Mission Statement
The Biology Department offers programs leading to the Master of Science (M.S.) and Master of Arts (M.A.) degrees in Biology. These flexible programs meet the needs of students wishing to develop their skills as research scientists or prepare for admission to professional school or doctoral programs. Both programs can prepare students to enter science-related careers or help them advance in education or corporate settings. The M.S. program is thesis-based and designed to be completed within two years of full-time study. Competitive Teaching Assistantships are available for students who qualify. The M.A. program is course-based and accommodates both full and part-time students.

Program learning goals and objectives

Learning Goal 1: Students will develop their identity as scientists through interactions with faculty mentors, with their colleagues and with non-scientists. They will become informed about prospective careers for life scientists in government, industry, and academia as well as learning about the professional and ethical expectations for scientists.

Objective 1.1: Students will be familiar with the appropriate set of research, laboratory and/or field skills used by specialists in their subfields of choice.

Learning Goal 2: Students will be able to understand and critique articles from the primary literature in biology. They will improve their skills in communicating about science, particularly about biology, including data presentation, writing, and oral communication appropriately targeted to various audiences.

Objective 2.1: Students will be able to locate, read, interpret, evaluate and discuss primary literature in Biology.

Objective 2.2: Students will be able to analyze, interpret and present data of various kinds.

Objective 2.3: Students will design, execute and communicate results of research. (For M.A. students, this will take the form of projects completed for courses. M.S. students will complete a traditional thesis that includes a public defense and a written report.)

Learning Goal 3: Students will develop skills in experimental design, data collection and analysis.

Objective 3.1: Students will be able to analyze, interpret and present data of various kinds.

Objective 3.2: Students will design, execute and communicate results of research. (For M.A. students, this will take the form of projects completed for courses. M.S. students will complete a traditional thesis that includes a public defense and a written report.)

Learning Goal 4: Students will have a deeper and more sophisticated understanding of one or more of the subfields of biology, and they will develop the appropriate set of research, laboratory and/or field skills necessary for specialization in the subfields.

Objective 4.1: Students will increase their knowledge and understanding of one or more of the subfields of biology through assignments in courses and research experiences in courses and/or independent study.

Objective 4.2: Students will be familiar with the appropriate set of research, laboratory and/or field skills used by specialists in their subfields of choice.

The graduate programs of the Biology Department are intended for graduates who desire training in specialized fields and who are planning a career in teaching, research or professional practice in these areas. Applicants must have a bachelor’s degree from an accredited college or university and must present evidence of ability to pursue graduate work as exemplified by high scholastic achievement, high GRE test scores and exemplary recommendations. The Biology Department reserves the right to require additional undergraduate work prior to admission.

Applicants should submit or have sent to the Office of Graduate Operations the following:
• a completed Saint Joseph's University graduate application.
• official sealed transcript(s) of undergraduate/graduate coursework. If you are a SJU graduate the Office of Graduate Operations will obtain your SJU transcripts for you.
• official copies of scores of the Graduate Record Examination (general test).
• letters of recommendation from at least two faculty evaluating the candidate's promise and capacity for graduate study a personal statement outlining the candidate's professional goals and educational objectives for the program, including the applicant's rationale for program choice and professional study.
• $35 application fee – waived if attended an Open House or an SJU graduate.

The application to the Biology graduate programs is by rolling admissions and there is no specific deadline. However, applicants wishing to be considered for teaching or research assistantships are advised to apply by March 1. The Graduate Admissions Committee will evaluate all applicants and decide whether the applicant has sufficient credentials to be admitted to the program. A personal interview with the applicant may be requested.

M.S. in Biology

Course requirements
Degree candidates for the Master of Science degree in Biology must be full time students and will be required to complete 30 credit hours of graduate study in biology. All candidates will be required to complete 24 credit hours of formal classroom study and 6 credit hours of thesis research (BIO 79). The 24 credit hours of formal classroom study must be in graduate level courses (600-700 level), which may include up to 4 credit hours of seminar (BIO 552) and 6 credit hours of research (BIO 793). Seminar participation is required during each semester of enrollment.

Thesis requirement
Degree candidates for the Master of Science Degree in Biology will be required to complete a research problem in their area of specialization and to publish their findings in thesis form. A Thesis Committee will be formed to follow the progress of the candidate, evaluate the final thesis and administer a final oral examination based on the thesis research. The Thesis Committee will consist of three faculty members, and be chaired by the candidate's research mentor. The thesis must be acceptable in both scholarship and literary quality. Both a public presentation of the thesis work and a private defense of the thesis are required. To be recommended for the Master of Science degree in Biology, the candidate must receive approval of the majority of the committee members. Not later than three weeks prior to the commencement at which the degree is to be conferred, two copies of the completed thesis suitable for binding and bearing approval of the Thesis Committee must be deposited in the Department of Biology office. The cost of preparation, reproduction, and binding of the thesis is the responsibility of the candidate.

Other specific requirements
a. The candidate for the M.S. Degree in Biology must maintain a grade point average of 3.0 or above to remain in the program.

b. Successful completion of all requirements must be accomplished within a maximum of 5 years from the time of acceptance to the program.

c. All of the requirements described in this document represent minimum requirements, and it is understood that the Thesis Committee may require additional work to make up for deficiencies in the student's background.

Graduate Assistantships
Full-time M.S. students will automatically be considered for Biology Department teaching assistantships that provide a stipend and a scholarship for tuition and fees. Notice of other fellowships is posted on the department website. Students seeking financial support are encouraged to apply by March 1 or earlier for the fall semester.

M.A. in Biology

Course requirements
Degree candidates for the Master of Arts Degree in Biology will be required to complete 32 credit hours of graduate study in biology. A minimum of two semesters of seminar must be taken, with a maximum of 4 credit hours counting toward the degree. Students must take Research Techniques (BIO 550) and at least one each from two of the three broad categories of Evolution and Diversity, Cell Structure and Function, and Systemic Organization.

Other specific requirements
a. The candidate for the M.A. degree in Biology must maintain a grade point
average of 3.0 or above to remain in the program.

b. Successful completion of all requirements must be accomplished within a maximum of 5 years from the time of acceptance to the program.

c. All of the requirements described in this document represent minimum requirements, and it is understood that the Graduate Committee may require additional work to make up for deficiencies in the student's background.

Biology Curriculum

Core:
BIO 550  Research Techniques
BIO 550L Research Techniques Lab
BIO 552  Graduate Seminar

Electives:
BIO 793  Research
BIO 7XX Advanced Topics in Biology*
BIO 794  Thesis Research

*Various topics, may qualify for one of the groups below

Evolution and Diversity of Life
BIO 601  Animal Behavior
BIO 606  Comparative Anatomy
BIO 609  Ecology
BIO 614  Plant Systematics
BIO 619  Invertebrate Zoology
BIO 620  Bioinformatics
BIO 622  Applied and Environmental Microbiology
BIO 623  Evolution
BIO 624  Biotechnology

Cell Structure and Function
BIO 602  Advanced Cell Biology
BIO 604  Biochemistry
BIO 610  Light and Electron Microscopy
BIO 611  Molecular Genetics
BIO 612  Neurobiology
BIO 616  General Microbiology
BIO 621  Molecular and Cellular Biophysics

Systemic organization
BIO 603  Biometrics and Modeling
BIO 605  Biomechanics
BIO 607  Developmental Biology
BIO 613  Plant Physiological Ecology
BIO 615  Immunology
BIO 617  Systemic Physiology
BIO 625  Bacterial Pathogenesis

BIO 550 Research Techniques (3 credits)
An introduction to techniques commonly used in life science research laboratories. Weekly meetings by different faculty members on their area of specialty. One lecture period.

BIO 550L Research Techniques Lab (1 credit)
This course is designed to expose students to the research activity within the department. Students will be rotated through 2-3 faculty research laboratories, working in each lab for a four-week period. Students will select the labs to work in based on their interest. This experience is designed to allow students the opportunity to learn the practical side of laboratory techniques and to help students select a research area for study. Times to be arranged.

BIO 552 Graduate Seminar (1 credit)
Presentations and discussions of primary literature articles. Topic varies by semester. One period.

BIO 601 Animal Behavior (4 credits)
Study of animals and their behaviors with strong emphasis on evolutionary relationships and ecology. Two lecture periods, one four hour laboratory period.

BIO 602 Advanced Cell Biology (4 credits)
In depth analysis of eukaryotic cell structure and function. Emphasis is on experimental approaches to understanding concepts in cell biology. Two lecture periods, one four-hour laboratory period.

BIO 603 Biometrics and Modeling (4 credits)
Computer simulation of life science phenomena from the subcellular to population levels. Appropriate statistics are included along with exposure to simulation software. Two lecture periods, one four-hour laboratory.

BIO 604 Biochemistry (3 credits)
Study of the chemistry of living systems. The study of important macromolecules, metabolic pathways, and control systems. Two lecture periods.

BIO 605 Biomechanics (4 credits)
Students are introduced to the ways in which the behavior, morphology and material composition of plants and animals are affected by and take advantage of physical forces. This course will include lectures given by the members of the Biology and Physics Department, as well as an integrated laboratory section where students will
observe and measure the effect of physical forces on organisms in both aquatic and terrestrial systems. 
Two 75-minute lecture periods, one three-hour laboratory period.

**BIO 606 Comparative Anatomy (4 credits)**
An integrated comparative study of vertebrate structure and development. A synthesis of the embryological development, the gross anatomy, and the histology of selected forms. 
*Two lecture periods, one four-hour laboratory period.*

**BIO 607 Developmental Biology (4 credits)**
A study of the molecular and cellular aspects of development. Emphasis will be on induction, regeneration, and genetic control of differentiation. 
*Two lecture periods, one four-hour laboratory period.*

**BIO 608 Histology (4 credits)**
A study in depth of the microscopic structure and function of normal cells, tissues, and organs as found in the vertebrates. Students will make extensive use of computer imaging, CD-ROM presentations and biological specimens for study in the laboratory. 
*Two three-hour sessions per week.*

**BIO 609 Ecology (4 credits)**
Study of complex interrelationship between organisms and their environment. 
*Two lecture periods, one four-hour laboratory period.*

**BIO 610 Light and Electron Microscopy (4 credits)**
The techniques of light and electron microscopy, including aspects of technique, theory, and operation. 
*Two lecture periods, one four-hour laboratory period.*

**BIO 611 Molecular Genetics (4 credits)**
Study of the molecular biology of the genetic material, its structure, expression, regulation, and its dynamic nature. 
*Two lecture periods, one four-hour laboratory period.*

**BIO 612 Neurobiology (4 credits)**
A study of neural activity using examples from invertebrate and vertebrate model systems. The emphasis will be at the cellular and tissue levels with appropriate neurochemistry and pharmacology included. Laboratory work will focus on computer simulation of neural processes including simple nerve nets. 
*Two lecture periods, one four-hour laboratory.*

**BIO 613 Plant Physiological Ecology (4 credits)**
This course will focus on the physiological mechanisms plants use to respond to their environment. Major topic areas include the basic environmental physiology of carbon, water, and mineral nutrient exchange, and the adaptive mechanisms plants use to survive the variety of global environments. Labs will cover common physiological research methods ranging from cellular to whole organism level measurements and will involve both laboratory and field work. 
*Two lecture periods, one four-hour lab period.*

**BIO 614 Plant Systematics (4 credits)**
Students will learn to recognize vascular plant families and understand how taxonomists study evolutionary relationships among plant groups. Economic, medical, and ecological importance of various seed plants will be emphasized. 
*Two lecture periods, two, two-hour laboratory periods.*

**BIO 615 Immunology (4 credits)**
An introductory course providing students with an overview of how the immune system works, including molecules, cells, and organs of the immune system and their functions and interactions. Discussion of the experimental techniques used to understand the cell-cell interactions that occur in immunity as well as the differentiation and activation of the immune response will be included. 
*Two 50-minute lecture periods, one four-hour laboratory period.*

**BIO 616 Microbiology (4 credits)**
The structural, cultural, and physiological characteristics of microorganisms and their role in the economy of nature. 
*Two lecture periods, one four-hour laboratory period.*

**BIO 617 Systemic Physiology (4 credits)**
A study of the fundamental mechanisms of vertebrate physiology. The basis for the function of the various organ systems and the biological controls that result in the integration of these systems will be discussed. 
*Two lecture periods, one four-hour laboratory period.*

**BIO 619 Invertebrate Zoology (4 credits)**
A study of the morphology, physiology, behavior, and phylogenetic relationships of the major groups of invertebrates. Participants will compare and contrast the physical and biological challenges facing the invertebrates that live on land, in water, and inside other organisms. The laboratory will include observations and experiments on live and preserved animals. **Two lecture periods; one four-hour lab period.**

**BIO 620 Bioinformatics (4 credits)**
Introduction to the use of computers in biology. Students learn about important scientific questions and the contemporary tools used to answer them. Topics include genome sequence assembly and annotation, database mining, genome organization, phylogenetics and genetics of human disease. **Two 50-minute lecture periods, one four-hour lab period.**

**BIO 621 Molecular and Cellular Biophysics (4 credits)**
The course is designed to show students how the integration of physics, chemistry and molecular biology are used to explain and predict molecular and cellular processes such as protein-protein interactions, protein folding, diffusion, and signaling. The course will also provide students with a basic understanding and hands-on experience of several biophysical and biochemical laboratory techniques. **Two 50-minute lecture periods, one four-hour lab period.**

**BIO 622 Applied and Environmental Microbiology (4 credits)**
The course will introduce us to the complex relationships between microbes and their environment, including other organisms. In the frame of these relationships, we will explore how microbial activities are key to geochemical cycles and to human-engineered processes that are essential part of our lives. **Two 50-minute lecture periods, one four-hour lab period.**

**BIO 623 Evolution (4 credits)**
This course covers the major concepts of evolutionary biology, including natural selection, adaptation, genetic drift, and phylogenetic trees. The course trains students to know how to generate and test evolutionary hypotheses using data and inference. The lab portion of the course encourages hands-on learning through computer simulation and problem-solving. **Two 50-minute lecture periods, one four-hour lab period.**

**BIO 624 Biotechnology (4 credits)**
A course in which students will learn how basic cell and molecular biology are used to develop products for biomedical, agricultural and industrial applications. The course will also cover fundamental and emerging techniques in the biotechnology field. The lab section will focus on the steps involved in the production and purification of recombinant proteins expressed in bacterial cells. **Two 50-minute lecture periods, one four-hour lab period.**

**BIO 625 Bacterial Pathogenesis (4 credits)**
A study of the physiological, genetic, and biochemical basis underlying some of the commonly encountered bacterial diseases. The course also addresses the roles of antimicrobial compounds and the host immune system in counteracting disease. Finally, in the lab module for the course, students perform discovery-oriented research as they identify novel genes in enteropathogenic *Escherichia coli* (EPEC) that affect bacterial virulence in a *C. elegans* (roundworm) model of disease. **Two 75-minute lecture periods, one three-hour laboratory period.**

**BIO 770 Advanced Topics in Biology  3–4 credits**
Topics, course format, and instructors may vary each semester.

**BIO 793 Research  1–6 credits**
Research project undertaken in the laboratory of a member of the graduate faculty. *Meeting times arranged.*

**BIO 794 Thesis Research (6 credits)**
Research credit during preparation of thesis. *Times to be arranged.*