

DEPARTMENT OF MOLECULAR MICROBIOLOGY AND IMMUNOLOGY

Mission Statement

The mission of the department is to conduct outstanding research and provide exceptional educational experiences in a collegial environment. At the same time, we transform academic experiences from classrooms to careers by merging scholarly activities with practical skills in translational science, vaccine development, microbial pathogenesis, and immunology.

The Department of Molecular Microbiology and Immunology holds to the core values of integrity in academic studies and research; respect; responsibility and accountability; and fostering a culture of community and communication.

General Information

The Department of Molecular Microbiology and Immunology connects outstanding research programs to the academic mission of preparing students for professional careers in microbiology and immunology, medical and public health service fields, education, research, and industry. The Department of Molecular Microbiology and Immunology is committed to providing students with foundations to link their educational experience to basic and translational biomedical research activities built by department faculty with expertise in the areas of vaccine development, microbial pathogenesis, and mechanisms of immune dysregulation in health and disease.

Program Outcomes

The Department of Molecular Microbiology and Immunology program provides students the opportunity to:

- Understand the foundations of host-pathogen interactions and immune-related diseases.
- Understand how to relate core methods of microbiology and immunology to the science of vaccine development, microbial pathogenesis, and human disease.
- Apply microbiology and immunology knowledge to solve current health problems.
- Effectively communicate microbiology- and immunology-related methods and results in written and oral form.

Degrees

The Department of Molecular Microbiology and Immunology offers a Bachelor of Science (B.S.) degree in Microbiology and Immunology.

The **B.S. Degree in Microbiology and Immunology** program of study is structured around a comprehensive core curriculum that includes upper-division level course work designed to achieve a deeper knowledge, understanding, and experience in several specialized areas of microbiology and immunology.

Health Careers Pathways

The Department of Molecular Microbiology and Immunology offers programs that support students interested in pursuing professional or graduate programs (e.g., medical, dental) in health-related professions

through the B.S. Microbiology & Immunology degree. Microbiology & Immunology majors can also participate in the Joint Early Acceptance Program between UTSA and UT Health San Antonio, where students can earn their B.S. Microbiology & Immunology degree from UTSA and a Master of Science (M.S) in Medical Laboratory Sciences from UT Health San Antonio. See the Degrees (<http://catalog.utsa.edu/undergraduate/sciences/integrativebiology/#degreestext>) page and visit the UTSA Health Professions office (<https://www.utsa.edu/healthprofessions/>) for more information.

COS Signature Experiences in Molecular Microbiology and Immunology

The Department of Molecular Microbiology and Immunology offers experiential learning opportunities for undergraduate students in which they can gain real-world experiences while also learning about the broader impacts of their work within their fields of study. All undergraduate students have the option to participate in a College of Sciences (COS) Signature Experience. Students should contact the Undergraduate Advisor of Record for the Microbiology and Immunology major for a list of relevant signature experiences.

Undergraduate Research Opportunities

The Department of Molecular Microbiology & Immunology offers a mentored laboratory-based research experience (MMI 3733) for undergraduate students in which they can gain real-world research experiences while also learning about the broader impacts of their work within the microbiology and immunology fields.

Bachelor of Science Degree in Microbiology and Immunology

The Bachelor of Science (B.S.) degree in Microbiology and Immunology is designed to prepare students for careers in the medical/health professions and service fields, research, education, and industry.

A minimum number of 120 semester credit hours is required for the B.S. in Microbiology and Immunology, including Core Curriculum requirements. At least 39 of the total semester credit hours required for the degree must be at the upper-division level.

All major and support work courses and the required prerequisites must be completed with a grade of "C-" or better.

Core Curriculum Requirements (42 semester credit hours)

Students seeking the B.S. Degree in Microbiology and Immunology 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.

Two of the following courses may be used to satisfy the core requirement in Life and Physical Sciences as well as major requirements: BIO 1203, BIO 1223, PHY 1943, or PHY 1963.

Gateway Courses

Students pursuing the B.S. Degree in Microbiology and Immunology must successfully complete each of the following Gateway Courses with a grade of "C-" or better in no more than two attempts. A student who is unable to successfully complete these courses within two attempts, including dropping a course with a grade of "W" or taking an equivalent course at another institution, will be required to change their major.

| Code | Title | Credit Hours |
|----------|-----------------------------------|--------------|
| BIO 1203 | Biosciences I for Science Majors | 3 |
| BIO 1223 | Biosciences II for Science Majors | 3 |
| BIO 2313 | Genetics | 3 |

Degree Requirements

| Code | Title | Credit Hours |
|------|-------|--------------|
|------|-------|--------------|

A. Required major courses

1. Required biology courses (31 credit hours):

| | | |
|---------------------|----------------------------------------------------------------------------------|---|
| BCH 3303 | Essentials of Biochemistry | 3 |
| BIO 1203 & BIO 1201 | Biosciences I for Science Majors and Biosciences I Laboratory for Science Majors | 4 |
| BIO 1223 | Biosciences II for Science Majors | 3 |
| BIO 2313 | Genetics | 3 |
| BIO 2362 | Molecular Genetics Laboratory | 2 |
| MMI 3343 | Microbial Evolution | 3 |
| MMI 3353 | Molecular and Cell Biology | 3 |
| MMI 3713 & MMI 3722 | Microbiology and Microbiology Laboratory | 5 |
| MMI 4743 & MMI 4752 | Immunology and Immunology Laboratory | 5 |

2. In combination, 5 courses from the following lists (15 credit hours) 15

2a. Complete two to four of the following courses:

| | |
|----------|------------------|
| MMI 3743 | Bacteriology |
| MMI 4483 | Medical Mycology |
| MMI 4723 | Virology |
| MMI 4763 | Parasitology |

2b. Complete one to three of the following courses:

| | |
|----------|-------------------------------------------------|
| MMI 3013 | Introduction to Clinical Medicine and Pathology |
| MMI 3733 | MMI Research Experience |
| MMI 4473 | Advanced Clinical Medicine and Pathology |
| MMI 4773 | Microbial Ecology and Metagenomics |
| MMI 4783 | Microbial Genomes and Virulence |
| MMI 4923 | Laboratory Research |
| MMI 4953 | Special Studies |
| MMI 4993 | Directed Research |

B. Required support courses

The support courses listed below are mandatory prerequisites for various Microbiology and Immunology and/or Biology courses. Students need to complete their support work as soon as possible, in their freshman and sophomore years, to be eligible to register for upper-division core courses and electives. Failure to complete the support courses listed below in a timely fashion will significantly delay a student's progress toward graduation.

1. Required chemistry courses (18 credit hours):

| | | |
|---------------------|----------------------------------------------------------|---|
| CHE 1103 & CHE 1121 | General Chemistry I and General Chemistry I Laboratory | 4 |
| CHE 1113 & CHE 1131 | General Chemistry II and General Chemistry II Laboratory | 4 |
| CHE 2603 & CHE 2612 | Organic Chemistry I and Organic Chemistry I Laboratory | 5 |
| CHE 3643 & CHE 3652 | Organic Chemistry II and Organic Chemistry II Laboratory | 5 |

2. Required mathematics and statistics courses (6 credits):

| | | |
|----------|------------------------------------------------|---|
| MAT 1193 | Calculus for the Biosciences | 3 |
| STA 1403 | Probability and Statistics for the Biosciences | 3 |

3. Required physics courses; select one option (8 credits): 8

Option 1

| | |
|---------------------|------------------------------------------------------------------|
| PHY 1603 & PHY 1611 | Algebra-based Physics I and Algebra-based Physics I Laboratory |
| PHY 1623 & PHY 1631 | Algebra-based Physics II and Algebra-based Physics II Laboratory |

Option 2

| | |
|---------------------|------------------------------------------------------------------------------------------------|
| PHY 1943 & PHY 1951 | Physics for Scientists and Engineers I and Physics for Scientists and Engineers I Laboratory |
| PHY 1963 & PHY 1971 | Physics for Scientists and Engineers II and Physics for Scientists and Engineers II Laboratory |

C. Free electives (9 credit hours) 9

Select 9 semester credit hours of free electives, of which 3 must be at the upper division level, to reach the minimum requirement of 39 upper-division semester credit hours and to complete 120 total hours.

| | |
|---------------------------|-----------|
| Total Credit Hours | 87 |
|---------------------------|-----------|

Course Sequence Guide for B.S. Degree in Microbiology and Immunology

This course sequence guide is designed to assist students in completing their B.S. Degree in Microbiology and Immunology. *This course sequence is only a guide, and students must satisfy other requirements of this catalog and meet with their academic advisor for individualized degree plans.* Progress within this guide depends upon such factors as course availability, individual student academic preparation, student time management, work obligations, and individual financial considerations. **Students may choose to take courses during Summer terms to reduce course loads during long semesters.**

B.S. in Microbiology and Immunology – Recommended Four-Year Academic Plan

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 |
| CHE 1103 & CHE 1121 | General Chemistry I and General Chemistry I Laboratory | 4 |
| WRC 1013 | Freshman Composition I (core) | 3 |
| Credit Hours | | 14 |

| | | |
|---------------------|----------------------------------------------------------|-----------|
| Spring | | |
| BIO 1223 | Biosciences II for Science Majors (core and major) | 3 |
| CHE 1113 & CHE 1131 | General Chemistry II and General Chemistry II Laboratory | 4 |
| MAT 1193 | Calculus for the Biosciences (core and major) | 3 |
| WRC 1023 | Freshman Composition II (core) | 3 |
| Credit Hours | | 13 |

Second Year

| | | |
|------------------------------|-----------------------------------------------------------------------------------------------------|-----------|
| Fall | | |
| BIO 2313 | Genetics | 3 |
| BIO 2362 | Molecular Genetics Laboratory | 2 |
| CHE 2603 & CHE 2612 | Organic Chemistry I and Organic Chemistry I Laboratory | 5 |
| Select one of the following: | | 4 |
| PHY 1603 & PHY 1611 | Algebra-based Physics I and Algebra-based Physics I Laboratory | |
| Or | | |
| PHY 1943 & PHY 1951 | Physics for Scientists and Engineers I and Physics for Scientists and Engineers I Laboratory (core) | |
| Credit Hours | | 14 |

| | | |
|----------------------------------------|-----------------------------------------------------------------------------------------------------------------|-----------|
| Spring | | |
| CHE 3643 & CHE 3652 | Organic Chemistry II and Organic Chemistry II Laboratory | 5 |
| STA 1403 | Probability and Statistics for the Biosciences | 3 |
| Select one of the following: | | 4 |
| PHY 1623 & PHY 1631 | Algebra-based Physics II and Algebra-based Physics II Laboratory | |
| Or | | |
| PHY 1963 & PHY 1971 | Physics for Scientists and Engineers II and Physics for Scientists and Engineers II Laboratory (core and major) | |
| Language, Philosophy, & Culture (core) | | 3 |
| Credit Hours | | 15 |

Third Year

| | | |
|-----------------------------------------------------|----------------------------|-----------|
| Fall | | |
| BCH 3303 | Essentials of Biochemistry | 3 |
| MMI 3343 | Microbial Evolution | 3 |
| MMI 3713 | Microbiology | 3 |
| MMI 3722 | Microbiology Laboratory | 2 |
| Upper-Division Microbiology and Immunology elective | | 3 |
| American History (core) | | 3 |
| Credit Hours | | 17 |

| | | |
|---------------|----------------------------|---|
| Spring | | |
| MMI 3353 | Molecular and Cell Biology | 3 |

| | | |
|-------------------------|-----------------------|-----------|
| MMI 4743 | Immunology | 3 |
| MMI 4752 | Immunology Laboratory | 2 |
| American History (core) | | 3 |
| Creative Arts (core) | | 3 |
| Free elective | | 3 |
| Credit Hours | | 17 |

Fourth Year

| | | |
|-----------------------------------------------------|--|-----------|
| Fall | | |
| Upper-division Microbiology and Immunology elective | | 3 |
| Upper-division Microbiology and Immunology elective | | 3 |
| Government-Political Science (core) | | 3 |
| Social & Behavioral Sciences (core) | | 3 |
| Free elective | | 3 |
| Credit Hours | | 15 |

| | | |
|-----------------------------------------------------|--|------------|
| Spring | | |
| Upper-division Microbiology and Immunology elective | | 3 |
| Upper-division Microbiology and Immunology elective | | 3 |
| Government-Political Science (core) | | 3 |
| Component Area Option (core) | | 3 |
| Free elective (to meet 120 hour minimum) | | 3 |
| Credit Hours | | 15 |
| Total Credit Hours | | 120 |

Note: Some courses are only offered once a year: Fall or Spring. Check with the Department of Molecular Microbiology and Immunology for scheduling of courses.

Molecular Microbiology and Immunology (MMI) Courses**MMI 1053. Introductory Microbiology. (3-0) 3 Credit Hours.**

Prerequisite: BIO 1233 or BIO 1203 (formerly listed as BIO 1404 in previous catalogs); concurrent enrollment in MMI 1061 is recommended for students intending to complete both courses. A general study of microorganisms, their characteristics, isolation, growth, and importance in nature, particularly with regards to public health and human disease. (Formerly BIO 1053. Credit cannot be earned for both BIO 1053 and MMI 1053. MMI 1053 cannot substitute for MMI 3713.) Generally offered: Fall, Spring, Summer. Course Fee: LRS1 \$46.20; STSI \$21.60.

MMI 1061. Introductory Microbiology Laboratory. (0-3) 1 Credit Hour.

Prerequisites: BIO 1233 or BIO 1203 (formerly listed as BIO 1404 in previous catalogs), and completion of or concurrent enrollment in MMI 1053. Course provides basic microbiology lab skills and procedures, with emphasis on the growth, identification, and control of microbes of concern to health-care professionals. Immunodeficient and pregnant students must contact the Coordinator of the Microbiology Teaching Labs, for additional instructions prior to the class start date. (Formerly BIO 1061. Credit cannot be earned for both BIO 1061 and MMI 1061. MMI 1061 cannot substitute for MMI 3722.) Generally offered: Fall, Spring, Summer. Course Fees: IUB2 \$10; L001 \$30; LRS1 \$15.40; STSI \$7.20.

MMI 3013. Introduction to Clinical Medicine and Pathology. (3-0) 3 Credit Hours.

Prerequisite: BIO 1233 or BIO 2313. Introduction to concepts of human disease, diagnosis, and underlying pathology. (Formerly BIO 3013. Credit cannot be earned for both BIO 3013 and MMI 3013.) Generally offered: Fall. This course has Differential Tuition. Course Fee: IUB2 \$10.

MMI 3343. Microbial Evolution. (3-0) 3 Credit Hours.

Prerequisite: BIO 2313. Microbes are everywhere. They contribute to the health of our bodies and of natural ecosystems. Microbial pathogens continue to emerge and re-emerge, underscoring considerable epidemic challenges to public health. In this course, you will be introduced to the major principles of microbial evolution. Topics to be covered include natural selection, adaptation, the origins of life, and evolution of virulence and antimicrobial resistance. (Same as BIO 3323. Formerly MMI 3323. Credit can only be earned for one of the following: BIO 3323, MMI 3323, and MMI 3343.) Generally offered: Fall and Spring. This course has Differential Tuition. Course Fee: IUB2 \$10.

MMI 3353. Molecular and Cell Biology. (3-0) 3 Credit Hours.

Prerequisite: BIO 2313; prior completion of BCH 3303 is recommended. A detailed study of cell structure and function, genes and their expression, genetic engineering, emerging genetic and molecular techniques, genome sequences, epigenetics, cellular signaling pathways, and cell cycle in prokaryotic and eukaryotic cells. Students who have taken NDRB 3813 and NDRB 3913 should not also take MMI 3353. Generally offered: Spring. This course has Differential Tuition. Course Fee: IUB2 \$10.

MMI 3713. Microbiology. (3-0) 3 Credit Hours.

Prerequisite: BIO 2313; concurrent enrollment in MMI 3722 is recommended for students intending to complete both courses. A comprehensive study of microorganisms, including their composition, morphology, growth, metabolism, classification, ecology, and significance in disease. MMI 1053 cannot substitute for MMI 3713. (Formerly BIO 3713. Credit cannot be earned for both MMI 3713, BIO 3713, and ES 3103.) Generally offered: Fall, Spring, Summer. This course has Differential Tuition. Course Fee: IUB2 \$10.

MMI 3722. Microbiology Laboratory. (1-6) 2 Credit Hours.

Prerequisite: BIO 2313 and completion or concurrent enrollment in MMI 3713. Basic microbiology techniques with emphasis on microscopy, cell staining and characterization, species isolation techniques, bacterial cultivation, nutrition, and physical requirements, and the physical and chemical control of microbes. Immunodeficient and pregnant students must contact the Coordinator of the Microbiology Teaching Labs for additional instructions prior to the class start date. (Formerly BIO 3722. Credit cannot be earned for both BIO 3722 and MMI 3722. BIO 1061 cannot substitute for MMI 3722.) Generally offered: Fall, Spring, Summer. This course has Differential Tuition. Course Fee: IUB2 \$10; L001 \$30.

MMI 3733. MMI Research Experience. (0-9) 3 Credit Hours.

Prerequisite: Permission in writing (form available in the MMI Department Office) from the faculty mentor, the student's advisor, the Department Chair, and the Dean of the College. The Department of Molecular Microbiology & Immunology offers a mentored laboratory-based research experience for undergraduate students in which they can gain real-world research experiences while also learning about the broader impacts of their work within the microbiology and immunology fields. This course has Differential Tuition. Course Fee: L001 \$30; IUB2 \$10.

MMI 3743. Bacteriology. (3-0) 3 Credit Hours.

Prerequisite: BIO 2313 and MMI 3713; prior completion of MMI 3722 is also recommended. A study of the phylogeny of prokaryotes, structure and function of prokaryotic cells, ecology and physiological diversity of prokaryotes, growth and control of microorganisms, genetics of bacteria and bacteriophages, bacteria as agents of disease, antibacterials, and other chemotherapeutics, human applications of microbiology, microbial genomics, and principles of microbial biotechnology. (Formerly BIO 3743. Credit cannot be earned for both BIO 3743 and MMI 3743.) Generally offered: Fall. This course has Differential Tuition. Course Fee: IUB2 \$10.

MMI 4473. Advanced Clinical Medicine and Pathology. (3-0) 3 Credit Hours.

Prerequisite: MMI 3013. Advanced concepts of human disease, diagnosis, and underlying pathology. (Formerly BIO 4473. Credit cannot be earned for both BIO 4473 and MMI 4473.) Generally offered: Spring. This course has Differential Tuition. Course fee: IUB2 \$10.

MMI 4483. Medical Mycology. (3-0) 3 Credit Hours.

Prerequisite: BIO 2313. Comprehensive study of causative agents, pathogenesis, and treatment of human fungal diseases. (Formerly BIO 4483. Credit cannot be earned for both BIO 4483 and MMI 4483.) Generally offered: Fall. This course has Differential Tuition. Course Fee: IUB2 \$10.

MMI 4723. Virology. (3-0) 3 Credit Hours.

Prerequisite: BIO 2313. Introduction to the molecular, genetic, and biological properties of viruses. Course covers the basic concepts of virus structure, replication, virus/host interactions, pathogenesis, and evolution. (Formerly BIO 4723. Credit cannot be earned for both BIO 4723 and MMI 4723.) Generally offered: Fall and Spring. This course has Differential Tuition. Course Fee: IUB2 \$10.

MMI 4743. Immunology. (3-0) 3 Credit Hours.

Prerequisite: BIO 2313; concurrent enrollment in MMI 4752 is recommended for students intending to complete both courses. This course introduces students to the molecular, cellular, and genetic principles of innate and adaptive immunity. The course covers the development of B and T lymphocytes, and explains how these components of adaptive immunity function in the contexts of infection by pathogenic microbes, allergic reactions, autoimmunity, transplant rejection, cancer, and vaccination. (Formerly BIO 4743. Credit cannot be earned for both BIO 4743 and MMI 4743.) Generally offered: Fall, Spring, Summer. This course has Differential Tuition. Course fee: IUB2 \$10.

MMI 4752. Immunology Laboratory. (0-6) 2 Credit Hours.

Prerequisite: BIO 2313 and completion or concurrent enrollment in MMI 4743. Laboratory applications of principles presented in MMI 4743. (Formerly BIO 4752. Credit cannot be earned for both BIO 4752 and MMI 4752.) Generally offered: Fall, Spring, Summer. This course has Differential Tuition. Course Fee: IUB2 \$10; L001 \$30.

MMI 4763. Parasitology. (3-0) 3 Credit Hours.

Prerequisite: BIO 2313; prior completion of MMI 3713 is strongly recommended. This course focuses on eukaryotic parasites of medical or veterinary importance: their life cycles, epidemiology, control, and the diseases and pathology they cause. Evolutionary aspects of host-parasite interactions, the diversity of parasite biology, and the interrelationships between parasitology, vector biology, and public health will be emphasized. (Formerly BIO 4763. Credit cannot be earned for both BIO 4763 and MMI 4763.) Generally offered: Spring. This course has Differential Tuition. Course Fee: IUB2 \$10; LRS1 \$46.20.

MMI 4773. Microbial Ecology and Metagenomics. (3-0) 3 Credit Hours.

Prerequisite: BIO 2313 and MMI 1053 or MMI 3713. This course will provide an overview of microbial ecology principles and application of microbial ecological approaches to understand microbial structure and function across environments, including the soil, freshwater, and marine environments. The course will focus its content on prokaryotes and fungi. An emphasis in this course will be on learning foundational concepts in microbiome science and applying concepts to laboratory and computational techniques through hands-on experiments. (Same as BIO 4773, credit cannot be earned for both BIO 4773 and MMI 4773.) Generally offered: Spring. This course has Differential Tuition. Course Fee: IUB2 \$10.

MMI 4783. Microbial Genomes and Virulence. (3-0) 3 Credit Hours.

Prerequisite: BIO 2313; prior completion of MMI 3713 is recommended. This course is focused on microbial pathogens of medical importance. Insights into the genome make-up and virulence inventories of pathogens is essential for understanding their biology, epidemiology, human disease, and trajectories of pathogen evolution. Topics covered include the basic concepts of genome sequencing, pathogen-specific virulence traits, and the role of genetic exchange in genome evolution, speciation, fitness, and pathogenicity. (Formerly BIO 4783. Credit cannot be earned for both BIO 4783 and MMI 4783.) Generally offered: Spring. This course has Differential Tuition. Course Fee: IUB2 \$10; LRS1 \$46.20.

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

Prerequisite: Permission in writing (form available in the MMI office) from the instructor, an undergraduate academic advisor, the Department Chair, and the Dean of the College in which the course is offered. Independent reading, non-laboratory research, discussion, and/or writing under the direction of a faculty member. Will be applied to the degree as a free elective. May be repeated for credit, but no more than 6 semester credit hours of MMI 4911-3 will apply to a bachelor's degree regardless of discipline. Generally offered: Fall, Spring, Summer. This course has Differential Tuition. Course Fee: IUB2 \$10.

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

Prerequisite: Permission in writing (form available in the MMI office) from the instructor, an undergraduate academic advisor, the Department Chair, and the Dean of the College in which the course is offered. Independent reading, non-laboratory research, discussion, and/or writing under the direction of a faculty member. Will be applied to the degree as a free elective. May be repeated for credit, but no more than 6 semester credit hours of MMI 4911-3 will apply to a bachelor's degree regardless of discipline. Generally offered: Fall, Spring, Summer. This course has Differential Tuition. Course Fee: IUB2 \$10.

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

Prerequisite: Permission in writing (form available in the MMI office) from the instructor, an undergraduate academic advisor, the Department Chair, and the Dean of the College in which the course is offered. Independent reading, non-laboratory research, discussion, and/or writing under the direction of a faculty member. Will be applied to the degree as a free elective. May be repeated for credit, but no more than 6 semester credit hours of MMI 4911-3 will apply to a bachelor's degree regardless of discipline. Generally offered: Fall, Spring, Summer. This course has Differential Tuition. Course Fee: IUB2 \$10.

MMI 4923. Laboratory Research. (0-9) 3 Credit Hours.

Prerequisite: Permission in writing (form available in the MMI Department Office) from the faculty mentor, the student's advisor, the Department Chair, and the Dean of the College. 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 MMI 4911-3, MMI 4923, and MMI 4993, in any combination, can be taken as MMI upper-division 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. This course has Differential Tuition. Course Fee: L001 \$30; IUB2 \$10.

MMI 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. Generally offered: Fall, Spring, Summer. This course has Differential Tuition. Course Fee: IUB2 \$10.

MMI 4993. Directed Research. (0-0) 3 Credit Hours.

Prerequisite: Approval from the instructor, the Department Chair, and the Associate Dean of Undergraduate Studies in the College for which this course is offered; form available on the College of Sciences website. Supervised research mentored by a faculty member engaged in active research within the student's designated area of concentration. Students may produce a thesis in addition to active research. This course can also be used for students pursuing the COS Undergraduate Thesis Option. 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 MMI 4911-3, MMI 4923, and MMI 4993, in any combination, can be taken as MMI upper-division 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. This course has Differential Tuition. Course Fee: IUB2 \$10; DL01 \$75.