# Biological Sciences

## Master of Science in Biology

### Master of Science Graduate Program in Biology Course of Study and Program Requirements

#### Advisement

In the first year of study, students are advised on all academic matters by the MS Program Coordinator. During the first year of full-time study (or part-time equivalent), students complete sufficient course work to fulfill most core curricular requirements and to develop a potential research project (library or laboratory) that will serve as the basis of the capstone Thesis requirement. By the start of the second year, students must choose a faculty member to serve as advisor during their laboratory or bibliographic thesis research project.

#### Other Source of Information Regarding the Program's Regulations

The Rutgers-Newark Graduate School Catalog (http://catalogs.rutgers.edu/generated/nwk-grad_current/pg127.html) and the NJIT Graduate Catalog http://catalog.njit.edu/graduate/ should be consulted for University regulations. The new department regulations outlined above for the Masters program in Biology apply to all students who enter the Program as of September 2010.

## Doctor of Philosophy in Biology

### Program Procedures and Requirements

#### I. Graduate Standards Committee

The Graduate Standard Committee is responsible for monitoring and advising all graduate students through completion of the Thesis Prospectus stage of the program. The Committee meets with students each semester to evaluate coursework and research progress in an effort to provide advisement on course selections, first-semester mentoring, laboratory rotations, and potential thesis advisors. Records of Standards Committee meeting are kept on file via the Standards Committee Report form. Whenever necessary, the Committee will discuss student progress with faculty mentors and advisors to ensure proper and successful progress within the program. The ultimate charge of the Committee is to assist and guide the student toward successful completion of the Qualifying Exam and Thesis Prospectus.

## NJIT Faculty

### B

Barden, Phillip M, Assistant Professor

Bucher, Dirk M., Associate Professor

Bunker, Daniel E., Assistant Professor

### D

Devan, Caroline M, University Lecturer

### F

Flammang-Lockyer, Brooke E., University Lecturer

Fortune, Eric S., Associate Professor

### G

Garnier, Simon J., Assistant Professor

Golowasch, Jorge P., Professor

### H

Haspel, Gal, Assistant Professor

### K

Konsolaki, Mary, University Lecturer

### N

Nadim, Farzan, Professor

## R

Russell, Gareth J., Associate Professor

## S

Severi, Kristen E, Assistant Professor

Soares, Daphne F., Assistant Professor

Stanko, Maria L., University Lecturer

## T

Tai, Xiaonan

## Y

Yarotsky, John J., University Lecturer

- Biology - M.S. (http://catalog.njit.edu/graduate/science-liberal-arts/biology/ms/)
- Biology of Health - M.S (http://catalog.njit.edu/graduate/science-liberal-arts/biology/biology-of-health-ms/).
- Biology - Ph.D. (http://catalog.njit.edu/graduate/science-liberal-arts/biology/phd/)

# Biological Sciences Courses

**BIOL 590. Grad Coop Work Experience I. 1 credit, 1 contact hour.**

**BIOL 591. Graduate Coop Work Exper II. 1 credit, 1 contact hour.**

**BIOL 593. Graduate Co-Op Work Exp IV. 0 credits, 0 contact hours.**

**BIOL 601. Computational Biology I. 3 credits, 3 contact hours.**
This course will describe mathematical and simulation techniques used in modeling a variety of biological systems. Students will learn stability analysis, phase space analysis, basic bifurication theory and numerical simulation techniques with examples from neuroscience, cell and molecular biology as well as ecology and evolution. Students enrolling in this course are expected to have basic knowledge of calculus, linear algebra and some programming abilities.

**BIOL 605. Prin of Bioscience Processing. 3 credits, 3 contact hours.**
This course covers the main concepts of cell physiology, molecular biology, and cell biology. The fundamental aspects of biochemistry that relate directly to pharmaceutical developments are discussed and include basic organic chemistry, blood and buffers, protein based enzymes, complex carbohydrates, nucleic acids, and fats. Those topics will then be integrated into a thorough understanding of Bioprocessing in pharmaceutical industries. This course is for Professional Science Master's Biotechnology students with limited knowledge of Biology.

**BIOL 606. App Bioproc & Immun Based Ther. 3 credits, 3 contact hours.**
Prerequisite: BIOL 605 or permission of the instructor. This course provides foundational knowledge about immunology and immunological applications relevant to bioprocessing science including immunoglobulin genetics, leukocyte activation and migration, transplant immunology, and immunotherapy and vaccines.

**BIOL 610. Comparative Vertebrate Anatomy. 3 credits, 3 contact hours.**
This course introduces students to the groups of vertebrates and explores the anatomical evolution of vertebrates within the context of the functional interrelationships of organs and the changing environments to which vertebrates have adapted. An ideal entry point into the ways living creatures interact with their immediate physical world, we examine how the forms and activities of animals reflect the materials available to nature and consider rules for structural design under environmental forces.

**BIOL 612. Comparative Animal Physiology. 3 credits, 3 contact hours.**
This course will explore how animals, from invertebrates to vertebrates, function from the cellular to the organism level. The study of the structure and function of the various organs provides insight into how animals survive extreme environments and how they respond to changes in their environment. The comparative approach shows that the underlying physiological principles that govern life are common to all animals and yet animals have evolved unique and sometimes startling physiological solutions to problems posed by their particular environments.

**BIOL 621. Ecology. 3 credits, 3 contact hours.**
Prerequisites: Graduate student status or permission of the instructor. Ecological patterns and processes shape global biodiversity. From the community of microbes under your fingernail to entire continents and the planet, the field of ecology seeks to understand complex interactions among biological species and the environment. These themes are increasingly important; humans are reliant on functioning ecosystems even as anthropogenic factors alter our planet in profound ways. This course introduces graduate students to ecology at multiple conceptual and geographic scales.

**BIOL 622. Evolution. 3 credits, 3 contact hours.**
This course will provide a comprehensive overview of research in the field of evolutionary biology. Topics will include: the development of evolutionary theory, the history of the evolution of life on Earth, the genetic bases of variation and heredity, natural selection, evolution and development, and speciation. The format will be brief lectures to review topics covered in text, followed by class discussions of relevant primary literature. Students will write two papers on the topic of their choice and will be required to lead a minimum of one class discussion.

**BIOL 628. Cell Biology of Disease: Cells Gone Bad. 3 credits, 3 contact hours.**
This course will briefly review normal physiological function of humans and will then extensively explore the basis of many human diseases at cellular lever. The goal is to understand how alterations in normal cell functions affect human physiology by reviewing current research in the field of cell biology.

**BIOL 630. Critical Thinking for the Life Sciences. 3 credits, 3 contact hours.**
Researchers in the biological sciences must understand and be able to effectively apply the scientific method, and they must also be able to clearly communicate their ideas and results. This course will involve heavy student participation and discuss the scientific method, analyze and discuss data gathering and organizing, and will analyze existing grant proposals with the goal of enabling graduate students to write a clear and convincing grant proposal.

**BIOL 635. Intro to Comp Neuroscience. 3 credits, 3 contact hours.**
Prerequisite: Permission by instructor. Introduction to the modeling, computational and analysis techniques for single neurons and small neuronal networks. The course work is designed so that students can develop an independent modeling/computational project by the end of the semester. The required knowledge of neurobiology, electric circuits and numerical tools for the solution of differential equations will be introduced as needed.

**BIOL 636. Advanced Comp Neuroscience. 3 credits, 3 contact hours.**
Prerequisites: BIOL 635 or permission by the instructor. Modeling and computational analysis of biological neuronal networks. The course consists of lectures, scientific paper presentations and computational work. Students are expected to develop an independent modeling/computational project by the end of the semester.

**BIOL 638. Computational Ecology. 3 credits, 3 contact hours.**
An overview of computational approaches to the study of mathematical models in ecology. Topics include one-, two-, and multi-species models, life history analysis, spatial dynamics, epidemiology. The course is taught as a hands-on computer lab in which students explore models, perform simulations and solve problems.

**BIOL 640. Cellular Neurophysiology. 3 credits, 3 contact hours.**
Prerequisites: Graduate student status or permission of the instructor. This course will examine the nervous system from a functional perspective. The goal is to understand how ion channels and other components of nerve cells give rise to electrical excitability and synaptic function, and how those properties are then used for coding information and higher order function in the nervous system.

**BIOL 641. Systems Neuroscience. 3 credits, 3 contact hours.**
This course will examine neurophysical phenomena from a systems perspective. The course will review basic concepts of cellular neuroscience, such as excitability, impulse conduction, and integration of activity at the cellular, before focusing on network level physiology of the nervous system and its role in the generation of behavior. The goal is to provide students with the basic knowledge to understand neurobiological processes at all levels of complexity.

**BIOL 643. Biology of Addiction. 3 credits, 3 contact hours.**
Prerequisites: Graduate status. This course will explore Substance Use Disorder from a biological viewpoint. The psychological, epidemiological, social and economical aspects of addiction will be touched upon as needed. The course will consist of several Modules that would be taught in parallel. The Modules include: ‘Psychopharmacology’, ‘The Structure and Function of the Nervous System’, ‘Neurotransmitters and Neuromodulators’, ‘Substances of Abuse’, and ‘What is Addiction?’ The goal is to provide students with a comprehensive understanding of biological mechanisms, both in the body and in the brain, that lead to and underlie Substance Use Disorder.

**BIOL 644. Physiological Mechanisms. 3 credits, 3 contact hours.**
Prerequisites: Undergraduate level background in basic physiology and cell biology. This course utilizes clinical (pathological) case studies to reinforce and extend physiological knowledge, and provides students a strong basis for future studies in biomedical and health related fields.

**BIOL 645. Biological Imaging Techniques. 3 credits, 3 contact hours.**
Prerequisites: Graduate student status or permission of the instructor. This combined lecture and lab course will introduce the students to a variety of approaches to examine biological structures at different microscopic scales: conventional light microscopy, fluorescent microscopy, modern high resolution light microscopy, and electron microscopy. In addition, the course will cover optical approaches to study the dynamics of cellular function, including calcium and voltage imaging, and molecular interactions.

**BIOL 646. Endocrinology. 3 credits, 3 contact hours.**
Prerequisites: Undergraduate level background in basic physiology, biochemistry, and cell biology. The course will cover the entire human endocrine system from both an anatomical and physiological perspective. The development, gross anatomy, regulation and interaction between various endocrine components will be discussed. Emphasis will be placed on student learning through detailed examinations of endocrine disorders in a clinical setting in order to apply critical thinking about the endocrine system in a real world context.

**BIOL 648. Neuropathology. 3 credits, 3 contact hours.**
Prerequisites: Undergraduate level background in basic physiology and neurobiology. This course will utilize clinical (pathological) case studies to reinforce and extend Neuropathological knowledge, providing students a strong basis for future studies in biomedical and health related fields.

**BIOL 650. Human Anatomy. 3 credits, 3 contact hours.**
Prerequisites: Undergraduate level background in basic physiology and cell biology. This course in an introduction to human anatomy and physiology from an integrative perspective. Students learn the structure and function of human tissues, skeletal system, nervous system, endocrine system, and muscular system from the cellular to organismal levels.

**BIOL 653. Medical Genetics and Genomics. 3 credits, 3 contact hours.**
Prerequisites: Understanding of basic undergraduate-level classic genetics. The objective of this course is to offer students an opportunity to explore how the field of Genetics has been shaped after the completion of the sequencing of the genomes of humans and a variety of other organisms. Students will be able to describe new technologies that are available in medicine, diagnostics, genetic testing and the generation of genetically modified organisms and evaluate the advantages and current obstacles of these technologies. Through the analysis of case studies and primary literature, students will acquire a real-life knowledge of applications of Genomics in the 21st century.

**BIOL 660. College Teaching. 3 credits, 3 contact hours.**
College Teaching helps students in STEM fields who teach or plan to teach in colleges or universities develop important professional knowledge, skills, values, and dispositions that can enable them to help undergraduate and graduate students develop societally and personally significant abilities. The course emphasizes research-based methods demonstrated to be effective for enhancing learning in diverse people.

**BIOL 668. Evolutionary Medicine. 3 credits, 3 contact hours.**
Restrictions: Students should have a background that includes basic biology, including evolutionary mechanisms. This course addresses the evolutionary principles and processes underlying many types of disease (both infectious and hereditary/genetic). The class is a mixture of lecture and discussion of case studies. Material covered includes biology, epidemiological models, and some aspects of human behavior.

**BIOL 672. Computational Systems Biology. 3 credits, 3 contact hours.**
Prerequisite: Permission by the instructor. Introduction to the mathematical and computational modeling of biological systems with a focus on chemical, biochemical, metabolic and genetic networks. The course work is designed so that students can develop an independent modeling/computational project by the end of the semester. The required knowledge of biology and numerical tools for the solution of differential equations will be introduced as needed.

**BIOL 698. Selected topics in Biology. 3 credits, 3 contact hours.**
Survey of recent research topics in Biology at the Master's level.

**BIOL 699. Selected Topics in Biology. 3 credits, 3 contact hours.**
Survey of recent research topics in Biology at the Masters level.

**BIOL 700B. Master's Project. 3 credits, 3 contact hours.**
Approval of the project advisor is required for registration. Experimental and/or theoretical investigation of a relevant topic in biology. A written report must be submitted to the project advisor. The student cannot register in BIOL 700B more than once and the incomplete (I) grade is not allowed. Master’s students registering for the first time in Master’s Project must take simultaneously the INTD 799 (Responsible Conduct of Research) course, if they have not already taken it.

**BIOL 701B. Master's Thesis. 3 credits, 3 contact hours.**
Approval of the thesis advisor is required for registration. Experimental and/or theoretical investigation of a relevant topic in biology that can lead to a quality publication. A written thesis must be defended and approved by a committee of at least three faculty members. The student is expected to defend the thesis upon accrual of six thesis credits. Additional registration in BIOL 701B, beyond six credits, is required every semester until successful thesis defense (six credits count toward degree requirements and time limits apply). Master’s students registering for the first time in Master’s Thesis must take simultaneously the INTD 799 (Responsible Conduct of Research) course, if they have not already taken it.

**BIOL 701C. Master's Thesis. 6 credits, 6 contact hours.**
Approval of the thesis advisor is required for registration. Experimental and/or theoretical investigation of a relevant topic in biology that can lead to a quality publication. A written thesis must be defended and approved by a committee of at least three faculty members. The student must continue registering for three thesis credits (BIOL 701B) each semester until successful thesis defense (six credits count toward degree requirements and time limits apply).

**BIOL 725. Independent Study I. 3 credits, 3 contact hours.**
Approvals of the academic advisor and course instructor are required for registration. Students working on their PhD dissertation or MS thesis cannot normally register for this course with their respective dissertation/thesis advisor. This special course covers areas of study in which one or more students may be interested but there is not sufficiently broad interest to warrant a regular course offering. Students may not register for this course more than once.

**BIOL 726. Independent Study II. 3 credits, 3 contact hours.**
Approvals of the academic advisor and course instructor are required for registration. Students working on their PhD dissertation or MS thesis cannot normally register for this course with their respective dissertation/thesis advisor. This special course covers areas of study in which one or more students may be interested but there is not sufficiently broad interest to warrant a regular course offering. Students may not register for this course more than once. Students should only register for BIOL 726 if they have taken BIOL 725 in a prior semester.

**BIOL 731. Proposal Prep for Extnl Fundin. 3 credits, 3 contact hours.**
Prerequisite: BIOL 630. This course is intended for doctoral students in their first or second year who intend to apply for external funding for their research. The course is hands-on and students are required to identify sources of funding and to write and submit a grant proposal. Topics covered include developing research questions and hypotheses, organization of specific aims, components of the proposal, including significance, innovation, expected outcomes, potential pitfalls and broader impact. The course also emphasizes practices of good grantsmanship and provides an overview of how proposals are reviewed at NSF and NIH.

**BIOL 788. Selected Topics in Biology. 3 credits, 3 contact hours.**
Survey of recent research topics in Biology at the doctoral level.

**BIOL 790. Doct Dissertation & Resrch. 0 credits, 0 contact hours.**

**BIOL 790A. Doct Dissertation & Resrch. 1 credit, 1 contact hour.**
Co-requisite: BIOL 791. Approval of the dissertation advisor is required for registration. Experimental and/or theoretical investigation of a relevant topic in biology. For PhD students who have successfully defended their dissertation proposal. The student must register in BIOL 790A every semester until successful dissertation defense. A written dissertation must be defended and approved by a committee of at least five members. Students enrolled in the PhD program before 2015 Fall must accumulate a minimum number of credits in Doctoral Dissertation Research and Pre-Doctoral Research (see graduate catalog for program-specific details; the same requirement may apply to joint PhD programs with other universities).

**BIOL 790B. Doct Dissertation & Resrch. 3 credits, 3 contact hours.**
Co-requisite: BIOL 791. Since the BIOL 790A course should normally be taken instead, approvals of academic and dissertation advisors are required for registration. Experimental and/or theoretical investigation of a relevant topic in biology. For PhD students who have successfully defended their dissertation proposal. Students enrolled in the PhD program before 2015 Fall must accumulate a minimum number of credits in Doctoral Dissertation Research and Pre-Doctoral Research (see graduate catalog for program-specific details; the same requirement may apply to joint programs with other universities).

**BIOL 790C. Doctoral Dissertn & Resrch. 6 credits, 6 contact hours.**
Co-requisite: BIOL 791. Since the BIOL 790A course should normally be taken instead, approvals of academic and dissertation advisors are required for registration. For PhD students who have successfully defended their dissertation proposal. Experimental and/or theoretical investigation of a relevant topic in biology. Students enrolled in the PhD program before 2015 Fall must accumulate a minimum number of credits in Doctoral Dissertation Research and Pre-Doctoral Research (see graduate catalog for program-specific details; the same requirement may apply to some joint programs with other universities).

**BIOL 790D. Doct Dissertation & Resrch. 9 credits, 0 contact hours.**

**BIOL 790E. Doctoral Dissertation. 12 credits, 12 contact hours.**

**BIOL 791. Biology Seminar. 0 credits, 0 contact hours.**
This seminar includes student and faculty presentations on current papers, student presentations related to their research and occasional outside speakers. It will acquaint students with possible topics for dissertation search, and provide an opportunity to present and receive feedback on current work.

**BIOL 792B. Pre-Doctoral Research. 3 credits, 3 contact hours.**
Co-requisite: BIOL 791. Approval of the dissertation advisor is required for registration. Preliminary experimental and/or theoretical investigation of a relevant topic in biology. For students who have passed the qualifying examination but have not defended the dissertation proposal. Permission is needed of the academic advisor as well for students who have completed the required coursework but have not passed the qualifying examination.

**BIOL 792C. Pre-Doctoral Research. 6 credits, 6 contact hours.**

**BIOL 792D. Pre-Doctoral Research. 12 credits, 12 contact hours.**

**BIOL 794. Computational Biology Colloquium. 1 credit, 1 contact hour.**
Restriction: graduate standing. Students and outside speakers present and discuss current research activities in computational biology and related scientific areas.

## Rutgers-Newark Courses

**R120 503. Plant Morphology. 3 credits, 3 contact hours.**

**R120 504. Plant Physiology. 3 credits, 3 contact hours.**

**R120 505. Bio Stat And Compt Meth. 3 credits, 3 contact hours.**

**R120 507. Computational Ecology. 3 credits, 3 contact hours.**

**R120 509. Adv Problems In Biology. 3-5 credits, 3-5 contact hours.**

**R120 510. Adv Prob In Biol. 3 credits, 3 contact hours.**

**R120 512. Cell Biology: Methods & Appl. 3 credits, 0 contact hours.**

**R120 513. Epigenetics. 3 credits, 3 contact hours.**

**R120 515. Molecular Bio Of Eukaryotes. 3 credits, 3 contact hours.**

**R120 516. Microbial Ecology. 3 credits, 3 contact hours.**

**R120 517. Develomental Neurobiology. 3 credits, 3 contact hours.**

**R120 518. Neuroimmunology. 3 credits, 3 contact hours.**

**R120 519. Microbial Metal. 3 credits, 0 contact hours.**

**R120 520. Analyt & Comp Neurosci. 3 credits, 3 contact hours.**

**R120 522. Resource Sustainability. 3 credits, 3 contact hours.**

**R120 523. Scale Of Biodiversity. 3 credits, 3 contact hours.**

**R120 524. Cell Molec Dev. 3 credits, 3 contact hours.**

**R120 526. Topics in Cell Biology. 3 credits, 0 contact hours.**

**R120 530. Cell Surface Recept. 3 credits, 3 contact hours.**

**R120 532. Evolution. 3 credits, 3 contact hours.**

**R120 534. Biological Invasion. 3 credits, 3 contact hours.**

**R120 536. Mulitvariate Biostatistics. 3 credits, 3 contact hours.**

**R120 538. Topics In Molecular Genetics. 3 credits, 3 contact hours.**

**R120 539. Adv Human Physio I. 3 credits, 0 contact hours.**

**R120 540. Adv Human Phsiology & Patho II. 3 credits, 3 contact hours.**

**R120 543. Envr Microbiology. 3 credits, 3 contact hours.**

**R120 545. Plant Molecular Bio. 3 credits, 3 contact hours.**

**R120 547. Pathophysiology. 3 credits, 3 contact hours.**

**R120 548. Biology Of Cancer. 3 credits, 3 contact hours.**

**R120 551. Biology Of Pollution. 3 credits, 3 contact hours.**

**R120 552. Paleobotany. 3 credits, 3 contact hours.**

**R120 560. College Teaching. 3 credits, 3 contact hours.**

**R120 563. Topics in Modern Plant Biology. 3 credits, 3 contact hours.**

**R120 568. Neuroendocrinology. 3 credits, 0 contact hours.**

**R120 571. Biochemistry I. 3 credits, 3 contact hours.**

**R120 572. Concepts in Pharm Drug Dev. 3 credits, 3 contact hours.**

**R120 573. Pharmacology. 3 credits, 3 contact hours.**

**R120 580. Topic Marine Ecology. 3 credits, 3 contact hours.**

**R120 587. Systems Ecology. 3 credits, 0 contact hours.**

**R120 588. Topics Adv Ecology. 3 credits, 0 contact hours.**

**R120 590. Intro to Env Biophys. 3 credits, 3 contact hours.**

**R120 593. Physiological Ecol. 3 credits, 0 contact hours.**

**R120 594. Systematics. 3 credits, 3 contact hours.**

**R120 601. Human Molecular Genetics. 3 credits, 3 contact hours.**

**R120 604. Microbio: Prin & Appl. 3 credits, 3 contact hours.**

**R120 616. Topics In Biology. 3 credits, 3 contact hours.**

**R120 624. Cell Biol:Signal Transduction. 3 credits, 3 contact hours.**