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 UTechSA, 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 an accelerated degree program in conjunction with UTHealth San Antonio that 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. For eligibility requirements and application visit the DEAP website (http://utsa.edu/healthprofessions/deap.html).

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

Admission Policy for Students Admitted Under this Catalog Prior to Fall 2019

The goal of the Department of Biology is to provide undergraduate students a program of study with the highest possible standards. To achieve this goal, the admission policy of the Department of Biology is designed to identify those students most likely to succeed in their undergraduate biology education.

All applicants for admission to the Department of Biology will be admitted to the Department as Pre-Biology (PBI) or Pre-Microbiology and Immunology (PMI) students. In order to declare a major in Biology or a major in Microbiology and Immunology, a student’s academic performance will be evaluated after the following criteria are met:

- A grade point average of at least 2.0 for all UTSA coursework
- A grade point average of at least 2.25 for all Biology coursework (UTSA and/or transfer credit). Transfer students, in addition, must have a grade point average of at least 2.0 for all UTSA Department of Biology coursework
- Successfully satisfied all three sections (mathematics, reading, and writing) of the Texas Success Initiative (TSI)
- Successfully completed the following or equivalent courses with a grade of “C-” or better:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIO 1404</td>
<td>Biosciences I</td>
<td>4</td>
</tr>
<tr>
<td>BIO 1414</td>
<td>Biosciences II</td>
<td>4</td>
</tr>
<tr>
<td>CHE 1103</td>
<td>General Chemistry I</td>
<td>3</td>
</tr>
<tr>
<td>MAT 1193</td>
<td>Calculus for the Biosciences (Students in the teaching concentration can substitute STA 1053.)</td>
<td>3</td>
</tr>
<tr>
<td>PHY 1943</td>
<td>Physics for Scientists and Engineers I</td>
<td>3</td>
</tr>
<tr>
<td>or PHY 1603</td>
<td>Algebra-based Physics I</td>
<td></td>
</tr>
</tbody>
</table>

PBI and PMI students are restricted from registering for upper-division (3000- and 4000-level) Biology courses without the consent of an undergraduate academic advisor in Life and Health Sciences Advising. A student who does not meet all the above requirements after completing 60 hours of credit will no longer be considered a PBI or PMI student and their major will be changed from PBI/PMI to undeclared (UND) in the University student record system. The student must choose a major other than Biology or Microbiology and Immunology. A biology minor is, however, available to all UTSA students who seek to supplement a different academic major with a strong foundation in biology. Students can be reinstated as a Biology major or Microbiology and Immunology major, but only after successfully completing all the PBI/PMI requirements, and upon approval of the Biology department.

Admission Policy for Students Admitted Under this Catalog Beginning Fall 2019

Direct Admission Criteria

Freshman applicants entering UTSA will be directly admitted to the Department of Biology if they:

- meet all UTSA undergraduate admission requirements, and
- are ranked in the top 15 percent of their high school class and have a minimum 1350 SAT* or 29 ACT score, and
- are Calculus I ready (https://future.utsa.edu/ready/calculus-ready).

* New SAT scores combine Evidence-Based Reading and Writing and Math.

Transfer applicants entering UTSA will be directly admitted to the Department of Biology if they:

- meet all UTSA undergraduate admission requirements, and
- transfer the following or equivalent courses with a grade of “C-” or better:
  - BIO 1404 Biosciences I
  - MAT 1023 College Algebra with Applications, or MAT 1073 Algebra for Scientists and Engineers.

Admission Criteria for Applicants Who Do Not Meet Direct Admission Criteria

Applicants who do not meet the criteria for direct admission stated above will be admitted to University College under “Life and Health Sciences
Students’ (XLHS.) Students will have two semesters to complete both of the following courses with a grade of "C-" or better for admission to the major:

- Biosciences I (BIO 1404), and
- College Algebra (MAT 1023 or MAT 1073) or higher.

Students who do not meet the above criteria within two semesters will be classified as undeclared (UND).

**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.

All majors in Biology or Microbiology and Immunology must maintain:

- A minimum overall UTSA grade point average of 2.0
- A minimum overall grade point average of 2.25 in all Biology courses (UTSA and transfer credit). Transfer students, in addition, must have a grade point average of at least 2.0 for all UTSA Department of Biology coursework.

Students who do not meet these requirements are placed on Department of Biology academic probation. Once on Department of Biology academic probation, students who do not meet the minimum requirements by the end of the next subsequent-enrolled long semester will be dismissed from the B.S. degree in Biology or the B.S. degree in Microbiology and Immunology and classified as undeclared (UND) in the University student record system. The student 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. Dismissed students may appeal one time for reinstatement to either B.S. degree program: such appeals will be granted only under extraordinary circumstances. See Life and Health Sciences Advising for required forms. All Biology majors and Microbiology and Immunology majors must have the required minimum grade point averages in order to receive the Bachelor of Science degree.

- B.S. degree in Biology (p. 2)
- B.S. degree in Microbiology and Immunology (p. 7)

**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 126 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, in addition, students must meet the grade point average requirements under the Academic Standing Policy.

For students wishing to add focus and expertise to their degree, the Department of Biology also offers the B.S. degree 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.

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/bachelorsdegree_regulations/corecurriculumcomponentarearequirements)

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>First Year Experience Requirement</td>
<td>3</td>
</tr>
<tr>
<td>Communication</td>
<td>6</td>
</tr>
<tr>
<td>Mathematics</td>
<td>3</td>
</tr>
<tr>
<td>Life and Physical Sciences</td>
<td>6</td>
</tr>
<tr>
<td>Language, Philosophy and Culture</td>
<td>3</td>
</tr>
<tr>
<td>Creative Arts</td>
<td>3</td>
</tr>
<tr>
<td>American History</td>
<td>6</td>
</tr>
<tr>
<td>Government-Political Science</td>
<td>6</td>
</tr>
<tr>
<td>Social and Behavioral Sciences</td>
<td>3</td>
</tr>
<tr>
<td>Component Area Option</td>
<td>3</td>
</tr>
<tr>
<td>Total Credit Hours</td>
<td>42</td>
</tr>
</tbody>
</table>

**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

**Degree Requirements**

**A. Required courses in the major**

1. Biology requirements:
### Required physics courses:

- PHY 1603: Algebra-based Physics I
  - PHY 1611: Algebra-based Physics I Laboratory
- PHY 1623: Algebra-based Physics II
  - PHY 1631: Algebra-based Physics II Laboratory

### Required mathematics and statistics courses:

- BIO 3413: Physiohy
  - BIO 3422: Physiology Laboratory
- BIO 3513: Biochemistry
  - BIO 3522: Biochemistry Laboratory
- BIO 3813: Cell Biology
  - BIO 3822: Cell Biology Laboratory

### Required chemistry courses:

- CHE 1103: General Chemistry I
  - CHE 1121: General Chemistry I Laboratory
- CHE 1113: General Chemistry II
  - CHE 1131: General Chemistry II Laboratory
- CHE 2603: Organic Chemistry I
  - CHE 2612: Organic Chemistry I Laboratory
- CHE 3673: Organic Chemistry II with Biological Applications
  - CHE 3643: Organic Chemistry II

### Computer-based data visualization and analysis:

- CS 1173: Data Analysis and Visualization

### Biology electives:

- BIO 3913
- BIO 3933
- BIO 4923
- BIO 4723
- BIO 4743
- BIO 4453
- BIO 4143
- BIO 3933

### Concentrations

**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:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIO 3913</td>
<td>Molecular Biology</td>
<td>3</td>
</tr>
</tbody>
</table>

Select three of the following:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIO 3933</td>
<td>Principles of Cancer Biology</td>
<td>9</td>
</tr>
<tr>
<td>BIO 4143</td>
<td>Developmental Biology</td>
<td>3</td>
</tr>
<tr>
<td>BIO 4453</td>
<td>Endocrinology</td>
<td>3</td>
</tr>
<tr>
<td>BIO 4792</td>
<td>Immunology</td>
<td>3</td>
</tr>
<tr>
<td>BIO 4923</td>
<td>Laboratory Research: Biology Concentrations</td>
<td>3</td>
</tr>
</tbody>
</table>

Total Credit Hours: 12

Note: Courses noted by an asterisk (*) are not required for the teaching certification concentration.
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:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIO 3283 &amp; BIO 3292</td>
<td>Principles of Ecology and Principles of Ecology Laboratory</td>
<td>5</td>
</tr>
</tbody>
</table>

Select two of the following:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIO 3213</td>
<td>Animal Behavior</td>
<td></td>
</tr>
<tr>
<td>BIO 3323</td>
<td>Evolution</td>
<td></td>
</tr>
<tr>
<td>BIO 4033</td>
<td>Conservation Biology</td>
<td></td>
</tr>
<tr>
<td>BIO 4053</td>
<td>Wildlife Biology</td>
<td></td>
</tr>
<tr>
<td>BIO 4063</td>
<td>Ornithology</td>
<td></td>
</tr>
<tr>
<td>BIO 4233</td>
<td>Field Biology</td>
<td></td>
</tr>
<tr>
<td>BIO 4923</td>
<td>Laboratory Research: Biology Concentrations (Research must be in a laboratory engaged in integrative biology research.)</td>
<td>11</td>
</tr>
</tbody>
</table>

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:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIO 3433 &amp; BIO 3442</td>
<td>Neurobiology and Neurobiology Laboratory</td>
<td>5</td>
</tr>
</tbody>
</table>

Select two of the following:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIO 3213</td>
<td>Animal Behavior</td>
<td></td>
</tr>
<tr>
<td>BIO 3623</td>
<td>Neuropsychopharmacology</td>
<td></td>
</tr>
<tr>
<td>BIO 4583</td>
<td>The Computational Brain</td>
<td></td>
</tr>
<tr>
<td>BIO 4813</td>
<td>Brain and Behavior</td>
<td></td>
</tr>
<tr>
<td>BIO 4823</td>
<td>Cognitive Neuroscience</td>
<td></td>
</tr>
<tr>
<td>BIO 4923</td>
<td>Laboratory Research: Biology Concentrations (Research must be in a laboratory engaged in neurobiology research.)</td>
<td>11</td>
</tr>
</tbody>
</table>

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:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIO 3343</td>
<td>Plant Cell Biology</td>
<td>3</td>
</tr>
</tbody>
</table>

Select three of the following:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIO 3263</td>
<td>The Woody Plants</td>
<td></td>
</tr>
<tr>
<td>BIO 3273</td>
<td>Biology of Flowering Plants</td>
<td>9</td>
</tr>
</tbody>
</table>

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 careers in medicine, dentistry, pharmacy or veterinary science. This concentration has a fixed curriculum that is designed to meet the requirements for entry into these professional schools and to prepare students for the MCAT, DAT, PCAT or VCAT examinations. Students will have small specialty courses that are medically focused and have a Pre-Medical Sciences Advisor within the Biology Department. The concentration is limited to 20 students each year.

Admission requirements for the Pre-Medical Sciences Concentration
The admission policy for this concentration is designed to identify those students most likely to succeed in their application to professional programs in the medical sciences. To declare the Pre-Medical Sciences Concentration a student must:

• have already earned at least 45 semester credit hours at UTSA
• complete BIO 1404, BIO 1414, BIO 2313, CHE 1103, CHE 1113, CHE 2603, PHY 1603 and MAT 1193
• have an overall UTSA grade point average (GPA) of 3.5 or greater
• have a UTSA science GPA of 3.5 or greater
• complete a Pre-Medical Sciences Concentration application and interview.

For completion of the Pre-Medical Sciences Concentration students must have both an overall minimum UTSA 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 courses in addition to the Biology coursework, support work and Core Curriculum requirements required for the B.S. Degree in Biology:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIO 3713</td>
<td>Microbiology</td>
<td>3</td>
</tr>
<tr>
<td>BIO 3722</td>
<td>Microbiology Laboratory</td>
<td>2</td>
</tr>
<tr>
<td>BIO 3433</td>
<td>Neurobiology</td>
<td>3</td>
</tr>
<tr>
<td>BIO 4743</td>
<td>Immunology</td>
<td>3</td>
</tr>
<tr>
<td>BIO 4813</td>
<td>Brain and Behavior</td>
<td>3</td>
</tr>
<tr>
<td>BIO 3213</td>
<td>Animal Behavior *</td>
<td></td>
</tr>
<tr>
<td>BIO 4841</td>
<td>Seminar in Medical Sciences</td>
<td>1</td>
</tr>
<tr>
<td>BIO 4842</td>
<td>Clinical Gross Anatomy</td>
<td>2</td>
</tr>
<tr>
<td>PSY 1013</td>
<td>Introduction to Psychology</td>
<td>3</td>
</tr>
</tbody>
</table>

Total Credit Hours 20

* NOTE: BIO 3213 is intended only for students interested in Veterinary Sciences.
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 126. 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 3063 Second Language Teaching and Learning for Grades 4–8 and 7–12 3
- LTED 3773 Reading and Writing Across the Disciplines-Grades 4–8 and 7–12 3
- UTE 1111 Introduction to STEM Teaching Step 1 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

1 Error in course description: Credit may be earned for both UTE 1111 and GEM 1011.

Course Sequence Guide for B.S. Degree in Biology

This course sequence guide is designed to assist students in completing their UTSA undergraduate Biology degree requirements. This is merely 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 Biology – Recommended Four-Year Academic Plan

First Year

<table>
<thead>
<tr>
<th>Fall</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>AIS 1203</td>
<td>Academic Inquiry and Scholarship (core)</td>
</tr>
<tr>
<td>BIO 1404</td>
<td>Biosciences I (core and major)</td>
</tr>
<tr>
<td>CHE 1103</td>
<td>General Chemistry I</td>
</tr>
<tr>
<td>CHE 1121</td>
<td>General Chemistry I Laboratory</td>
</tr>
<tr>
<td>WRC 1013</td>
<td>Freshman Composition I (Q) (core)</td>
</tr>
</tbody>
</table>

Credit Hours 14

Spring

| BIO 1414 | Biosciences II (core and major) | 4 |
| CHE 1113 | General Chemistry II | 3 |
| CHE 1131 | General Chemistry II Laboratory | 2 |
| CS 1173 | Data Analysis and Visualization (core and major) | 3 |
| MAT 1193 | Calculus for the Biosciences (core and major) | 3 |
| WRC 1023 | Freshman Composition II (Q) (core) | 3 |

Credit Hours 17

Second Year

<table>
<thead>
<tr>
<th>Fall</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHE 2603</td>
<td>Organic Chemistry I</td>
</tr>
<tr>
<td>CHE 2612</td>
<td>Organic Chemistry I Laboratory</td>
</tr>
<tr>
<td>American History core</td>
<td>3</td>
</tr>
<tr>
<td>Select one of the following:</td>
<td>4</td>
</tr>
<tr>
<td>PHY 1603 &amp; PHY 1611</td>
<td>Algebra-based Physics I and Algebra-based Physics I Laboratory</td>
</tr>
<tr>
<td>PHY 1943 &amp; PHY 1951</td>
<td>Physics for Scientists and Engineers I and Physics for Scientists and Engineers I Laboratory</td>
</tr>
</tbody>
</table>

Credit Hours 12

Spring

| BIO 2313 | Genetics | 3 |
| BIO 2322 | Genetics Laboratory | 2 |
| CHE 3673 or CHE 3643 | Organic Chemistry II with Biological Applications or Organic Chemistry II | 3 |
| 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 | 1 |
| PHY 1963 & PHY 1971 | Physics for Scientists and Engineers II and Physics for Scientists and Engineers II Laboratory | 3 |

Credit Hours 15
### Third Year

#### Fall
- **BIO 3413** Physiology 3
- **BIO 3422** Physiology Laboratory 2
- **BIO 3513** Biochemistry 3
- **BIO 3522** Biochemistry Laboratory 2
- Language, Philosophy & Culture core 3
- Social & Behavioral Sciences core 3
- **Credit Hours** 16

#### Spring
- **BIO 3813** Cell Biology 3
- **BIO 3822** Cell Biology Laboratory 2
- Free elective 3
- Upper-division BIO lab (BIO 3XX2) 2
- Upper-division BIO lecture (BIO 3XX3) 3
- **Credit Hours** 16

#### Fourth Year

#### Fall
- Upper-division BIO elective 3
- Upper-division BIO elective 3
- Upper-division BIO elective 3
- American History core 3
- Government-Political Science core 3
- **Credit Hours** 15

#### Spring
- Upper-division BIO elective 3
- Upper-division free elective 3
- Upper-division free elective 3
- Government-Political Science core 3
- Free elective (to meet 120 hour minimum) 3
- **Credit Hours** 15

#### Total Credit Hours 120

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1. In order to declare Biology as a major, a student’s academic performance will be evaluated after these five courses have been completed. Students must see their academic advisor to declare a Biology major.

2. These laboratory courses include a lecture component as indicated on the University Schedule of Classes.

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

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

#### First Year

#### 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 2 1
- **WRC 1013** Freshman Composition I (Q) (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 2 1
- **WRC 1023** Freshman Composition II (Q) (core) 3
- **UTES 1122** Introduction to STEM Teaching Step 2 2
- Select one of the following: 1 3
- **MAT 1193** Calculus for the Biosciences (core) 3
- **STA 1053** Basic Statistics (core) 3
- **Credit Hours** 16

#### Summer
- American History core 3
- Government-Political Science core 3
- **Credit Hours** 9

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#### Second Year

#### Fall
- **BIO 2313** Genetics 3
- **BIO 2322** Genetics Laboratory 2
- **CHE 2603** Organic Chemistry I 3
- **CHE 2612** Organic Chemistry I Laboratory 2
- **UTES 3203** Knowing and Learning in Mathematics and Science 3
- Select one of the following: 3
- **PHY 1603** Algebra-based Physics I 1
- **PHY 1943** Physics for Scientists and Engineers I 3
- **Credit Hours** 16

#### Spring
- **CS 1173** Data Analysis and Visualization (core and major) 3
- **UTES 3023** Perspectives on Science and Mathematics 3
- Social & Behavioral Sciences core 3
- Select one of the following: 3
- **CHE 3673** Organic Chemistry II with Biological Applications 3
- **CHE 3643** Organic Chemistry II 3
- Select one of the following: 3
- **PHY 1623** Algebra-based Physics II 3
- **PHY 1963** Physics for Scientists and Engineers II 3
- **Credit Hours** 15

#### Summer
- American History core 3
- Government-Political Science core 3
- Creative Arts core 3
- **Credit Hours** 9
Department of Biology

Third Year

Fall
BIO 3283 Principles of Ecology 3
BIO 3513 Biochemistry 3
BIO 3522 Biochemistry Laboratory 2
BIO 3713 Microbiology 3
LTED 3773 Reading and Writing Across the Disciplines-Grades 7–12 3
Credit Hours 14

Spring
BIO 3043 UTeachSA Research Methods 3
BIO 3413 Physiology 3
BIO 3422 Physiology Laboratory 2
BIO 4813 Brain and Behavior 3
UTE 3213 Classroom Interactions 3
Credit Hours 14

Fourth Year

Fall
BIO 3323 Evolution 3
BIO 3813 Cell Biology 3
ESL 3063 Second Language Teaching and Learning for Grades 4–8 and 7–12 3
UTE 4203 Project-Based Instruction 3
Credit Hours 12

Spring
UTE 4646 Clinical Teaching 6
Credit Hours 6
Total Credit Hours 126

1 In order to declare Biology as a major, a student’s academic performance will be evaluated after these five courses have been completed. Students must see their academic advisor to declare a Biology major.

2 These laboratory courses include a lecture component as indicated on the University Schedule of Classes.

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, in addition, students must meet the grade point average requirements under the Academic Standing Policy.

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.

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/bachelorsdegree/regulations/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 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

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 5
   & BIO 2322 and Genetics Laboratory
   BIO 3413 Physiology 3
   BIO 3513 Biochemistry 5
   & BIO 3522 and Biochemistry Laboratory
Course Sequence Guide for B.S. Degree in Microbiology and Immunology

This course sequence guide is designed to assist students in completing their UTSA undergraduate Microbiology and Immunology degree requirements. This is merely 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

<table>
<thead>
<tr>
<th>Credit Hours</th>
<th>Fall</th>
</tr>
</thead>
<tbody>
<tr>
<td>AIS 1203</td>
<td>Academic Inquiry and Scholarship (core)</td>
</tr>
<tr>
<td>BIO 1404</td>
<td>Biosciences I (core and major)</td>
</tr>
<tr>
<td>CHE 1103</td>
<td>General Chemistry I</td>
</tr>
<tr>
<td>CHE 1121</td>
<td>General Chemistry I Laboratory</td>
</tr>
<tr>
<td>WRC 1013</td>
<td>Freshman Composition I (Q) (core)</td>
</tr>
<tr>
<td>Free elective</td>
<td></td>
</tr>
<tr>
<td>Credit Hours</td>
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</table>

Second Year

<table>
<thead>
<tr>
<th>Credit Hours</th>
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<tbody>
<tr>
<td>CHE 2603</td>
<td>Organic Chemistry I</td>
</tr>
<tr>
<td>CHE 2612</td>
<td>and Organic Chemistry I Laboratory</td>
</tr>
<tr>
<td>STA 1403</td>
<td>Probability and Statistics for the Biosciences</td>
</tr>
<tr>
<td>Select one of the following:</td>
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<table>
<thead>
<tr>
<th>Credit Hours</th>
<th>Spring</th>
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<tbody>
<tr>
<td>BIO 1414</td>
<td>Biosciences II (core and major)</td>
</tr>
<tr>
<td>CHE 1113</td>
<td>General Chemistry II</td>
</tr>
<tr>
<td>CHE 1131</td>
<td>General Chemistry II Laboratory</td>
</tr>
<tr>
<td>MAT 1193</td>
<td>Calculus for the Biosciences (core and major)</td>
</tr>
<tr>
<td>WRC 1023</td>
<td>Freshman Composition II (Q) (core)</td>
</tr>
<tr>
<td>Free elective</td>
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<td>Credit Hours</td>
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<table>
<thead>
<tr>
<th>Credit Hours</th>
<th>Spring</th>
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<tbody>
<tr>
<td>PHY 1603</td>
<td>Algebra-based Physics I</td>
</tr>
<tr>
<td>PHY 1611</td>
<td>and Algebra-based Physics I Laboratory</td>
</tr>
<tr>
<td>PHY 1943</td>
<td>Physics for Scientists and Engineers I</td>
</tr>
<tr>
<td>PHY 1951</td>
<td>and Physics for Scientists and Engineers I Laboratory</td>
</tr>
<tr>
<td>PHY 1963</td>
<td>Physics for Scientists and Engineers II</td>
</tr>
<tr>
<td>PHY 1971</td>
<td>and Physics for Scientists and Engineers II Laboratory</td>
</tr>
<tr>
<td>Total Credit Hours</td>
<td>87</td>
</tr>
</tbody>
</table>

Option 1

| PHY 1603 & PHY 1611 | Algebra-based Physics I and Algebra-based Physics I Laboratory |
| PHY 1623 & PHY 1631 | Algebra-based Physics I and Algebra-based Physics II Laboratory |
| PHY 1943 & PHY 1951 | Physics for Scientists and Engineers I and Physics for Scientists and Engineers I Laboratory |

Option 2

| PHY 1963 & PHY 1971 | Physics for Scientists and Engineers II and Physics for Scientists and Engineers II Laboratory |

Laboratory

<table>
<thead>
<tr>
<th>Credit Hours</th>
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<tbody>
<tr>
<td>BIO 2313</td>
<td>Genetics</td>
</tr>
<tr>
<td>BIO 2322</td>
<td>Genetics Laboratory</td>
</tr>
<tr>
<td>CHE 3673</td>
<td>Organic Chemistry II with Biological Applications</td>
</tr>
<tr>
<td>or CHE 3643</td>
<td>Organic Chemistry II Laboratories</td>
</tr>
<tr>
<td>CHE 3652</td>
<td>Organic Chemistry II Laboratory</td>
</tr>
<tr>
<td>Select one of the following:</td>
<td></td>
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<table>
<thead>
<tr>
<th>Credit Hours</th>
<th>Spring</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIO 3713</td>
<td>Microbiology and Microbiology Laboratory</td>
</tr>
<tr>
<td>&amp; BIO 3722</td>
<td>Cell Biology and Cell Biology Laboratory</td>
</tr>
<tr>
<td>BIO 3813</td>
<td>Immunology and Immunology Laboratory</td>
</tr>
<tr>
<td>&amp; BIO 3822</td>
<td>Microbial Genetics and Physiology</td>
</tr>
<tr>
<td>BIO 4743</td>
<td>Senior Seminar in Microbiology and Immunology</td>
</tr>
<tr>
<td>&amp; BIO 4752</td>
<td>Microbial Genetics and Physiology</td>
</tr>
<tr>
<td>BIO 4783</td>
<td>Microbial Genetics and Physiology</td>
</tr>
<tr>
<td>BIO 4981</td>
<td>Microbial Genetics and Physiology</td>
</tr>
<tr>
<td>2. Required mathematics and statistics courses:</td>
<td></td>
</tr>
<tr>
<td>STA 1403</td>
<td>Probability and Statistics for the Biosciences</td>
</tr>
<tr>
<td>STA 1403</td>
<td>Probability and Statistics for the Biosciences</td>
</tr>
<tr>
<td>3. Two free elective courses</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td></td>
</tr>
</tbody>
</table>

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 |
| CHE 1113 & CHE 1131 | General Chemistry II and General Chemistry Laboratory |
| CHE 2603 & CHE 2612 | Organic Chemistry I and Organic Chemistry I Laboratory |
| CHE 3673 & CHE 3652 | Organic Chemistry II with Biological Applications and Organic Chemistry II Laboratory |

2. Required mathematics and statistics courses:

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

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

Option 1

| PHY 1603 & PHY 1611 | Algebra-based Physics I and Algebra-based Physics I Laboratory |
| PHY 1623 & PHY 1631 | Algebra-based Physics I and Algebra-based Physics II Laboratory |
| PHY 1943 & PHY 1951 | Physics for Scientists and Engineers I and Physics for Scientists and Engineers I Laboratory |

Option 2

| PHY 1963 & PHY 1971 | Physics for Scientists and Engineers II and Physics for Scientists and Engineers II Laboratory |

Total Credit Hours: 87
### Third Year

#### Fall
- **BIO 3513**  Biochemistry  3
- **BIO 3522**  Biochemistry Laboratory  2
- **BIO 3713**  Microbiology  3
- **BIO 3722**  Microbiology Laboratory  2
- Language, Philosophy & Culture core  3
- Social & Behavioral Sciences core  3

#### Credit Hours  14

#### Spring
- **BIO 3813**  Cell Biology  3
- **BIO 3822**  Cell Biology Laboratory  2
- **BIO 4743**  Immunology  3
- **BIO 4752**  Immunology Laboratory  2
- Upper-division BIO elective  3

#### Credit Hours  16

### Fourth Year

#### Fall
- **BIO 3413**  Physiology  3
- **BIO 4783**  Microbial Genetics and Physiology  3
- Upper-division BIO elective  3
- American History core  3
- Government-Political Science core  3

#### Credit Hours  15

#### Spring
- **BIO 4981**  Senior Seminar in Microbiology and Immunology  1
- Free elective  3
- Upper-division BIO elective  3
- American History core  3
- Component Area Option core  3

#### Credit Hours  16

#### Total Credit Hours  52

### 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. 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 courses. Excludes laboratory, independent study, research and seminar courses. Substitutions are not allowed without approval of the Biology department.

#### Total Credit Hours  15

### 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 their academic advisors 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:
- **BIO 4953**  Special Studies in Biology
- **CS 4593**  Topics in Computer Science
- **IS 3313**  Introduction to Pathogenic Outbreak Investigations

#### B. Required course according to major:
- **BIO 3713**  Microbiology

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1. In order to declare Microbiology and Immunology as a major, a student’s academic performance will be evaluated after these five courses have been completed. Students must see their academic advisor to declare a Microbiology and Immunology major.

2. These laboratory courses include a lecture component as indicated on the University Schedule of Classes.

Note: Some courses are only offered once a year; Fall or Spring. Check with the Department of Biology for scheduling of courses.
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Prerequisites</th>
</tr>
</thead>
<tbody>
<tr>
<td>CS 4593</td>
<td>Topics in Computer Science (Cloud Computing)</td>
<td></td>
</tr>
<tr>
<td>IS 4953</td>
<td>Special Studies in Information Systems (Topic:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Malware Agent Analysis</td>
<td></td>
</tr>
</tbody>
</table>

C. Elective courses for each major. Select 6 hours from one of the following groups depending on major:

### Biology elective options
- 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

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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 $15; STSI $15.

#### 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 $15; STSI $15.

#### 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; LRC1 $5; STSI $5.

#### 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 $15; STSI $15.

#### 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. Course Fees: LRC1 $12; LRS1 $15; STSI $15.

#### 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 $20; STSI $20.
BIO 1414. Biosciences II. (3-4) 4 Credit Hours. (TCCN = BIOL 1407)
Prerequisite: BIO 1404. 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 $20; STSI $20.

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 2013. Credit cannot be earned for both BIO 2003 and BIO 1023.) Generally offered: Spring. Course Fees: LRS1 $15; STSI $15.

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. Credit cannot be earned for both BIO 2043 and AHS 2043.) Generally offered: Fall, Spring, Summer. Course Fees: IUB1 $10; L001 $30; LRC1 $16; LRS1 $20; STSI $20.

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 2051 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; LRC1 $16; LRS1 $20; STSI $20.

BIO 2053. Human Anatomy and Physiology Laboratory I. (0-3) 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: IUB1 $10; L001 $30; LRS1 $15; STSI $15.

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 $15.

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 $15; STSI $15.

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. Concurrent enrollment in BIO 2322 is recommended. 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 $15; STSI $15.

BIO 2322. Genetics Laboratory. (1-4) 2 Credit Hours.
Prerequisites: BIO 1414 and completion or concurrent enrollment in BIO 2313, and in one of the following: MAT 1093 (or higher) or STA 1053. A practical introduction to genetic problem solving that focuses on experiments with model organisms using classic, biochemical and molecular biological techniques. This laboratory includes a lecture component. Generally offered: Fall, Spring, Summer. Course Fees: IUB1 $10; L001 $30; LRS1 $10; STSI $10.

BIO 3013. Introduction to Clinical Medicine and Pathology. (3-0) 3 Credit Hours.
Prerequisite: BIO 1404. Introduction to concepts of human disease, diagnosis, and underlying pathology. Generally offered: Fall. Course Fees: LRS1 $15; STSI $15.

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. Course Fees: LRS1 $15; STSI $15.

BIO 3123. Comparative Vertebrate Anatomy. (3-0) 3 Credit Hours.
Prerequisite: BIO 1414. 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. Course Fees: LRS1 $15; STSI $15.

BIO 3213. Animal Behavior. (3-0) 3 Credit Hours.
Prerequisite: BIO 1414 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. Course Fees: LRS1 $15; STSI $15.
BIO 3263. The Woody Plants. (2-3) 3 Credit Hours. 
Prerequisite: 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. 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. Course Fees: LRS1 $15; STFB $40; STSI $15.

BIO 3273. Biology of Flowering Plants. (2-3) 3 Credit Hours. 
Prerequisite: 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. 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. Course Fees: LRS1 $15; STFB $40; STSI $15.

BIO 3283. Principles of Ecology. (3-0) 3 Credit Hours. 
Prerequisite: BIO 1414. Concurrent enrollment in BIO 3292 is recommended for biology majors. 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. Course Fees: LRS1 $15; STSI $15.

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. Course Fees: IUB1 $10; L001 $30; LRS1 $10; STFB $40; STSI $10.

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. Course Fees: LRS1 $15; STSI $15.

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. Course Fees: LRS1 $15; STSI $15.

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. Course Fees: LRS1 $15; STSI $15.

BIO 3413. Physiology. (3-0) 3 Credit Hours. 
Prerequisite: BIO 2313. Concurrent enrollment in BIO 3422 is also recommended. 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. Course Fees: LRS1 $15; STSI $15.

BIO 3422. Physiology Laboratory. (0-5) 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. Course Fees: IUB1 $10; L001 $30; LRS1 $10; STSI $10.

BIO 3433. Neurobiology. (3-0) 3 Credit Hours. 
Prerequisite: BIO 1414. Concurrent enrollment in BIO 3442 is recommended. Anatomy and physiology of nervous systems; the mechanisms of neuronal functions. Generally offered: Fall, Spring. Course Fees: LRS1 $15; STSI $15.

BIO 3442. Neurobiology Laboratory. (0-4) 2 Credit Hours. 
Prerequisite: Completion of or concurrent enrollment in BIO 3433. A laboratory course emphasizing principles presented in BIO 3433. Generally offered: Fall, Spring, Summer. Course Fees: IUB1 $10; L001 $30; LRS1 $10; STSI $10.

BIO 3513. Biochemistry. (3-0) 3 Credit Hours. 
Prerequisites: CHE 3643 or CHE 3673; BIO 2313 is highly recommended. Concurrent enrollment in BIO 3522 is recommended. 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. Course Fees: LRS1 $15; STSI $15.

BIO 3522. Biochemistry Laboratory. (1-4) 2 Credit Hours. 
Prerequisites: CHE 2603 and 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. Generally offered: Fall, Spring, Summer. Course Fees: IUB1 $10; L001 $30; LRS1 $10; STSI $10.

BIO 3613. The Biology of Aging. (3-0) 3 Credit Hours. 
Prerequisite: BIO 2313. The biological principles of human life and health; changes that occur with aging and their implications for the lives of students and their families. Course Fees: LRS1 $15; STSI $15.

BIO 3623. Neuropsychopharmacology. (3-0) 3 Credit Hours. 
Prerequisite: BIO 1414; 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. Course Fees: LRS1 $15; STSI $15.

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. Course Fees: LRS1 $15; STSI $15.

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. Course Fees: LRS1 $15; STSI $15.
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. Course Fees: IUB1 $10; L001
$30; LRS1 $10; STSI $10.

BIO 3743. Bacteriology. (3-0) 3 Credit Hours.
Prerequisite: 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. Course Fees: LRS1 $15;
STSI $15.

BIO 3813. Cell Biology. (3-0) 3 Credit Hours.
Prerequisite: BIO 2313; BIO 3513 is recommended. Concurrent
enrollment in BIO 3822 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. Course Fees: LRS1 $15; STSI $15.

BIO 3822. Cell Biology Laboratory. (1-4) 2 Credit Hours.
Prerequisites: BIO 2313 and either BIO 2322 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 BME 3114.) Generally offered: Fall, Spring,
Summer. Course Fees: IUB1 $10; L001 $30; LRS1 $10; STSI $10.

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. Course Fees: LRS1 $15; STSI $15.

BIO 3933. Principles of Cancer Biology. (3-0) 3 Credit Hours.
Prerequisite: BIO 1414; 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. Course Fees: LRS1 $15; STSI $15.

BIO 4033. Conservation Biology. (3-0) 3 Credit Hours.
Prerequisite: 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. Course Fees: LRS1
$15; STSI $15.

BIO 4043. Desert Biology. (2-3) 3 Credit Hours.
Prerequisite: 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. Generally offered: Summer. Course Fees: LRS1 $15;
STSI $15.

BIO 4053. Wildlife Biology. (3-0) 3 Credit Hours.
Prerequisite: 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.
Course Fees: LRS1 $15; STSI $15.

BIO 4063. Ornithology. (3-0) 3 Credit Hours.
Prerequisite: BIO 1404. 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. Course Fees: LRS1 $15; STSI $15.

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,
organogenesis, embryonic pattern formation, cell differentiation, and
organogenisis. (Formerly BIO 3143. Credit cannot be earned for both
BIO 4143 and BIO 3143.) Generally offered: Fall. Course Fees: LRS1
$15; STSI $15.

BIO 4233. Field Biology. (3-0) 3 Credit Hours.
Prerequisite: 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. Course Fees: LRS1
$15; STSI $15.

BIO 4241. Field Biology Laboratory. (0-3) 1 Credit Hour.
Prerequisite: 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. Course Fees: L001 $30;
LRS1 $5; STSI $5.
BIO 4453. Endocrinology. (3-0) 3 Credit Hours.
Prerequisite: BIO 1414. 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. Course Fees: LRS1 $15; STSI $15.

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

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

BIO 4583. The Computational Brain. (3-0) 3 Credit Hours.
Prerequisite: 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. Course Fees: LRS1 $15; STSI $15.

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. Course Fees: LRS1 $15; STSI $15.

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. Course Fees: LRS1 $15; STSI $15.

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. Course Fees: LRS1 $15; STSI $15.

BIO 4752. Immunology Laboratory. (0-4) 2 Credit Hours.
Prerequisites: BIO 2313 and BIO 2322, 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. Course Fees: IUB1 $10; L001 $10; LRS1 $10; STSI $10.

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. Course Fees: LRS1 $15; STSI $15.

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

BIO 4813. Brain and Behavior. (3-0) 3 Credit Hours.
Prerequisite: BIO 1414. 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. Generally offered: Fall. Course Fees: LRS1 $15; STSI $15.

BIO 4823. Cognitive Neuroscience. (3-0) 3 Credit Hours.
Prerequisite: BIO 3433 or BIO 3813 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. Course Fees: LRS1 $15; STSI $15.

BIO 4841. Seminar in Medical Sciences. (1-0) 1 Credit Hour.
Prerequisite: This course is only open to seniors participating in the Biology Pre-Medical Sciences Concentration. Students will learn how to interpret the scientific literature and to organize and present scientific research findings as reported in the current literature. The grade report for this course is either “CR” (satisfactory performance) or “NC” (unsatisfactory performance). Generally offered: Spring.

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. Course Fees: IUB1 $10; L001 $30; LRS1 $10; STSI $10.

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. Course Fees: LRS1 $5; STSI $5.
**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. Course Fees: LRS1 $10; STSI $10.

**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. Course Fees: LRS1 $15; STSI $15.

**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. Course Fees: LRS1 $15; STSI $15.

**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. Course Fees: LRS1 $5; STFB $40; STSI $5.

**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. Generally offered: Fall, Spring, Summer. Course Fees: LRS1 $15; STSI $15.

**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. Course Fees: LRS1 $15; STSI $15.