.

NDRB 7211. Doctoral Research. (0-0) 1 Credit Hour.
Prerequisite: Admission to either the Neuroscience or Developmental and Regenerative Sciences doctoral program. May be repeated for credit, but no more than 52 hours may be applied to the Doctoral degree. Differential Tuition: $50. Course Fee: GS01 $30; IUB1 $0.

NDRB 7212. Doctoral Research. (0-0) 2 Credit Hours.
Prerequisite: Admission to either the Neuroscience or Developmental and Regenerative Sciences doctoral program. May be repeated for credit, but no more than 52 hours may be applied to the Doctoral degree. Differential Tuition: $100. Course Fee: GS01 $60; IUB1 $10.

NDRB 7213. Doctoral Research. (0-0) 3 Credit Hours.
Prerequisite: Admission to either the Neuroscience or Developmental and Regenerative Sciences doctoral program. May be repeated for credit, but no more than 52 hours may be applied to the Doctoral degree. Differential Tuition: $150. Course Fee: GS01 $90; IUB1 $10.

NDRB 7214. Doctoral Research. (0-0) 4 Credit Hours.
Prerequisite: Admission to either the Neuroscience or Developmental and Regenerative Sciences doctoral program. May be repeated for credit, but no more than 52 hours may be applied to the Doctoral degree. Differential Tuition: $200. Course Fee: GS01 $120; IUB1 $10.

NDRB 7215. Doctoral Research. (0-0) 5 Credit Hours.
Prerequisite: Admission to either the Neuroscience or Developmental and Regenerative Sciences doctoral program. May be repeated for credit, but no more than 52 hours may be applied to the Doctoral degree. Differential Tuition: $250. Course Fee: GS01 $150; IUB1 $10.

NDRB 7216. Doctoral Research. (0-0) 6 Credit Hours.
Prerequisite: Admission to either the Neuroscience or Developmental and Regenerative Sciences doctoral program. May be repeated for credit, but no more than 52 hours may be applied to the Doctoral degree. Differential Tuition: $300. Course Fee: GS01 $180; IUB1 $10.

NDRB 7313. Doctoral Dissertation. (0-0) 3 Credit Hours.
Prerequisite: Admission to candidacy for the Doctoral degree and completion of at least 18 semester credit hours of NDRB 7211, NDRB 7212, or NDRB 7213. May be repeated for credit. Differential Tuition: $150. Course Fee: GS01 $90; IUB1 $10.

NDRB 7314. Doctoral Dissertation. (0-0) 4 Credit Hours.
Prerequisite: Admission to candidacy for the Doctoral degree and completion of at least 18 semester credit hours of NDRB 7211, NDRB 7212, or NDRB 7213. May be repeated for credit. Differential Tuition: $200. Course Fee: IUB1 $10; GS01 $120.

NDRB 7315. Doctoral Dissertation. (0-0) 5 Credit Hours.
Prerequisite: Admission to candidacy for the Doctoral degree and completion of at least 18 semester credit hours of NDRB 7211, NDRB 7212, or NDRB 7213. May be repeated for credit. Differential Tuition: $250. Course Fee: GS01 $150; IUB1 $10.

NDRB 7316. Doctoral Dissertation. (0-0) 6 Credit Hours.
Prerequisite: Admission to candidacy for the Doctoral degree and completion of at least 18 semester credit hours of NDRB 7211, NDRB 7212, or NDRB 7213. May be repeated for credit. Differential Tuition: $300. Course Fee: GS01 $180; IUB1 $10.

NDRB 7571. Research Rotations. (0-2) 1 Credit Hour.
Prerequisite: Consent of instructor. Topics may include research methods in developmental biology, regenerative biology, cellular neuroscience, and systems neuroscience. May be repeated for credit as topics vary. Formerly "Experimental Techniques in Biology." Differential Tuition: $50. Course Fee: GS01 $30; IUB1 $10.

NDRB 7572. Experimental Techniques in Biology. (0-4) 2 Credit Hours.
Prerequisite: Consent of Instructor. Topics may include research methods in developmental biology, regenerative biology, cellular neuroscience, and systems neuroscience. May be repeated for credit as topics vary. Formerly "Experimental Techniques in Biology" (Same as BIO 7572. Credit cannot be earned for both BIO 7572 and NDRB 7572.) Differential Tuition: $100. Course Fee: GS01 $60.