

DEPARTMENT OF BIOLOGY

The Department of Biology offers a Bachelor of Science (B.S.) degree in Biology and a B.S. degree in Microbiology and Immunology, as well as a Minor in Biology. The Department also offers Grades 7–12 Biology Teacher Certification in collaboration with UTeachSA, and the Certificate in Pathogenic Outbreak Investigations in collaboration with the Department of Computer Science and the Department Information of Systems and Cyber Security in the College of Business.

The B.S. degree in Biology is designed to prepare students for professional careers in the biological sciences, medical and health service fields, research, industry, and education. The program of study is structured around a comprehensive core curriculum that includes genetics, physiology, cell biology, chemistry, physics, computer science, and mathematics. At the upper-division level, students wanting to specialize can choose one of six area concentrations: Cell and Molecular Biology, Integrative Biology, Neurobiology, Plant Biology, Pre-Medical Sciences, or Grades 7–12 Biology Teacher Certification.

The B.S. degree in Microbiology and Immunology is designed to prepare students for professional careers in the medical and health service fields, research, industry, education and as specialists in industrial quality testing and control, and as regulatory workers in government agencies and public health laboratories. The program of study is structured around a comprehensive core curriculum that is similar to the Biology degree but upper-division level coursework is designed to achieve a deeper education in several specialized areas of microbiology.

Due to extensive curriculum overlap, students cannot receive a double major in Biology and Microbiology and Immunology. Students must choose between a B.S. in Biology or a B.S. in Microbiology and Immunology.

The UTSA Department of Biology offers two accelerated degree program in conjunction with UTHealth San Antonio. The DEAP Program allows students to earn both the Bachelor of Science (B.S.) degree in Biology from UTSA and their Doctor of Dental Surgery (D.D.S.) degree at the UTHealth San Antonio Dental School within a seven-year period. The RCEAP Program allows students to earn both the Bachelor of Science (B.S.) degree in Biology from UTSA and their Master of Science in Respiratory Care (M.S.) degree at the UTHealth San Antonio Dental School within a five-year period. For eligibility requirements and application visit the UTSA Health Professions Office website (<http://www.utsa.edu/healthprofessions/>).

Admission Policy

Applicants entering UTSA as Freshmen or Transfer students with less than 30 transferable credit hours earned will be admitted to the Department of Biology if they:

- meet all UTSA undergraduate first-time freshman or transfer admission requirements.

Applicants with 30 or more transferable credit hours will be admitted to the Department of Biology if they:

- meet all UTSA undergraduate transfer admission requirements, and
- have completed College Algebra (or higher) or an equivalent with a grade of "C-" or better.

Academic Standing Policy for the B.S. Degree in Biology and the B.S. Degree in Microbiology and Immunology

The goal of the Department of Biology is to provide undergraduate students a program of study that maintains high standards, and that promotes graduation in four years. To achieve this goal, the academic standing policy of the Department of Biology is designed to identify those students most likely to succeed in their undergraduate biology education.

After a student has earned 60 hours of credit, the Department of Biology will evaluate a student's academic performance. To remain either a Biology or Microbiology and Immunology major, a student must complete the following requirements within 60 credit hours:

- A minimum overall UTSA grade point average of 2.0
- A minimum grade point average of 2.0 in all Biology coursework (UTSA and transfer credit)
- Successfully complete the following or equivalent courses with a grade of "C-" or better within 60 credit hours:

BIO 1404	Biosciences I	4
BIO 1414	Biosciences II	4
BIO 2313	Genetics	3
CHE 1103	General Chemistry I	3
MAT 1193	Calculus for the Biosciences (Students in the teaching concentration can substitute STA 1053)	3
PHY 1943 or PHY 1603	Physics for Scientists and Engineers I Algebra-based Physics I	3

Students who do not meet these requirements within 60 credit hours will have their major changed to undeclared in the University student record system. In order to return to a Biology or a Microbiology and Immunology major, the student must complete all the above requirements within 15 additional credit hours from the time of dismissal, and must submit a petition for reinstatement to the Department of Biology for approval. A student who still does not meet all the above requirements after completing a total of 75 hours must choose a major other than Biology or Microbiology and Immunology. A biology minor is, however, available to all UTSA students who seek to complement a different academic major with a strong foundation in biology.

- B.S. degree in Biology (p. 1)
- B.S. degree in Microbiology and Immunology (p. 6)y (<http://catalog.utsa.edu/undergraduate/sciences/biology/#microbiology>)

Bachelor of Science Degree in Biology

The minimum number of semester credit hours required for the Bachelor of Science (B.S.) degree in Biology, including the Core Curriculum requirements, is 120. To complete the concentration in Biology Teaching Certification requires a minimum of 124 semester credit hours. Thirty-nine of the total semester credit hours required for the degree must be at the upper-division level. All major and support work courses and the required prerequisites must be completed with a grade of "C-" or better.

For students wishing to add focus and expertise to their degree, the Department of Biology also offers the B.S. degree in Biology with a concentration in one of six areas: Cell and Molecular Biology, Integrative Biology, Neurobiology, Plant Biology, Pre-Medical Sciences, and Grades 7–12 Biology Teacher Certification. Specific grade point average

requirements and courses required for each concentration are listed following the general degree requirements.

Due to extensive curriculum overlap, students cannot receive a double major in Biology and Microbiology and Immunology. Students must choose between a B.S. in Biology or a B.S. in Microbiology and Immunology.

Sophomore Biology Research Initiative

In the sophomore year, students may take the required laboratories Molecular Genetics Laboratory (BIO 2362) and Molecular Biochemistry Laboratory (BIO 3362) alone as standard courses, or in conjunction with the Sophomore Biology Research Initiative (SBRI). SBRI gives second year students the opportunity to engage in authentic research with faculty and graduate students. Students working in teams will conduct their own research projects on a specific biological problem over two semesters. Several different research topics will be available to choose from. There will be approximately two hours of lecture/lab meeting and six hours of lab work per week. Students will receive credit for BIO 2362 and BIO 3362 and be concurrently enrolled in 3 semester credit hours of Independent Study to reflect the additional hours required to complete their research. Students will present their final data in poster format at an organized symposium. The opportunity to be part of the SBRI is limited, students should register early.

All candidates for this degree must fulfill the Core Curriculum requirements and the degree requirements, which are listed below.

Core Curriculum Requirements (42 semester credit hours)

Students seeking the B.S. degree in Biology 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. (Students in the teaching concentration can substitute STA 1053 for MAT 1193.) Two of the following courses may be used to satisfy the core requirement in Life and Physical Sciences, as well as major requirements: BIO 1404, BIO 1414, PHY 1943 or PHY 1963. CS 1173 may be used to satisfy the core requirement in Component Area Option as well as a major requirement.

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

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

Gateway Courses

Students pursuing the B.S. degree in Biology 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 his or her major.

BIO 1404	Biosciences I
BIO 1414	Biosciences II
BIO 2313	Genetics

Degree Requirements

A. Required courses in the major

1. Biology requirements:		
BIO 1404	Biosciences I	4
BIO 1414	Biosciences II	4
BIO 2313	Genetics	3
BIO 3413	Physiology	3
BIO 3513	Biochemistry	3
BIO 3813	Cell Biology	3
2. Select one of the following laboratory options:		4-7

Option 1 Standard Class Laboratory		
BIO 2362	Molecular Genetics Laboratory	
BIO 3362	Molecular Biochemistry Laboratory	
Option 2 Sophomore Research Initiative		
BIO 2362 & BIO 4911	Molecular Genetics Laboratory and Independent Study	
BIO 3362 & BIO 4912	Molecular Biochemistry Laboratory and Independent Study	

Note: In laboratory Option 1 students will learn laboratory techniques in a standard class setting. In laboratory Option 2 students will learn laboratory techniques while conducting research on a specific biological problem over two semesters. There will be several different research topics offered for Option 2.

3. Biology electives:	
Additional biology electives at the upper-division level	21

B. Support work

The support courses listed below are mandatory prerequisites for various biology courses starting in a student's sophomore year. 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 biology 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:		
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	Organic Chemistry II	3
2. Required mathematics and statistics courses:		
MAT 1193	Calculus for the Biosciences	3
STA 1403	Probability and Statistics for the Biosciences	3

Students pursuing the Grades 7–12 Teacher Certification concentration can substitute STA 1053 for both MAT 1193 and STA 1403.

3. Required physics courses selected from one of the following options: 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 *

4. Required computer science course:

CS 1173	Data Analysis and Visualization	3
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C. Free electives

Select 9-12 semester credit hours of free electives, depending on laboratory sequence chosen under section A2, to complete 120 hours. 1-4 credit hours must be at the upper-division level to reach the minimum requirement of 39 upper-division semester credit hours.

Students pursuing the Grades 7–12 Teacher Certification concentration will take required courses for teacher certification in lieu of free electives (see concentration requirements below).

Total Credit Hours 90

Note: Students in the 7-12 Teaching Certification Concentration have a defined program of study outlined below. Physics laboratories noted by an asterisk () are not required for the teaching certification concentration.

Concentrations

For students interested in research, teaching, graduate, or professional programs, the Department of Biology offers six areas of concentration. To declare a concentration or obtain advice, students should consult an undergraduate advisor in Life and Health Sciences Advising. If a student takes any of the courses listed below that satisfy both the Biology degree and concentration requirements, then the student may need to take additional upper-division Biology courses in order to meet the minimum number of semester credit hours required for the Biology degree. Students who do not satisfy all requirements of a given concentration will receive a standard B.S. degree in Biology.

Concentration in Cell and Molecular Biology

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

All candidates for the Concentration in Cell and Molecular Biology must complete the following:

BIO 3913	Molecular Biology	3
Select three of the following: 9		
BIO 3933	Principles of Cancer Biology	
BIO 4143	Developmental Biology	

BIO 4453	Endocrinology	
BIO 4723	Virology	
BIO 4743	Immunology	
BIO 4923	Laboratory Research: Biology Concentrations (Research must be in a laboratory engaged in molecular biology research.)	

Total Credit Hours 12

Concentration in Integrative Biology

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

All candidates for the Concentration in Integrative Biology must complete the following:

BIO 3283	Principles of Ecology	3
BIO 3292	Principles of Ecology Laboratory	2
Select two of the following: 6		

BIO 3213	Animal Behavior	
BIO 3323	Evolution	
BIO 4033	Conservation Biology	
BIO 4053	Wildlife Biology	
BIO 4063	Ornithology	
BIO 4233	Field Biology	
BIO 4923	Laboratory Research: Biology Concentrations (Research must be in a laboratory engaged in integrative biology research.)	

Total Credit Hours 11

Concentration in Neurobiology

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

All candidates for the Concentration in Neurobiology must complete the following:

BIO 3433	Neurobiology	3
BIO 3442	Neurobiology Laboratory	2

*Note: If a student has completed a SBRI course sequence (BIO 2362 and BIO 3362) in the area of neurobiology it can be substituted for BIO 3442.

Select two of the following: 6		
BIO 3213	Animal Behavior	
BIO 3623	Neuropsychopharmacology	
BIO 4583	The Computational Brain	
BIO 4813	Brain and Behavior	
BIO 4823	Cognitive Neuroscience	
BIO 4923	Laboratory Research: Biology Concentrations (Research must be in a laboratory engaged in neurobiology research.)	

Total Credit Hours 11

Concentration in Plant Biology

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

All candidates for the Concentration in Plant Biology must complete the following:

BIO 3343	Plant Cell Biology	3
Select three of the following:		9
BIO 3263	The Woody Plants	
BIO 3273	Biology of Flowering Plants	
BIO 3333	Plants and Society	
BIO 4643	Medicinal Plants	
BIO 4923	Laboratory Research: Biology Concentrations (Research must be in a laboratory engaged in plant-based research.)	
Total Credit Hours		12

Concentration in Pre-Medical Sciences

The B.S. degree in Biology with a concentration in Pre-Medical Sciences is designed to prepare students for professional programs in medicine, dentistry, pharmacy or veterinary science. This concentration has a recommended curriculum that is designed to meet the requirements for entry into these professional schools and to prepare students for the MCAT, DAT, PCAT or GRE examinations. Students will have the option to enroll in small specialty courses that are medically focused. For completion of the Pre-Medical Sciences Concentration students must have both an overall math/science GPA of 3.5 or higher, and complete all required coursework within the concentration with a minimum GPA of 3.5 or higher. All candidates for the concentration in Pre-Medical Sciences must complete the following:

BIO 3713	Microbiology	3
BIO 3722	Microbiology Laboratory	2
BIO 3433	Neurobiology	3
BIO 4743	Immunology	3
BIO 4813	Brain and Behavior	3
or BIO 3213	Animal Behavior	
BIO 4842	Clinical Gross Anatomy	2
PSY 1013	Introduction to Psychology	3
Total Credit Hours		19

Concentration in Grades 7–12 Biology Teacher Certification

The B.S. degree in Biology with Teacher Certification is designed to prepare students for professional careers in teaching Biology at the level of secondary education. The program of study is structured around a comprehensive Biology core curriculum and state requirements for grades 7–12 life science teaching certification. Students cannot receive a B.S. degree with Teacher Certification without completing the teacher certification coursework. A student who does not complete the Biology teacher certification must transfer to the B.S. degree in Biology or the B.S. degree in Microbiology and Immunology in order to receive a degree in Biology. Undergraduates seeking elementary teacher certification must complete the Interdisciplinary Studies degree.

The minimum number of semester credit hours required for the Bachelor of Science degree in Biology with Teacher Certification, including the Core Curriculum requirements, is 124. Thirty-nine of the total semester credit

hours required for the degree must be at the upper-division level. The coursework within the Biology Teacher concentration must be completed with a minimum cumulative grade point average of 2.5 or better.

All candidates for the Concentration in Grades 7–12 Biology Teacher Certification must complete the following:

BIO 3043	UTeachSA Research Methods	3
BIO 3283	Principles of Ecology	3
BIO 3323	Evolution	3
BIO 3713	Microbiology	3
BIO 4813	Brain and Behavior	3
ESL 3083	Second Language Teaching and Learning for Grades 7-12	3
LTED 3773	Reading and Writing Across the Disciplines-Grades 7–12	3
UTE 1111	Introduction to STEM Teaching Step 1	1
UTE 1122	Introduction to STEM Teaching Step 2	2
UTE 3023	Perspectives on Science and Mathematics	3
UTE 3203	Knowing and Learning in Mathematics and Science	3
UTE 3213	Classroom Interactions	3
UTE 4203	Project-Based Instruction	3
UTE 4646	Clinical Teaching	6
Total Credit Hours		42

Course Sequence Guide for B.S. Degree in Biology

B.S. in Biology – Recommended Four-Year Academic Plan

First Year

Fall		Credit Hours
AIS 1203	Academic Inquiry and Scholarship (core)	3
BIO 1404	Biosciences I (core and major) ¹	4
CHE 1103	General Chemistry I ¹	3
CHE 1121	General Chemistry I Laboratory	1
WRC 1013	Freshman Composition I (core)	3
Credit Hours		14

Spring

BIO 1414	Biosciences II (core and major) ¹	4
CHE 1113	General Chemistry II	3
CHE 1131	General Chemistry II Laboratory	1
CS 1173	Data Analysis and Visualization (core and major)	3
MAT 1193	Calculus for the Biosciences (core and major) ¹	3
WRC 1023	Freshman Composition II (core)	3
Credit Hours		17

Second Year

Fall		Credit Hours
BIO 2313	Genetics ¹	3
Select one of the following Laboratory Options:		2-3
Option 1 Standard Laboratory Class		
BIO 2362	Molecular Genetics Laboratory	
or		
Option 2 Biology Research Initiative		

BIO 2362 & BIO 4911	Molecular Genetics Laboratory and Independent Study	
CHE 2603	Organic Chemistry I	3
CHE 2612	Organic Chemistry I Laboratory	2
Select one of the following:		4
PHY 1603	Algebra-based Physics I ¹	
PHY 1611	Algebra-based Physics I Laboratory	
or		
PHY 1943	Physics for Scientists and Engineers I ¹	
PHY 1951	Physics for Scientists and Engineers I Laboratory	
	Credit Hours	14-15

Spring

Select one of the following Laboratory Options:		2-4
Option 1 Standard Laboratory Class		
BIO 3362	Molecular Biochemistry Laboratory	
or		
Option 2 Biology Research Initiative		
BIO 3362 & BIO 4912	Molecular Biochemistry Laboratory and Independent Study	
Free elective for those choosing Option 1 laboratory		3
CHE 3643	Organic Chemistry II	3
STA 1403	Probability and Statistics for the Biosciences	3
Select one of the following:		4
PHY 1623	Algebra-based Physics II	
PHY 1631	Algebra-based Physics II Laboratory	
or		
PHY 1963	Physics for Scientists and Engineers II	
PHY 1971	Physics for Scientists and Engineers II Laboratory	
	Credit Hours	15-14

Third Year

Fall		
BIO 3513	Biochemistry	3
BIO 3413	Physiology	3
Upper-division BIO lecture (BIO 3XX3)		3
American History core		3
Social & Behavioral Sciences core		3
	Credit Hours	15

Spring

BIO 3813	Cell Biology	3
Upper-division BIO lecture (BIO 3XX3)		3
Upper-division BIO lecture (BIO 3XX3)		3
American History core		3
Creative Arts core		3
	Credit Hours	15

Fourth Year

Fall		
Upper-division BIO elective		3
Upper-division BIO elective		3

Government-Political Science core	3	
Language, Philosophy & Culture core	3	
Free elective	3	
	Credit Hours	15

Spring

Upper-division BIO elective	3	
Upper-division BIO elective	3	
Government-Political Science core	3	
Select one of the following depending on laboratory option:	6	
Option 1: Two upper-division free electives		
or		
Option 2: Two free electives (one must be an upper-division course)		
	Credit Hours	15
	Total Credit Hours	120

¹ In order to remain a Biology major, a student must complete these six courses within 60 semester credit hours.

Note: Some courses are only offered once a year; Fall or Spring. Check with the Department of Biology for scheduling of courses.

B.S. in Biology with Teaching Certification – Recommended Four-Year Academic Plan**First Year**

Fall		Credit Hours
AIS 1203	Academic Inquiry and Scholarship (core)	3
BIO 1404	Biosciences I (core and major) ¹	4
CHE 1103	General Chemistry I ¹	3
CHE 1121	General Chemistry I Laboratory	1
WRC 1013	Freshman Composition I (core)	3
UTE 1111	Introduction to STEM Teaching Step 1	1
	Credit Hours	15

Spring

BIO 1414	Biosciences II (core and major) ¹	4
CHE 1113	General Chemistry II	3
CHE 1131	General Chemistry II Laboratory	1
WRC 1023	Freshman Composition II (core)	3
UTE 1122	Introduction to STEM Teaching Step 2	2
Select one of the following: ¹		3
MAT 1193	Calculus for the Biosciences (core)	
STA 1053	Basic Statistics (core)	
	Credit Hours	16

Summer

American History core	3	
Government-Political Science core	3	
	Credit Hours	6

Second Year

Fall		
BIO 2313	Genetics ¹	3
CHE 2603	Organic Chemistry I	3

CHE 2612	Organic Chemistry I Laboratory	2
CS 1173	Data Analysis and Visualization (core and major)	3
UTE 3203	Knowing and Learning in Mathematics and Science	3
Select one of the following:		3
PHY 1603	Algebra-based Physics I ¹	
or		
PHY 1943	Physics for Scientists and Engineers I ¹	
Credit Hours		17

Spring

BIO 2362	Molecular Genetics Laboratory	2
CHE 3643	Organic Chemistry II	3
UTE 3213	Classroom Interactions	3
Social & Behavioral Sciences core		3
Select one of the following:		3
PHY 1623	Algebra-based Physics II	
or		
PHY 1963	Physics for Scientists and Engineers II	
Credit Hours		14

Summer

American History core		3
Government-Political Science core		3
Credit Hours		6

Third Year

Fall

BIO 3283	Principles of Ecology	3
BIO 3362	Molecular Biochemistry Laboratory	2
BIO 3513	Biochemistry	3
BIO 3713	Microbiology	3
UTE 3023	Perspectives on Science and Mathematics	3
Credit Hours		14

Spring

BIO 3413	Physiology	3
BIO 4813	Brain and Behavior	3
ESL 3083	Second Language Teaching and Learning for Grades 7-12	3
LTED 3773	Reading and Writing Across the Disciplines-Grades 7-12	3
Language, Philosophy, & Culture core		3
Credit Hours		15

Fourth Year

Fall

BIO 3323	Evolution	3
BIO 3813	Cell Biology	3
BIO 3043	UTeachSA Research Methods	3
UTE 4203	Project-Based Instruction	3
Creative Arts core		3
Credit Hours		15

Spring

UTE 4646	Clinical Teaching	6
Credit Hours		6
Total Credit Hours		124

¹ In order to remain Biology major, a student must complete these six courses within 60 semester credit hours.

Note: Some courses are only offered once a year; Fall or Spring. Check with the Department of Biology for scheduling of courses.

Bachelor of Science Degree in Microbiology and Immunology

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

Due to extensive curriculum overlap, students cannot receive a double major in Biology and Microbiology and Immunology. Students must choose between a B.S. in Biology or a B.S. in Microbiology and Immunology.

Sophomore Biology Research Initiative

In the sophomore year students can take the required laboratories Molecular Genetics Laboratory (BIO 2362) and Molecular Biochemistry Laboratory (BIO 3362) alone as standard courses, or in conjunction with the Sophomore Biology Research Initiative (SBRI). SBRI gives second year students the opportunity to engage in authentic research with faculty and graduate students. Students working in teams will conduct their own research projects on a specific biological problem over two semesters. Several different research topics will be available to choose from. There will be approximately two hours of lecture/lab meeting and six hours of lab work per week. Students will receive credit for BIO 2362 and BIO 3362 and be concurrently enrolled in three credit hours of Independent Study to reflect the additional hours required to complete their research. Students will present their final data in poster format at an organized symposium. The opportunity to be part of the SBRI is limited, students should register early.

All candidates for this degree must fulfill the Core Curriculum requirements and the degree requirements, which are listed below.

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 1404, BIO 1414, PHY 1943 or PHY 1963.

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

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

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 his or her major.

BIO 1404	Biosciences I
BIO 1414	Biosciences II
BIO 2313	Genetics

Degree Requirements

A. Required courses in the major, 34 of which must be at the upper-division level

1. Required biology courses:	
BIO 1404	Biosciences I 4
BIO 1414	Biosciences II 4
BIO 2313	Genetics 3
BIO 3413	Physiology 3
BIO 3513	Biochemistry 3
BIO 3813	Cell Biology 3
BIO 3713 & BIO 3722	Microbiology and Microbiology Laboratory 5
BIO 4743 & BIO 4752	Immunology and Immunology Laboratory 5
BIO 4783	Microbial Genetics and Physiology 3
2. Select one of the following laboratory options: 4-7	
Option 1 Standard Laboratory Class	
BIO 2362	Molecular Genetics Laboratory
BIO 3362	Molecular Biochemistry Laboratory
Option 2 Research Initiative	
BIO 2362 & BIO 4911	Molecular Genetics Laboratory and Independent Study
BIO 3362 & BIO 4912	Molecular Biochemistry Laboratory and Independent Study

Note: Laboratory Option 1 students will learn laboratory techniques in standard class setting. In laboratory Option 2 students will learn laboratory techniques while conducting research on a specific biological problem over two semesters. There will be different research stream topics offered for Option 2.

3. All candidates must complete three of the following prescribed upper-division elective courses: 9	
BIO 3013	Introduction to Clinical Medicine and Pathology
BIO 3743	Bacteriology
BIO 4473	Advanced Clinical Medicine and Pathology
BIO 4483	Medical Mycology
BIO 4723	Virology
BIO 4763	Parasitology
BIO 4923	Laboratory Research: Biology Concentrations

B. Support work

The support courses listed below are mandatory prerequisites for various biology courses starting in a student's sophomore year. 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 biology 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:	
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	Organic Chemistry II 3
CHE 3652	Organic Chemistry II Laboratory 2
2. Required mathematics and statistics courses:	
MAT 1193	Calculus for the Biosciences 3
STA 1403	Probability and Statistics for the Biosciences 3
3. Required physics courses selected from one of the following options: 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	
Select 6-9 semester credit hours of free electives, depending on the laboratory sequence chosen under section A2, to complete 120 hours. For students selecting option 1, at least 1 credit hour must be at the upper-division level to reach the minimum requirement of 39 upper-division semester credit hours.	6-9

Total Credit Hours	87
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Course Sequence Guide for B.S. Degree in Microbiology and Immunology

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

First Year

		Credit Hours
Fall		
AIS 1203	Academic Inquiry and Scholarship (core)	3
BIO 1404	Biosciences I (core and major) ¹	4
CHE 1103	General Chemistry I ¹	3
CHE 1121	General Chemistry I Laboratory	1
WRC 1013	Freshman Composition I (core)	3
Credit Hours		14

Spring

BIO 1414	Biosciences II (core and major) ¹	4
CHE 1113	General Chemistry II	3
CHE 1131	General Chemistry II Laboratory	1
MAT 1193	Calculus for the Biosciences (core and major) ¹	3
WRC 1023	Freshman Composition II (core)	3
Credit Hours		14

Second Year

		Credit Hours
Fall		
BIO 2313	Genetics ¹	3
Select on of the following Laboratory Options:		2-3
Option 1 Standard Laboratory Class		
BIO 2362	Molecular Genetics Laboratory	
Or		
Option 2 Biology Research Initiative		
BIO 2362 & BIO 4911	Molecular Genetics Laboratory and Independent Study	
CHE 2603	Organic Chemistry I	3
CHE 2612	Organic Chemistry I Laboratory	2
Select one of the following:		4
PHY 1603	Algebra-based Physics I ¹	
PHY 1611	Algebra-based Physics I Laboratory	
Or		
PHY 1943	Physics for Scientists and Engineers I ¹	
PHY 1951	Physics for Scientists and Engineers I Laboratory	
Credit Hours		14-15

Spring

Select one of the following Laboratory Options:		2-4
Option 1 Standard Laboratory Class		
BIO 3362	Molecular Biochemistry Laboratory	
Or		
Option 2 Biology Research Initiative		
BIO 3362 & BIO 4912	Molecular Biochemistry Laboratory and Independent Study	
CHE 3643	Organic Chemistry II	3
CHE 3652	Organic Chemistry II Laboratory	2

STA 1403	Probability and Statistics for the Biosciences	3
Select one of the following:		4
PHY 1623	Algebra-based Physics II	
PHY 1631	Algebra-based Physics II Laboratory	
Or		
PHY 1963	Physics for Scientists and Engineers II	
PHY 1971	Physics for Scientists and Engineers II Laboratory	
Credit Hours		14-16

Third Year

		Credit Hours
Fall		
BIO 3413	Physiology	3
BIO 3513	Biochemistry	3
BIO 3713	Microbiology	3
BIO 3722	Microbiology Laboratory	2
American History core		3
Social & Behavioral Sciences core		3
Credit Hours		17

Spring

BIO 3813	Cell Biology	3
BIO 4743	Immunology	3
BIO 4752	Immunology Laboratory	2
American History core		3
Creative Arts core		3
Upper-division free elective for those choosing Option 1 laboratory.		3
Credit Hours		17-14

Fourth Year

		Credit Hours
Fall		
Upper-division Microbiology elective		3
Upper-division Microbiology elective		3
Government-Political Science core		3
Language, Philosophy, & Culture core		3
Upper-division free elective		3
Credit Hours		15
Spring		
BIO 4783	Microbial Genetics and Physiology	3
Upper-division Microbiology elective		3
Government-Political Science core		3
Component Area Option core		3
Upper-division free elective		3
Credit Hours		15
Total Credit Hours		120

¹ In order to remain Molecular and Immunology major, a student must complete these six courses within 60 semester credit hours.

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

Minor in Biology

The Minor in Biology is open to all majors in the University. To declare a Minor in Biology or obtain advice, students should consult with their academic advisor. All students pursuing the minor must complete a minimum of 20 semester credit hours of Biology courses. It should be noted that students seeking a minor must also complete applicable support coursework in chemistry, computer science, physics, mathematics and statistics, as needed to fulfill the normal prerequisites for any course listed below. All Biology courses and their prerequisites must be completed with a grade of "C-" or better, and students must achieve a grade point average of at least 2.0 on all work used to satisfy the requirements of the minor.

A. Required courses

BIO 1404	Biosciences I	4
BIO 1414	Biosciences II	4
BIO 2313	Genetics	3

B. 3000- or 4000-level organized biology courses

Three upper-division biology lecture courses. Excludes laboratory, independent study, research and seminar courses. Substitutions are not allowed without approval of the Biology department.

Total Credit Hours 20

Certificate in Pathogenic Outbreak Investigations

This interdisciplinary certificate program is designed for students in biology, information systems and cyber security, computer science and computer engineering disciplines to investigate biological and digital pathogen identification, propagation prediction, and mitigation. The required capstone project reinforces the cross-disciplinary learning fostered by the program and provides real-world practice.

This certificate is open only to biology, information systems and cyber security, computer science, and computer engineering majors. To apply for the Pathogenic Outbreak Investigations certificate, students should consult with the Director of the Office of Undergraduate Research for specific information about certificate requirements and consult with the Certificate Program Advisor to verify that they have met all University requirements. All courses used to satisfy the requirements of this undergraduate certificate program must be college-level courses taken at UTSA. Students must fulfill all prerequisite requirements for elective courses.

Students pursuing the Certificate in Pathogenic Outbreak Investigations must complete a minimum of 15 semester credit hours:

A. Courses required by all majors:

Topic: Introduction to Pathogenic Outbreak Investigations:	3
BIO 4953 Special Studies in Biology	
or CS 4593 Topics in Computer Science	
or IS 3313 Introduction to Pathogenic Outbreak Investigations	

Topic: Advanced Research in Pathogenic Outbreak Investigations:	3
BIO 4953 Special Studies in Biology	
or CS 4913 Independent Study	
or IS 4953 Special Studies in Information Systems	

B. Required course according to major:	3
BIO 3713 Microbiology	

CS 4593	Topics in Computer Science (Cloud Computing)	
IS 4533	Malware Analysis	
C. Elective courses for each major. Select 6 hours from one of the following groups depending on major:		6
Biology elective options ¹		
BIO 3513	Biochemistry	
BIO 3743	Bacteriology	
BIO 4743	Immunology	
BIO 5762	Fundamentals of Immunology for Biotechnology	
BIO 6973	Special Problems (Comparative Genomics)	
BIO 6973	Special Problems (Microbial Genomics)	
Information Systems/Cyber Security elective options		
IS 3523	Intrusion Detection and Incident Response	
IS 4463	Web Application Security	
IS 4483	Digital Forensic Analysis I	
IS 4513	Industrial Control Systems	
IS 4523	Digital Forensic Analysis II	
Computer Science elective options		
CS 3113	Principles of Cyber Security	
CS 3433	Computer and Information Security	
CS 3753	Data Science	
CS 3873	Computer Networks	
CS 4223	Bioinformatics and Big Data	
CS 4353	Unix and Network Security	
CS 4363	Cryptography	
CS 4373	Data Mining	
CS 4593	Topics in Computer Science	
CS 4633	Simulation Techniques	
CS 4643	Cellular and Mobile Technologies	
CS 4653	Software and Malware Reverse Engineering	
CS 4663	Distributed and Cloud Systems Security	
CS 4673	Cyber Operations	
CS 4683	Secure Software Development and Analysis	
CS 4713	Compiler Construction	
CS 4823	Parallel Programming	
CS 4833	Embedded Systems	
CS 4843	Cloud Computing	
CS 4853	Advanced Systems Programming	
CS 4863	Distributed Computing and Systems	
CS 4933	Internship in Computer Science	
CS 4963	Advanced Topics in Systems and Cloud	
CS 4973	Advanced Topics in Data Science	
Total Credit Hours		15

¹ Undergraduate biology students are permitted to take graduate courses based on need, student background/capability, and instructor consent.

Biology (BIO) Courses

BIO 1033. Drugs and Society. (3-0) 3 Credit Hours. (TCCN = PHED 1346)

An examination of licit and illicit drugs and their biosocial effects. Topics include pharmacology of alcohol, stimulants, hallucinogens, addiction, and abuse. May be applied toward the Core Curriculum requirement in Social and Behavioral Sciences. Generally offered: Fall, Spring. Course Fees: LRC1 \$12; LRS1 \$45; STSI \$21.

BIO 1053. Introductory Microbiology. (3-0) 3 Credit Hours. (TCCN = BIOL 2320)

Prerequisite: BIO 1233 or BIO 1404. A general study of microorganisms, their characteristics, isolation, growth, and importance in nature, industry, public health, and human disease. (Formerly AHS 1053. Credit cannot be earned for both BIO 1053 and AHS 1053. BIO 1053 cannot substitute for BIO 3713.) Generally offered: Fall, Spring. Course Fees: LRS1 \$45; STSI \$21.

BIO 1061. Introductory Microbiology Laboratory. (0-3) 1 Credit Hour. (TCCN = BIOL 2120)

Prerequisites: BIO 1233 or BIO 1404, and completion of or concurrent enrollment in BIO 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, Microbiology Teaching Labs, for additional instructions prior to the class start date. (Formerly AHS 1061. Credit cannot be earned for both BIO 1061 and AHS 1061. BIO 1061 cannot substitute for BIO 3722.) Generally offered: Fall, Spring, Summer. Course Fees: IUB1 \$10; L001 \$30; LRS1 \$15; STSI \$7.

BIO 1233. Contemporary Biology I. (3-0) 3 Credit Hours. (TCCN = BIOL 1308)

This is the first course in a two-part introduction to the science of biology for non-majors. This course focuses on the chemical basis of life, principles of inheritance, principles of evolution and biodiversity. May be applied toward the Core Curriculum requirement in Life and Physical Sciences. May not be applied to a B.S. degree in Biology or B.S. degree in Microbiology and Immunology. Generally offered: Fall, Spring. Course Fees: LRC1 \$12; LRS1 \$45; STSI \$21.

BIO 1243. Contemporary Biology II. (3-0) 3 Credit Hours. (TCCN = BIOL 1309)

This is the second course in a two-part introduction to the science of biology for non-majors. This course focuses on evolution, animal and plant physiology, and ecology. May be applied toward the Core Curriculum requirement in Life and Physical Sciences. May not be applied to a B.S. degree in Biology or the B.S. degree in Microbiology and Immunology. Generally offered: Fall, Spring, Summer. Course Fees: DL01 \$75; LRC1 \$12; LRS1 \$45, STSI \$21.

BIO 1404. Biosciences I. (3-4) 4 Credit Hours. (TCCN = BIOL 1406)

Prerequisite: Completion of or concurrent enrollment in one of the following: STA 1053, MAT 1023, MAT 1073, or higher. This is the first course in a two-part introduction to the science of biology for students majoring in biology or interested in pre-health professions. Topics include biochemistry, cell biology, genetics and molecular biology. The course includes 3 hours of lecture and a mandatory 3.5-hour laboratory per week. May be applied toward the Core Curriculum requirement in Life and Physical Sciences. (Formerly BIO 1113 and BIO 1203. Credit cannot be earned for both BIO 1404 and BIO 1113 or BIO 1203.) Generally offered: Fall, Spring, Summer. Course Fees: IUB1 \$10; L001 \$30; LRC1 \$16; LRS1 \$60; STSI \$28.

BIO 1414. Biosciences II. (3-4) 4 Credit Hours. (TCCN = BIOL 1407)

Prerequisites: BIO 1404 and completion of or concurrent enrollment in one of the following: STA 1053, MAT 1023, MAT 1073, or higher. This is the second course in a two-part introduction to the science of biology for students majoring in biology or interested in pre-health professions. Topics include evolutionary biology, biotic diversity, plant structure and function, and ecology. The course includes 3 hours of lecture and a mandatory 3.5-hour laboratory per week. May be applied toward the Core Curriculum requirement in Life and Physical Sciences. (Formerly BIO 1143, BIO 1223 and BIO 1413. Credit cannot be earned for more than one of the following: BIO 1143, BIO 1223, BIO 1413, BIO 1414, or ES 2013.) Generally offered: Fall, Spring, Summer. Course Fees: IUB1 \$10; L001 \$30; LRC1 \$16; LRS1 \$60; STSI \$28.

BIO 2003. Biology of Human Reproduction. (3-0) 3 Credit Hours.

An in-depth look at human reproductive anatomy, physiology, and behavior. Topics to be considered include anatomy, sex differentiation, neuroendocrine physiology, conception and development, birth control, and sexually transmitted diseases. (Formerly BIO 1023. Credit cannot be earned for both BIO 2003 and BIO 1023.) Generally offered: Spring. Course Fees: LRS1 \$45; STSI \$21.

BIO 2043. Nutrition. (3-0) 3 Credit Hours. (TCCN = BIOL 1322)

Prerequisite: BIO 1233 or BIO 1404. In-depth study of nutrient classes in foods: their ingestion, digestion, absorption and utilization by the human body. Clinical consequences of nutrient deficiency or excess, and Medical Nutrition Therapy to complement management of disease. (Formerly AHS 2043. Same as NDT 2043. Credit cannot be earned for more than one of the following courses: AHS 2043, BIO 2043, or NDT 2043.) Generally offered: Fall, Spring, Summer. Course Fees: LRS1 \$45; STSI \$21.

BIO 2051. Human Anatomy and Physiology Laboratory I. (0-3) 1 Credit Hour. (TCCN = BIOL 2101)

Prerequisite: BIO 1233 or BIO 1404. Concurrent enrollment in BIO 2053 is recommended. This laboratory supplements the BIO 2053 lecture. It is the first of a two-course laboratory sequence that uses both dissections of representative organisms and laboratory experimentation to study human anatomical systems and physiological processes. (Credit cannot be earned for both BIO 2051 and BIO 2091. BIO 2051 cannot substitute for BIO 3422.) Generally offered: Fall, Spring, Summer. Course Fees: IUB1 \$10; L001 \$30; LRS1 \$15; STSI \$7.

BIO 2053. Human Anatomy and Physiology I. (3-0) 3 Credit Hours. (TCCN = BIOL 2301)

Prerequisite: BIO 1233 or BIO 1404. Concurrent enrollment in BIO 2051 is recommended. This is the first of a two-course sequence that provides an integrative study of the anatomy and physiology of the human body with an emphasis on the structure/function interrelationships between organ systems. Topics covered include cell and tissue biology, the integumentary, skeletal, muscular, and nervous systems. (Credit cannot be earned for both BIO 2053 and BIO 2083. BIO 2053 cannot substitute for BIO 3413.) Generally offered: Fall, Spring, Summer. Course Fees: LRS1 \$45; STSI \$21.

BIO 2061. Human Anatomy and Physiology Laboratory II. (0-3) 1 Credit Hour. (TCCN = BIOL 2102)

Prerequisite: BIO 2051. Concurrent enrollment in BIO 2063 is recommended. This laboratory supplements the BIO 2063 lecture. It is the second of a two-course laboratory sequence that uses both dissections of representative organisms and laboratory experimentation to study human anatomical systems and physiological processes. (Credit cannot be earned for both BIO 2061 and BIO 2111. BIO 2061 cannot substitute for BIO 3422.) Generally offered: Fall, Spring, Summer. Course Fees: IUB1 \$10; L001 \$30; LRS1 \$15; STSI \$7.

BIO 2063. Human Anatomy and Physiology II. (3-0) 3 Credit Hours. (TCCN = BIOL 2302)

Prerequisite: BIO 2053. Concurrent enrollment in BIO 2061 is recommended. This is the second of a two-course sequence that provides an integrative study of the anatomy and physiology of the human body with an emphasis on the structure/function interrelationships between organ systems. Topics covered include the endocrine, digestive, respiratory, cardiovascular, lymphatic/immune, renal and reproductive systems. Human growth and development will also be covered. (Credit cannot be earned for both BIO 2063 and BIO 2103. BIO 2063 cannot substitute for BIO 3413.) Generally offered: Fall, Spring, Summer. Course Fees: LRS1 \$45; STSI \$21.

BIO 2313. Genetics. (3-0) 3 Credit Hours. (TCCN = BIOL 2316)

Prerequisites: BIO 1414 and completion or concurrent enrollment in one of the following: MAT 1093 (or higher) or STA 1053. Principles governing transmission of hereditary factors in plants and animals, with emphasis on molecular, biochemical, and population genetics. Generally offered: Fall, Spring, Summer. Course Fees: LRS1 \$45; STSI \$21.

BIO 2362. Molecular Genetics Laboratory. (1-4) 2 Credit Hours.

Prerequisites: BIO 1414, CHE 1103, and completion or concurrent enrollment in MAT 1093 or higher. A study of techniques used to investigate the inheritance of genetic information at the molecular level. Students will gain an understanding of the structure, function and regulation of genes. Techniques will include; nucleic acid biochemistry, molecular cloning mutagenesis and bioinformatics. (Formerly BIO 2322. Credit cannot be earned for both BIO 2362 and BIO 2322. Generally offered: Fall, Spring, Summer. Course Fees: L001 \$30; LRS1 \$30; STSI \$14.

BIO 2953. Special Topics in Biology. (3-0) 3 Credit Hours.

An organized course offering the opportunity for specialized study not normally or not often available as part of the regular course offerings. Special Topics may be repeated for credit when the topics vary, but not more than 6 semester credit hours will apply to a bachelor's degree, regardless of discipline. No more than 6 semester credit hours of BIO 2953, BIO 4951, or BIO 4953 can be applied to a Bachelor of Science degree in Biology or Microbiology and Immunology. Course Fees: LRS1 \$45; STSI \$21.

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

Prerequisite: BIO 2313. Introduction to concepts of human disease, diagnosis, and underlying pathology. Generally offered: Fall. Differential Tuition: \$150.

BIO 3043. UTeachSA Research Methods. (3-0) 3 Credit Hours.

Prerequisite: This course is only open to students who are participating in the UTeachSA teacher preparation program. Students design and carry out independent inquiries, which they write up and present in the manner that is common in the scientific community. Inquiries incorporate mathematics and the various science disciplines to solve research problems. Only 6 semester credit hours of BIO 3043, BIO 4911-3, BIO 4923 and BIO 4993, in any combination, can be taken as BIO 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. (Credit cannot be earned for both BIO 3043 and UTE 3043.) Generally offered: Fall, Spring. Differential Tuition \$150.

BIO 3123. Comparative Vertebrate Anatomy. (3-0) 3 Credit Hours.

Prerequisite: BIO 2313. A comparative analysis of developmental and adult anatomy of vertebrates (including human). Emphasis is placed on phylogenetic relationships between form, function and evolution. (Formerly BIO 2123. Credit cannot be earned for both BIO 2123 and BIO 3123.) Generally offered: Spring. Differential Tuition: \$150.

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

Prerequisite: BIO 2313 or consent of instructor. This course will introduce various approaches to the study of animals and their behavior in natural habitats. The course will examine basic principles derived from studying the evolution, ecology and development of animals, and use these principles to explain how and why animals behave as they do in particular situations. Generally offered: Fall, Summer, Spring. Differential Tuition \$150.

BIO 3263. The Woody Plants. (2-3) 3 Credit Hours.

Prerequisite: BIO 2313 and junior or senior status: a minimum of 60 semester credit hours. A study of the woody plants emphasizing the characteristics of family, genus, and species. Includes identification of the common woody plants. Leaf, stem, and flower morphology, anatomy, and collecting techniques. Lecture, laboratory, and fieldwork will be included as part of the course. (Same as ES 3223. Credit cannot be earned for both BIO 3263 and ES 3223.) Generally offered: Fall. Differential Tuition: \$150. Course Fee: STFB \$40.

BIO 3273. Biology of Flowering Plants. (2-3) 3 Credit Hours.

Prerequisite: BIO 2313 and junior or senior status: a minimum of 60 semester credit hours. A study of the wildflowers of Texas emphasizing identification of the more common wildflowers, as well as family characteristics, flower anatomy, plant morphology, and plant-collecting techniques will be included. Lecture, laboratory, and fieldwork will be included as part of the course. (Same as ES 3213. Credit cannot be earned for both BIO 3273 and ES 3213.) Generally offered: Spring. Spring. Differential Tuition \$150.

BIO 3283. Principles of Ecology. (3-0) 3 Credit Hours.

Prerequisite: BIO 1414. A study of the interaction of organisms with their environment, with focus on ecological principles, adaptations of organisms, environmental pollution, and principles of conservation. (Credit cannot be earned for both BIO 3283 and ES 3033.) Generally offered: Fall, Spring, Summer. Differential Tuition: \$150.

BIO 3292. Principles of Ecology Laboratory. (0-6) 2 Credit Hours.

Prerequisites: BIO 1414 and completion of or concurrent enrollment in BIO 3283. A field-oriented course emphasizing modern ecological techniques, including examinations of plant and animal populations and measurement of selected chemical and physical parameters. (Credit cannot be earned for both BIO 3292 and ES 3042.) Generally offered: Fall, Spring, Summer. Differential Tuition: \$150. Course Fees: IUB1 \$10; L001 \$30; STFB \$40.

BIO 3323. Evolution. (3-0) 3 Credit Hours.

Prerequisite: BIO 2313. A discussion of theories and possible mechanisms for evolutionary changes at various levels of organization. Generally offered: Spring. Differential Tuition: \$150.

BIO 3333. Plants and Society. (3-0) 3 Credit Hours.

Prerequisite: BIO 2313. The importance of plants and plant-derived products to human health and wellbeing through the provision of food, pharmaceuticals, and other important natural products. (Formerly BIO 2343. Credit cannot be earned for both BIO 3333 and BIO 2343.) Generally offered: Spring. Spring. Differential Tuition \$150.

BIO 3343. Plant Cell Biology. (3-0) 3 Credit Hours.

Prerequisite: BIO 2313. A comprehensive study of the molecular structures and functions of plant cells and their integration into the whole plant system. (Formerly titled "Plant Sciences.") Generally offered: Spring. Spring. Differential Tuition \$150.

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

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

BIO 3382. Sophomore Research Initiative Peer Mentor. (0-0) 2 Credit Hours.

Prerequisites: BIO 3362, completion of the Sophomore Research Initiative, and instructor consent. Student will be a peer mentor for students in the Sophomore Research Initiative (SRI) in a laboratory in which they were previously enrolled, and which they completed with a grade of "A" or "B". Students will work under the guidance of a graduate teaching assistant or laboratory coordinator. Besides assisting in the laboratory, students will be expected to attend group meetings associated with the laboratory, help with setup of the laboratories and complete a written assignment at the end of the semester. Students will not have any student grading responsibility. Cannot be repeated for credit. Differential Tuition: \$100. Course Fees: IUB1 \$10; L001 \$30.

BIO 3413. Physiology. (3-0) 3 Credit Hours.

Prerequisite: BIO 2313. This course is designed to develop the skills and competencies needed by students to understand the dynamic physiological processes underlying the maintenance of homeostatic balance in animals. Topics to be covered include endocrine, neural, muscular, cardiopulmonary and renal physiology. (BIO 2103 or BIO 3153 cannot substitute for BIO 3413.) Generally offered: Fall, Spring, Summer. Differential Tuition: \$150.

BIO 3422. Physiology Laboratory. (1-5) 2 Credit Hours.

Prerequisite: Completion or concurrent enrollment in BIO 3413. Basic understanding of the physiological processes in living systems employing methods and instruments of biological research. (BIO 2111 cannot substitute for BIO 3422.) Generally offered: Fall, Spring, Summer. Differential Tuition: \$100. Course Fees: DL01 \$50; IUB1 \$10; L001 \$30.

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

Prerequisite: BIO 1414. Anatomy and physiology of nervous systems; the mechanisms of neuronal functions. Generally offered: Fall, Spring. Differential Tuition: \$150.

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

Prerequisite: BIO 1414 and completion of or concurrent enrollment in BIO 3433. A laboratory course emphasizing principles presented in BIO 3433. Generally offered: Fall, Spring. Differential Tuition: \$100. Course Fees: IUB1 \$10; L001 \$30.

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

Prerequisite: BIO 2313. A discussion of the implications of recent Neuroscience discoveries. Students will use available literature and their own powers of reason to separate fact from fantasy, and determine what future applications of Neuroscience may be possible. Generally offered: Spring. Differential Tuition: \$150.

BIO 3513. Biochemistry. (3-0) 3 Credit Hours.

Prerequisites: BIO 2313 and CHE 3643. Introduction to biochemistry: amino acids, protein structure, enzymes, lipids, metabolism, nucleic acid structure, bioenergetics, and carbohydrates. (Credit cannot be earned for both BIO 3513 and CHE 4303.) Generally offered: Fall, Spring, Summer. Differential Tuition: \$150.

BIO 3522. Biochemistry Laboratory. (1-4) 2 Credit Hours.

Prerequisites: BIO 2313, CHE 2603, CHE 2612, and completion of or concurrent enrollment in BIO 3513. Basic biochemical laboratory techniques: Protein assay, centrifugation, protein purification, chromatography, electrophoresis, western blotting, and enzyme kinetics. This laboratory includes an online component. (Credit cannot be earned for both BIO 3522 and BIO 3362.) Generally offered: Fall, Spring, Summer. Differential Tuition: \$100. Course Fees: DL01 \$50; IUB1 \$10; L001 \$30.

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

Prerequisite: BIO 2313. BIO 3433 is recommended. A study of the pharmacology of drugs that affect the function of the central nervous system. Topics include drug-receptor interactions, drugs of abuse, and drugs used to treat mental illness. Generally offered: Fall. Differential Tuition: \$150.

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

Prerequisite: BIO 2313. Development of the human embryo from fertilization to the birth of the fetus. The origin of various tissues and organs will be followed during development. Environmental and genetic factors that can alter development will be discussed. Generally offered: Fall. Differential Tuition: \$150.

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

Prerequisite: BIO 1414. Concurrent enrollment in BIO 2313 and BIO 3722 is recommended. A comprehensive study of microorganisms, including their composition, morphology, growth, metabolism, classification, ecology, and significance in disease. (BIO 1053 cannot substitute for BIO 3713. Credit cannot be earned for both BIO 3713 and ES 3103.) Generally offered: Fall, Spring, Summer. Differential Tuition: \$150.

BIO 3722. Microbiology Laboratory. (0-6) 2 Credit Hours.

Prerequisites: BIO 1414, and completion of or concurrent enrollment in BIO 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, Microbiology Teaching Labs, for additional instructions prior to the class start date. (BIO 1061 cannot substitute for BIO 3722. Credit cannot be earned for both BIO 3722 and ES 3112.) Generally offered: Fall, Spring, Summer. Differential Tuition: \$100. Course Fees: IUB1 \$10; L001 \$30.

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

Prerequisite: BIO 2313 and BIO 3713. BIO 3722 is 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. Generally offered: Fall. Differential Tuition: \$150.

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

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

BIO 3822. Cell Biology Laboratory. (1-4) 2 Credit Hours.

Prerequisites: BIO 2313 and either BIO 2362 or CHE 1131, and completion of or concurrent enrollment in BIO 3813. A study of the microscopic, biochemical and molecular approaches used to investigate cellular structure and function, including the principles involved in the techniques, their practical application, and analysis of the data generated. This laboratory includes an online component. (Credit cannot be earned for both BIO 3822 and either of the following: BIO 3362 or BME 3114.) Generally offered: Fall, Spring, Summer. Differential Tuition: \$100. Course Fees: DL01 \$50; IUB1 \$10; L001 \$30.

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

Prerequisite: BIO 2313; BIO 3513 is recommended. A study of nucleotides, DNA, replication, recombination, RNA, transcription, genetic code, translation, genomes, and chromosomes. Generally offered: Fall, Spring. Differential Tuition: \$150.

BIO 3933. Principles of Cancer Biology. (3-0) 3 Credit Hours.

Prerequisite: BIO 2313. BIO 3813 is recommended. A study of the underlying molecular and cellular biology involved in carcinogenesis, the roles of oncogenes and tumor suppressor genes in cancer development and progression, and modern technologies in cancer screening, diagnosis, treatments and prevention. Upon completion of the class, students should have gained a basic understanding of the mechanisms by which tumors arise and progress to cancer, potential therapeutic targets in cancer treatments, and an individual's actions that are expected to decrease the chances of cancer development. Generally offered: Fall. Spring. Differential Tuition \$150.

BIO 4033. Conservation Biology. (3-0) 3 Credit Hours.

Prerequisite: BIO 2313 and BIO 3283. The class topics will include studying the nature of the biosphere, threats to its integrity, and ecologically sound responses to these threats. Also included will be the origin and preservation of biotic diversity, how the rich variety of plant and animal life around us arose, how it has been maintained by natural processes, and how we can prevent its destruction. (Same as ES 4213. Credit cannot be earned for both BIO 4033 and ES 4213.) Generally offered: Fall. Differential Tuition: \$150.

BIO 4043. Desert Biology. (2-3) 3 Credit Hours.

Prerequisite: BIO 2313 and junior or senior status: a minimum of 60 semester credit hours, or consent of instructor. A study of the deserts of the world with an emphasis on U.S. deserts. Adaptations of plants and animals and their responses to desert conditions, as well as examinations of desert climatic patterns, geology, and natural history. Lecture, laboratory, and fieldwork will be included. (Same as ES 4123. Credit cannot be earned for both BIO 4043 and ES 4123.) Generally offered: Summer. Spring. Differential Tuition \$150.

BIO 4053. Wildlife Biology. (3-0) 3 Credit Hours.

Prerequisite: BIO 2313 and BIO 3283. An introduction to wildlife biology and management including ecological principles dealing with ecosystems, natural communities, and populations. The importance of animal behavior, the availability of food, cover, wildlife diseases, predators, hunting, and trapping will be included. Field studies will allow students to observe and apply classroom topics. (Same as ES 4243. Credit cannot be earned for both BIO 4053 and ES 4243.) Generally offered: Fall. Differential Tuition: \$150.

BIO 4063. Ornithology. (3-0) 3 Credit Hours.

Prerequisite: BIO 2313. A course covering various aspects of the biology of birds, including anatomy, physiology, systematics, evolution, behavior, ecology, and biogeography. Field trips will be included. (Same as ES 3163. Credit cannot be earned for both BIO 4063 and ES 3163.) Generally offered: Spring. Spring. Differential Tuition \$150.

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

Prerequisite: BIO 2313; BIO 3813 is recommended. Overview of developmental biology focusing on the origins of classical concepts as well as modern molecular approaches. Emphasis will be placed on the mechanisms underlying developmental processes using both invertebrate and vertebrate examples. Subjects include axis formation, induction, morphogenesis, embryonic pattern formation, cell differentiation, and organogenesis. (Formerly BIO 3143. Credit cannot be earned for both BIO 4143 and BIO 3143.) Generally offered: Fall. Differential Tuition: \$150.

BIO 4233. Field Biology. (3-0) 3 Credit Hours.

Prerequisite: BIO 2313 and junior or senior status: a minimum of 60 semester credit hours, or consent of instructor. Concurrent enrollment in BIO 4241 is recommended. A study of the natural history of plants and animals in their native environment. Techniques for the identification of birds, mammals, reptiles, amphibians, insects, and the dominant flowering plants will be discussed. (Same as ES 4113. Credit cannot be earned for both BIO 4233 and ES 4113.) Generally offered: Summer. Spring. Differential Tuition \$150.

BIO 4241. Field Biology Laboratory. (0-3) 1 Credit Hour.

Prerequisite: BIO 2313 and junior or senior status: a minimum of 60 semester credit hours, or consent of instructor. Concurrent enrollment in BIO 4233 is recommended. A field-oriented course offering the opportunity for practical experience observing, collecting, and identifying Texas plants and animals. (Same as ES 4111. Credit cannot be earned for both BIO 4241 and ES 4111.) Generally offered: Summer. Differential Tuition \$50. Course Fees: IUB1 \$10; L001 \$30.

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

Prerequisite: BIO 2313. Molecular, cellular and physiological effects of hormones in health and disease. Topics include molecular mechanisms of hormone action in reproductive physiology, growth and development as well as defects in hormonal regulation underlying clinically important syndromes (e.g., diabetes, hypertension, osteoporosis and cancer). Generally offered: Fall. Differential Tuition: \$150.

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

Prerequisite: BIO 2313 and BIO 3013. Advanced concepts of human disease, diagnosis, and underlying pathology. Generally offered: Spring. Differential Tuition \$150.

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

Prerequisites: BIO 2313, BIO 3713, and BIO 3722. Comprehensive study of causative agents, pathogenesis, and treatment of human fungal diseases. Generally offered: Spring. Differential Tuition \$150.

BIO 4583. The Computational Brain. (3-0) 3 Credit Hours.

Prerequisite: BIO 2313 and BIO 3433. Principles of cellular neurophysiology and neuroanatomy are used to explore the computational operations performed by neurons and networks of neurons. Generally offered: Spring. Differential Tuition: \$150.

BIO 4643. Medicinal Plants. (3-0) 3 Credit Hours.

Prerequisite: BIO 2313; BIO 3513 is recommended. Ethnobotanical, biochemical and pharmacological aspects of some of our most important plant-derived drugs. Generally offered: Fall. Differential Tuition: \$150.

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

Prerequisites: BIO 2313 and BIO 3513. Introduction to the molecular, genetic, and biological properties of viruses. Course will cover the basic concepts of virus structure, replication, virus/host interactions, pathogenesis, and evolution. Generally offered: Fall. Differential Tuition: \$150.

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

Prerequisite: BIO 2313. Concurrent enrollment in BIO 4752 is recommended. A study of the properties of antigens and antibodies and current concepts of humoral and cell-mediated immunity and the cells involved. Generally offered: Fall, Spring, Summer. Differential Tuition: \$150.

BIO 4752. Immunology Laboratory. (0-4) 2 Credit Hours.

Prerequisites: BIO 2313, BIO 2362 (or BIO 2322 in previous catalogs), and completion or concurrent enrollment in BIO 4743. Laboratory applications of principles presented in BIO 4743. (Formerly BIO 4751. Credit cannot be earned for both BIO 4751 and BIO 4752.) Generally offered: Fall, Spring, Summer. Differential Tuition: \$100. Course Fees: IUB1 \$10; L001 \$30.

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

Prerequisite: BIO 2313. BIO 3713 is strongly recommended. This course is focused 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. Generally offered: Spring. Differential Tuition \$150.

BIO 4783. Microbial Genetics and Physiology. (3-0) 3 Credit Hours.

Prerequisite: BIO 2313 and BIO 3713. A study of the genetic, physiological and molecular processes that influence gene transfer, pathogenesis, and drug resistance related to bacteria, fungi, and viruses. Generally offered: Spring. Differential Tuition \$150.

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

Prerequisite: BIO 2313. This course explores the brain basis of behavior, with a focus on understanding the neurophysiological, neurochemical and neuroanatomical underpinnings for a variety of simple and complex behaviors. Students will explore topics such as sensation and perception, pain, movement, sleep, biological rhythms, emotions, addiction, learning and memory, and neurodevelopment. The topics are grounded with examples of typical human behavior and disorders, such as Parkinson's disease, Autism, Schizophrenia and psychopathology. (Credit cannot be earned for both BIO 4813 and PSY 4183.) Generally offered: Fall. Differential Tuition: \$150.

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

Prerequisite: BIO 2313 and BIO 3433 or BIO 4813 or PSY 4183 or consent of instructor. The biological basis of cognition, including perception, attention, learning, memory, emotion, language, and executive function. The course introduces students to the use of human neuroimaging experiments and clinical population, as well as research with other species, to study the brain basis of complex behavior and cognitive disorders, such as memory loss, language impairment and developmental disorders. Generally offered: Spring. Differential Tuition \$150.

BIO 4842. Clinical Gross Anatomy. (0-6) 2 Credit Hours.

Prerequisite: This course is only open to students participating in the Biology Pre-Medical Sciences Concentration. It will examine the anatomical/functional relationship of the human body, with special emphasis given to the different professional tracks (medical, pharmacy, dental and veterinarian). The course will encompass student presentations, discussion groups, online research, and demonstrations with models and use of the synthetic cadaver, in addition to lectures and dissection. Imaging techniques including CT scans, MRI, and x-ray radiography will be used to introduce the student to the clinical perspective, as well as a review of the histology of tissues both in health and diseased conditions. Generally offered: Fall. Differential Tuition: \$100. Course Fees: IUB1 \$10; L001 \$30.

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

Prerequisite: Permission in writing (form available) from the instructor, an undergraduate academic advisor, the Department Chair, and the Dean of the College in which the course is offered. Independent reading, research, discussion, and/or writing under the direction of a faculty member. May be repeated for credit, but no more than 6 semester credit hours, regardless of discipline, will apply to a bachelor's degree. Only 6 semester credit hours of BIO 3043, BIO 4911-3, BIO 4923 and BIO 4993, in any combination, can be taken as BIO electives. Additional research hours of these courses (excluding Independent Study) may be taken as free electives, for a maximum of 12 research hours being applied to the bachelor's degree. Generally offered: Fall, Spring, Summer. Differential Tuition: \$50.

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

Prerequisite: Permission in writing (form available) from the instructor, an undergraduate academic advisor, the Department Chair, and the Dean of the College in which the course is offered. Independent reading, research, discussion, and/or writing under the direction of a faculty member. May be repeated for credit, but no more than 6 semester credit hours, regardless of discipline, will apply to a bachelor's degree. Only 6 semester credit hours of BIO 3043, BIO 4911-3, BIO 4923 and BIO 4993, in any combination, can be taken as BIO electives. Additional research hours of these courses (excluding Independent Study) may be taken as free electives, for a maximum of 12 research hours being applied to the bachelor's degree. Generally offered: Fall, Spring, Summer. Differential Tuition: \$100. .

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

Prerequisite: Permission in writing (form available) from the instructor, an undergraduate academic advisor, the Department Chair, and the Dean of the College in which the course is offered. Independent reading, research, discussion, and/or writing under the direction of a faculty member. May be repeated for credit, but no more than 6 semester credit hours, regardless of discipline, will apply to a bachelor's degree. Only 6 semester credit hours of BIO 3043, BIO 4911-3, BIO 4923 and BIO 4993, in any combination, can be taken as BIO electives. Additional research hours of these courses (excluding Independent Study) may be taken as free electives, for a maximum of 12 research hours being applied to the bachelor's degree. Generally offered: Fall, Spring, Summer. Differential Tuition: \$150.

BIO 4923. Laboratory Research: Biology Concentrations. (0-0) 3 Credit Hours.

Permission in writing (form available in the Biology 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 BIO 3043, BIO 4911-3, BIO 4923 and BIO 4993, in any combination, can be taken as BIO electives. Additional research hours of these courses (excluding Independent Study) may be taken as free electives, for a maximum of 12 research hours being applied to the bachelor's degree. Generally offered: Fall, Spring, Summer. Differential Tuition: \$150.

BIO 4951. Special Studies in Biology. (1-0) 1 Credit Hour.

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

BIO 4953. Special Studies in Biology. (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 not more than 6 semester credit hours, regardless of discipline, will apply to a bachelor's degree. No more than 6 semester hours of BIO 2953, BIO 4951, or BIO 4953 can be applied to a B.S. degree in Biology or Microbiology and Immunology. Generally offered: Fall, Spring, Summer. Differential Tuition: \$150.

BIO 4981. Senior Seminar in Microbiology and Immunology. (1-0) 1 Credit Hour.

Prerequisite: Senior status, a minimum of 90 semester credit hours. This course is only open to seniors in the Microbiology and Immunology degree program. Students will learn how to interpret the scientific literature and to organize and present scientific research findings as reported in the current literature. May be repeated for credit. The grade report for the course is either "CR" (satisfactory performance) or "NC" (unsatisfactory performance). Generally offered: Fall, Spring. Course Fees: LRS1 \$5; STSI \$5.

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

Enrollment limited to biology majors who are members of the Honors College or who are pursuing College of Sciences Honors, and who are in their last two semesters of study. Approval by the Honors College or College Honors Committee is required. Supervised research and preparation of an Honors Thesis. May be repeated for credit with approval, but no more than 6 semester credit hours, regardless of discipline, will apply to a bachelor's degree. Only 6 semester credit hours of BIO 4911-3, BIO 4923 and BIO 4993, in any combination, can be taken as BIO 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. Differential Tuition: \$150.