DEPARTMENT OF BIOLOGY

No one really knows what the world will be like 50 years from now, but it is certain that biologists will be at the forefront of science attempting to find solutions to many of the world’s problems and to find answers to intriguing questions about animals, plants and microbes at the molecular, cellular, organismal and ecosystem levels. Biologists will be concerned with pollution of the environment, cause and cure of disease, population control, recurring food shortages, preservation of species and many other aspects resulting from the impact of technological changes on life forms. Those who are astounded by the array of living things on the earth and who seek challenging, creative work should consider a career in biology or in a biology-related field. The Department of Biology offers five distinct four-year curricula which lead to the baccalaureate degree. These are the Bachelor of Arts in Biology, Bachelor of Science in Biology, Bachelor of Science in Molecular and Cell Biology, Bachelor of Science in Microbiology and Bachelor of Science in Zoology. The curricula are designed to maximize postbaccalaureate opportunities in:

1. professional schools of medicine, veterinary medicine and dentistry;
2. allied health schools of physical and occupational therapy, physician assistant programs, optometry, pharmacy, and nursing;
3. graduate education leading to teaching and research careers in universities, in industry or in state or national agencies;
4. teaching at junior high or high school levels and
5. jobs in biotechnology, research laboratories, pharmaceutical companies and field biology.

The Department of Biology degree plans will enable students to complete all entrance requirements for graduate and professional schools as well as medical technology, pharmacy, optometry, nursing, physical therapy, and other paramedical and health support fields.

Advising

Because some careers in biology require advanced and/or specialized training, it is essential to take advantage of advising opportunities. In the Department of Biology, there are professional advisors in the Biology Undergraduate Programs Office. The advisor may be consulted prior to each registration period and as the student needs. Questions regarding registration, degree checks, transfer of courses, advanced placements and other academic matters are handled in the Office of Undergraduate Programs. Students with special interests in graduate study should consult the graduate advisor. Information concerning entrance to professional schools of medicine, dentistry and other health related fields is available from the Office of Professional School Advising.

Requirements for all Baccalaureate Degrees in the Department of Biology

Each student seeking a baccalaureate degree in the Department of Biology is required to master a common body of knowledge in science. In addition, the student must take courses essential to a liberal education. Students will note that the first two years of all curricula offered by the Department of Biology are similar. Electives must include the 6 hours of international and cultural diversity courses required for graduation. Students must also take at least two writing-intensive courses in biology. Other requirements for graduation are listed in the Texas A&M University Student Rules and this catalog.

Students in the Department of Biology must make a grade of C or better in BIOL 111 and BIOL 112. Additionally, students may have only one D in courses within the major used to satisfy required or directed electives for a given degree plan. It is required that the freshman and sophomore level biology, chemistry and math courses be completed before the start of the 5th full semester and before enrollment in any junior or senior level science.

Common Body of Knowledge

To assure that students have sufficient prerequisite training for advanced courses, Biology majors must complete a series of courses comprising a Common Body of Knowledge (CBK) prior to their junior year (5th full semester) and enrollment in upper level BIOL courses. A Biology student will be admitted into upper level Biology classes when he or she has met the following criteria:

Completion of a set of CBK courses (38 hours) before the student’s 5th full semester to include:

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Semester Credit Hours</th>
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</thead>
<tbody>
<tr>
<td>BIOL 111</td>
<td>Introductory Biology I</td>
<td>4</td>
</tr>
<tr>
<td>BIOL 112</td>
<td>Introductory Biology II</td>
<td>4</td>
</tr>
<tr>
<td>BIOL 213</td>
<td>Molecular Cell Biology</td>
<td>3</td>
</tr>
<tr>
<td>BIOL 214</td>
<td>Genes, Ecology and Evolution</td>
<td>3</td>
</tr>
<tr>
<td>CHEM 101</td>
<td>Fundamentals of Chemistry I</td>
<td>4</td>
</tr>
<tr>
<td>&amp; CHEM 111</td>
<td>Fundamentals of Chemistry Laboratory I</td>
<td></td>
</tr>
<tr>
<td>CHEM 102</td>
<td>Fundamentals of Chemistry II</td>
<td>4</td>
</tr>
<tr>
<td>&amp; CHEM 112</td>
<td>Fundamentals of Chemistry Laboratory II</td>
<td></td>
</tr>
<tr>
<td>CHEM 227</td>
<td>Organic Chemistry I</td>
<td>4</td>
</tr>
<tr>
<td>&amp; CHEM 237</td>
<td>Organic Chemistry Laboratory</td>
<td></td>
</tr>
<tr>
<td>CHEM 228</td>
<td>Organic Chemistry II</td>
<td>4</td>
</tr>
<tr>
<td>&amp; CHEM 238</td>
<td>Organic Chemistry Laboratory</td>
<td></td>
</tr>
</tbody>
</table>

Select one of the following:

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Semester Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATH 147</td>
<td>Calculus I for Biological Sciences</td>
<td></td>
</tr>
<tr>
<td>&amp; MATH 148</td>
<td>Calculus II for Biological Sciences</td>
<td></td>
</tr>
<tr>
<td>MATH 151</td>
<td>Engineering Mathematics I</td>
<td></td>
</tr>
<tr>
<td>&amp; MATH 152</td>
<td>Engineering Mathematics II</td>
<td></td>
</tr>
<tr>
<td>MATH 171</td>
<td>Analytic Geometry and Calculus</td>
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</tr>
<tr>
<td>&amp; MATH 172</td>
<td>Analytic Geometry and Calculus</td>
<td></td>
</tr>
</tbody>
</table>

Total Semester Credit Hours: 38

A grade of C or better must be earned.

A student must be in good academic standing with an overall grade point average of a 2.0 or better overall and in the major.

Process

Students will be audited by the department to monitor progress of completion of the CBK. Students failing to complete the CBK within the first four full semesters at Texas A&M University may be blocked and forced to change majors or be required to meet with an academic advisor to see if they can be successful in the major. Students registering for upper-level Biology classes without completing the CBK, or without
approval of the Undergraduate Advising Office, will be dropped from the roster.

**Transfer Students**

1. Transfer from within Texas A&M University: The Biology Department will accept changes of major from other departments at Texas A&M upon completion of AT LEAST one semester of an applicable BIOL course taken at Texas A&M and AT LEAST one semester of an applicable CHEM course taken at Texas A&M, with a minimum 2.5 grade point average overall for courses taken at Texas A&M, a 2.5 grade point average in BIOL courses taken at Texas A&M, and a 2.5 or better grade point average in CHEM courses taken at Texas A&M. Students still must complete the CBK before being admitted to upper level BIOL courses.

2. Transfer students from other institutions to Biology must have completed the following:
   a. A minimum of 24 accredited college hours
   b. Sixteen hours of prescribed coursework:
      i. Eight hours of General Biology (TAMU BIOL 111 and BIOL 112 or Texas Common Course Numbers BIOL 1406 and 1407) with B’s or better, and
      ii. Eight hours of General Chemistry (TAMU CHEM 101/CHEM 111 and CHEM 102/CHEM 112 or Texas Common Course Numbers CHEM 1411 and CHEM 1412) with B’s or better, and
      iii. Eight hours of Calculus (TAMU MATH 147/MATH 148 or MATH 151/MATH 152 or MATH 171/MATH 172 or Texas Common Course Numbers MATH 2413 and MATH 2414) with C’s or better
   c. A minimum cumulative grade point average of a 3.0
   d. A minimum Biology and Chemistry grade point average of a 3.0

**Biology Honors Program**

The Biology Department Honors Program is open to highly talented and motivated students pursuing a major in any of our degree plans. Honors students will be part of a vibrant community within the department with enriched learning experiences in both the classroom and biology research laboratories.

**Honors Requirements:** Students wishing to graduate with honors distinctions in either Biology (BIOL), Microbiology (MICR), Zoology (ZOOL), or Molecular and Cellular Biology (BMCB) must earn 21 credits in Honors courses and meet the following minimum honors requirements in addition to those listed in the degree plan:

- 4 credits BIOL 111H or BIOL 112H*
- 3 credits BIOL 213H or BIOL 214H
- 3 credits at 300/400 BIOL honors or honors contract; any 600 BIOL; not to include BIOL 485H, BIOL 491H, or BIOL 495H
- 6 credits BIOL 491H
- 2 credits BIOL 495H
- 3 credits any honors course outside the College of Science

* This requirement may be waved with a score of 5 on the Biology AP exam, a score of 6 on the IB exam, or by taking an additional honors biology course at the 300 or 400 level.

**Grade requirements at time of graduation:**

- cumulative Texas A&M University GPR of 3.5 or higher
- cumulative honors GPR of 3.25 or higher
- no grade lower than a B in courses counting toward honors. If a student earns less than a B in an honors course, they will still receive University credit. However, they will need to take a different course to fulfill the honors requirement.
- no F*, given in cases of academic dishonesty, on the transcript

**Honors recognition:** All honors courses will be denoted as honors on students’ official transcripts. Furthermore, students completing the honors program will have the departmental honors distinction, as well as, any earned university or college distinction noted on the official transcript.

**Admission to the Honors Program in Biology**

**Incoming Freshmen:** Incoming freshmen should indicate their interest in the departmental honors program though the ApplyTexas site and choosing the “Apply to any Honors Program” after August 1. To be admitted, students should have a SAT score of 1250 or above (verbal +math and minimum of 600 on both sections) or a composite score of 28 or above on the ACT (minimum 27 on both verbal and math sections).

Students who have already completed their application and now wish to apply to the Biology Honors program can use the "Apply to any Honors Program" link at the Texas A&M Honors program site (http://honorsprograms.tamu.edu/Home).

**Current or transfer students:** Current or transfer students with a cumulative GPR of 3.5 or better can apply for admissions to the Biology Honors Program by writing a short (less than 300 word) memo requesting admittance to the departments honors director. When applying, students should keep in mind that they will need to fulfill all honors requirements. Please send memos to: biohonors@bio.tamu.edu.

**Remaining in the program**

In order to remain in the Biology Honors program, students must maintain a cumulative GPR at Texas A&M of 3.5 and honors GPR of 3.25. Students falling below these standards will be placed on probation for the next semester. Students unable to meet these standards for a second semester may be dismissed from the Biology Honors Program.

**Human Biology Track**

This unofficial track is for students interested in pursuing professional schools including medical, dental and allied health programs (e.g., nursing, occupational therapy, optometry, pharmacy, physical therapy and physician assistant). The focus of the science courses on human biology will better prepare these students for their chosen fields. Suggested courses include:

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Semester Credit Hours</th>
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</thead>
<tbody>
<tr>
<td><strong>Social and Behavioral Science</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PSYC 107</td>
<td>Introduction to Psychology</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>or SOCI 205 or Introduction to Sociology</td>
<td></td>
</tr>
<tr>
<td><strong>Biology Electives</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BIOL 318</td>
<td>Chordate Anatomy</td>
<td>4</td>
</tr>
</tbody>
</table>
Biology Electives

Upper-level BIOL courses, including two writing intensive courses (http://catalog.tamu.edu/undergraduate/course-descriptions/biol) 14

Free Electives

RDNG 372 Reading and Writing across the Middle Grades Curriculum or RDNG 465 or Reading in the Middle and Secondary Grades 3

TEFB 322 Teaching and Schooling in Modern Society 3

TEFB 324 Teaching Skills II 3

TEFB 406 Science in the Middle and Secondary School 3

Total Semester Credit Hours 32

Students should consult their academic advisor about the courses that best fit their career interests.

Ecology/Environmental Track

This unofficial track is particularly designed for students interested in environmental consulting, environmental protection and ecosystem evaluation. This suggested degree plan can be adapted to focus on particular areas or populations within an ecosystem. A minimum of 18 hours is required to fulfill this requirement, to be chosen from the following:

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Semester Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENGL 210</td>
<td>Technical and Business Writing</td>
<td>3</td>
</tr>
</tbody>
</table>

Communication

Biology Electives

Select one of the following: 3-4

BIOL 335 Invertebrate Zoology

BIOL 357 Ecology

BIOL 358 Ecology Laboratory

BIOL 400 Tropical Ecology Costa Rica

BIOL 440 Marine Biology

BIOL 462/ WFSC 462 Amazon River Tropical Biology

WFSC 425 Marine Fisheries 3

Total Semester Credit Hours 20

Students should consult their academic advisor about the courses that best fit their career interests.
CHEM 315  & CHEM 318  
Fundamentals of Quantitative Analysis and Quantitative Analysis Laboratory

ENTO 201  General Entomology

MEPS 313  Introduction to Plant Physiology

Select one of the following: 3-4
- PLPA 301  Plant Pathology
- PLPA 303  and Plant Pathology Laboratory

WFSC 311  Ichthyology

WFSC 401  General Mammalogy

WFSC 402  General Ornithology

Total Semester Credit Hours  20-21

Students should consult their academic advisor about the courses that best fit their career interests.

**Quantitative Biology Track**

This unofficial track is for students interested in applying quantitative approaches, including mathematical, statistical, and computational techniques, to fundamental problems in biology. Because courses for this track are still being developed in conjunction with the Departments of Mathematics and Statistics, students should check with their advisor for new quantitative biology courses:

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Semester Credit Hours</th>
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</thead>
<tbody>
<tr>
<td><strong>Mathematics</strong></td>
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</tr>
<tr>
<td>MATH 171</td>
<td>Analytic Geometry and Calculus</td>
<td>4</td>
</tr>
<tr>
<td>MATH 172</td>
<td>Calculus</td>
<td>4</td>
</tr>
<tr>
<td><strong>Electives</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BIOL 289</td>
<td>Special Topics in...</td>
<td>1-4</td>
</tr>
<tr>
<td>MATH 308</td>
<td>Differential Equations</td>
<td>3</td>
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<tr>
<td><strong>Total Semester Credit Hours</strong></td>
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<td>12-15</td>
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</table>

**Liberal Education Requirements of the University, College or State**

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Semester Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>American history elective (<a href="http://catalog.tamu.edu/undergraduate/general-information/university-core-curriculum/#american-history">link</a>)</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>Communication elective (<a href="http://catalog.tamu.edu/undergraduate/general-information/university-core-curriculum/#communication">link</a>)</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>Language, philosophy and culture elective (<a href="http://catalog.tamu.edu/undergraduate/general-information/university-core-curriculum/#language-philosophy-culture">link</a>)</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Government/Political science elective (<a href="http://catalog.tamu.edu/undergraduate/general-information/university-core-curriculum/#government-political-science">link</a>)</td>
<td>6</td>
<td></td>
</tr>
</tbody>
</table>

**Faculty**

Alexander, Michael B, Lab Instructor

Biology

PHD, Texas A&M University, 2014

Aramayo, Rodolfo A, Associate Professor

Biology

PHD, University of Georgia, 1992

Armstrong, Beth E, Lab Instructor

Biology

MS, Texas A&M University, 2006

Aufderheide, Karl J, Associate Professor

Biology

PHD, University of Minnesota, Twin Cities, 1974

Bell-Pedersen, Deborah, Professor

Biology

PHD, State University of New York at Albany, 1991

Benedik, Michael J, Professor

Biology

PHD, Stanford University, 1982

Beremand, Phillip D, Lab Instructor

Biology

MS, Indiana University, 1979

Bernardo, Joseph, Research Associate Professor

Biology

PHD, Duke University, 1991

Carney, Ginger E, Professor

Biology

PHD, University of Georgia, 1998

Cohn, William B, Senior Lecturer

Biology

PHD, Texas A&M University, 2000

Criscone, Charles D, Associate Professor

Biology

PHD, Oregon State University, 2005

Epps, Sharon V, Lab Instructor

Biology

MS, Texas A&M University, 2013
Erickson, James W, Associate Professor
Biology
PHD, University of Wisconsin - Madison, 1989

Garcia, Luis R, Professor
Biology
PHD, The University of Texas at Austin, 1996

Gomer, Richard H, Professor
Biology
PHD, California Institute of Technology, 1983

Greenbaum, Ira F, Professor
Biology
PHD, Texas Tech University, 1978

Griffing, Lawrence R, Associate Professor
Biology
PHD, Stanford University, 1981

Hardin, Paul E, Distinguished Professor
Biology
PHD, Indiana University, 1987

Harlow, Mark L, Assistant Professor
Biology
PHD, Stanford University, 2001

Jones, Adam G, Professor
Biology
PHD, University of Georgia, 1998

Jung, Jae Hoon, Research Assistant Professor
Biology
PHD, Stanford University, 2009

Kemp, Walter M, Professor
Biology
PHD, The Tulane University of Louisiana, 1969

Lee, Christopher P, Lecturer
Biology
PHD, Texas A&M University, 2014

Lekven, Arne C, Professor
Biology
MS, University of California, Los Angeles, 1996

Lin, Xiaorong, Professor
Biology
PHD, University of Georgia, 2003

Lockless, Steve W, Associate Professor
Biology
PHD, The University of Texas at Dallas, 2002

Lyons, Jacob I, Lab Instructor
Biology
MS, Texas State University, 2010

Mackenzie, Duncan S, Associate Professor
Biology
PHD, University of California, Berkeley, 1980

Manson, Michael D, Professor
Biology
PHD, Stanford University, 1976

McKnight, Thomas D, Professor
Biology
PHD, University of Georgia, 1983

McMahan, Uel J, Professor
Biology
PHD, University of Tennessee Medical Units, 1964

Menet, Jerome, Assistant Professor
Biology
PHD, Louis Pasteur University, 2003

Merlin, Christine, Assistant Professor
Biology
PHD, University Pierre and Marie Curie, 2006

Moyes, Rita J, Instructional Associate Professor
Biology
PHD, Texas A&M University, 1992

Nan, Beiyan, Assistant Professor
Biology
PHD, Peking University, China, 2007

Norton, Jerry D, Lab Instructor
Biology
PHD, The University of Texas at Austin, 1994

Pepper, Alan E, Associate Professor
Biology
PHD, University of California, Davis, 1990

Pilling, Darrell, Research Assistant Professor
Biology
PHD, University of Birmingham, 1995

Qin, Hongmin, Associate Professor
Biology
PHD, Institute of Microbiology, Chinese Academy of Sciences, 1999

Rao, Asha, Senior Lecturer
Biology
PHD, Texas A&M University, 2002

Riley, Bruce B, Professor
Biology
PHD, University of Wisconsin - Madison, 1990

Rosenthal, Gil G, Professor
Biology
PHD, The University of Texas at Austin, 2000

Ryan, Kathryn J, Instructional Assistant Professor
Biology
PHD, Baylor College of Medicine, 1998

Sachs, Matthew S, Professor
Biology
PHD, Massachusetts Institute of Technology, 1986
Schartl, Manfred, Visiting Professor
Biology
PHD, University of Gießen, 1978

Scott, Timothy P, Professor
Biology
PHD, Texas A&M University, 1996

Siegele, Deborah A, Associate Professor
Biology
PHD, University of Wisconsin - Madison, 1989

Smith, James L, Associate Professor
Biology
PHD, University of Florida, 2002

Smotherman, Michael S, Associate Professor
Biology
PHD, University of California, Los Angeles, 1998

Sorg, Joseph A, Associate Professor
Biology
PHD, University of Chicago, 2006

Szule, Joseph A, Research Assistant Professor
Biology
PHD, University of Calgary, 2005

Tag, Andrew G, Senior Lecturer
Biology
PHD, Texas A&M University, 2003

Taylor, Lathrop, Senior Lecturer
Biology
PHD, Texas A&M University, 1985

Thomas, Terry L, Professor
Biology
PHD, The University of Georgia, 1975

Thompson, Wesley J, Professor
Biology
PHD, University of California, Berkeley, 1975

Versaw, Wayne K, Associate Professor
Biology
PHD, University of Wisconsin - Madison, 1995

Wan, Wei, Senior Lecturer
Biology
PHD, University of California, Davis, 2005

Whitaker, Gregory H, Lab Instructor
Biology
PHD, Texas A&M University, 2015

Wicksten, Mary K, Professor
Biology
PHD, University of Southern California, 1977

Winemiller, Leslie K, Senior Lecturer
Biology
PHD, The University of Texas at Austin, 1989

Wright, Rachel N, Lab Instructor
Biology
PHD, Texas A&M University, 2011

Zoran, Mark J, Professor
Biology
PHD, Iowa State University, 1987

Majors
- Bachelor of Arts in Biology (http://catalog.tamu.edu/undergraduate/science/biology/ba)
- Bachelor of Science in Biology (http://catalog.tamu.edu/undergraduate/science/biology/bs)
- Bachelor of Science in Microbiology (http://catalog.tamu.edu/undergraduate/science/biology/microbiology-bs)
- Bachelor of Science in Molecular and Cell Biology (http://catalog.tamu.edu/undergraduate/science/biology/molecular-cell-biology-bs)
- Bachelor of Science in Zoology (http://catalog.tamu.edu/undergraduate/science/biology/zoology-bs)

Minors
- Bioinformatics Minor (http://catalog.tamu.edu/undergraduate/science/biology/bioinformatics-minor)
- Biology Minor (http://catalog.tamu.edu/undergraduate/science/biology/minor)

Courses
- Biology (BIOL) (p. 6)
- Microbiology (MICR) (p. 10)
- Zoology (ZOOL) (p. 11)

Biology
BIOL 100 Horizons in Biology
Credit 1. 1 Lecture Hour.
Introduction to the study of biology at Texas A&M University; gain knowledge of departmental and campus resources to assist and enhance the pursuit of a degree in biology, microbiology, molecular and cellular biology or zoology.
Prerequisites: First-semester and first-time-in-college freshman majoring in BIOL, MICR, BMCB and ZOOL.

BIOL 101 Botany
Credits 4. 3 Lecture Hours. 3 Lab Hours.
(BIOL 1311 and 1111, BIOL 1411) Botany. Structure, physiology and development of plants with an emphasis on seed plants. (Not open to students who have taken BIOL 111 and BIOL 112 or BIOL 113.); includes laboratory that Reinforces and provides supplemental information related to the lecture topics.

BIOL 107 Zoology
Credits 4. 3 Lecture Hours. 3 Lab Hours.
(BIOL 1313 and 1113, 1413) Zoology. Survey of animal life with respect to cell organization, genetics, evolution, diversity of invertebrates/vertebrates, anatomy/physiology, and interaction of animals with their environment; includes laboratory that reinforces and provides supplemental information related to lecture topics. (Not open to students who have taken BIOL 111 and BIOL 112 or BIOL 113).
BIOL 111 Introductory Biology I  
Credits 4. 3 Lecture Hours. 3 Lab Hours.  
(BIOL 1306 and 1106, 1406) Introductory Biology I. First half of an introductory two-semester survey of contemporary biology that covers the chemical basis of life, structure and biology of the cell, molecular biology and genetics; includes laboratory that reinforces and provides supplemental information related to the lecture topics.

BIOL 112 Introductory Biology II  
Credits 4. 3 Lecture Hours. 3 Lab Hours.  
(BIOL 1307 and 1107, 1407) Introductory Biology II. The second half of an introductory two-semester survey of contemporary biology that covers evolution, history of life, diversity and form and function of organisms; includes laboratory that reinforces and provides supplemental information related to the lecture topics.  
Prerequisite: BIOL 111.

BIOL 113 Essentials in Biology  
Credits 4. 3 Lecture Hours. 3 Lab Hours.  
(BIOL 1308 and BIOL 1108) Essentials in Biology. One-semester in introductory biology for non-majors; chemical basis of life, cellular and molecular biology, genetics, evolution, biodiversity and interaction of organisms with their environment; includes a laboratory to supplement and reinforce lecture topics.

BIOL 206 Introductory Microbiology  
Credits 4. 3 Lecture Hours. 4 Lab Hours.  
(BIOL 2321 and 2121, 2421) Introductory Microbiology. Basic microbiology of prokaryotes and eukaryotes; main topics include morphology, physiology, genetics, taxonomy, ecology, medically important species and immunology; mandatory laboratory designed to give hands-on experience and to reinforce basic principles.  
Prerequisites: BIOL 101, BIOL 107, BIOL 111, or BIOL 113; CHEM 101 and CHEM 111 or CHEM 103 and CHEM 113. May not be used for credit by biology, molecular and cell biology, microbiology, zoology, predentistry or premedicine majors.

BIOL 213 Molecular Cell Biology  
Credits 3. 3 Lecture Hours.  
Explores the molecular basis of cell structure, function and evolution; gene regulation, cell division cycle, cancer, immunity, differentiation, multicellularity and photosynthesis; may not take concurrently with, or after the completion of, BIOL 413.  
Prerequisites: BIOL 112; CHEM 102 and CHEM 112.

BIOL 214 Genes, Ecology and Evolution  
Credits 3. 3 Lecture Hours.  
A genetically-based introduction to the study of ecology and evolution; emphasis on the interactions of organisms with each other and with their environment.  
Prerequisite: BIOL 112.

BIOL 285 Directed Studies  
Credits 1 to 4. 1 to 4 Other Hours.  
Problems in various phases of plant, animal and microbial science.  
Prerequisites: Freshman or sophomore classification; approval of ranking professor in field chosen and Undergraduate Advising Office.

BIOL 289 Special Topics in...  
Credits 1 to 4. 1 to 4 Lecture Hours.  
Selected topics in an identified area of biology. May be repeated for credit.  
Prerequisite: Approval of instructor.

BIOL 291 Research  
Credits 0 to 4. 0 to 4 Other Hours.  
Active research of basic nature under the supervision of a Department of Biology faculty member. May be repeated for credit.  
Prerequisites: Freshman or sophomore classification and approval of faculty member.

BIOL 295 Research Fundamentals in the Life Sciences  
Credit 1. 1 Lecture Hour.  
First course of four in capstone research program in biology; groundwork for subsequent research-intensive courses; practical understanding of how biological research is accomplished; develop models; synthesize work; glean predictive hypothesis; design critical tests; collect and analyze data; refine or reject hypotheses.  
Prerequisite: BIOL 213 or concurrent enrollment, or approval instructor.

BIOL 300 Research Seminar: Tropical Ecology in Costa Rica  
Credit 1. 1 Lecture Hour.  
Advanced instruction in research activities for Costa Rica; critical planning and writing skills essential in conducting research and communicating results using scientific methods and formatting.  
Prerequisites: Junior or senior classification; approval of instructor.

BIOL 302 Careers in Biology  
Credit 1. 1 Lecture Hour.  
Development of job search skills; utilization of career resources; self-assessment of career interests and career objectives; strategies for professional correspondence and networking; business etiquette and interviewing techniques; insight into life science career opportunities.  
Prerequisites: Junior or senior classification; department of biology majors only; or approval of instructor.

BIOL 318 Chordate Anatomy  
Credits 4. 3 Lecture Hours. 3 Lab Hours.  
Classification, phylogeny, comparative anatomy, and biology of chordates; diversity, protochordates, vertebrate skeletons, shark and cat anatomy studied in laboratory.  
Prerequisite: BIOL 112.

BIOL 319 Integrated Human Anatomy and Physiology I  
Credits 4. 3 Lecture Hours. 3 Lab Hours.  
Integrated approach to cellular, neural, skeletal, muscular anatomy and physiology; includes some histology, histopathology, radiology and clinical correlations.  
Prerequisite: BIOL 111 and BIOL 112, or BIOL 107.

BIOL 320 Integrated Human Anatomy and Physiology II  
Credits 4. 3 Lecture Hours. 3 Lab Hours.  
Continuation of BIOL 319. Integrated approach to endocrine, cardiovascular, respiratory, digestive, urinary, reproductive and developmental anatomy and physiology; includes some histology, histopathology, radiology and clinical correlations.  
Prerequisite: BIOL 111 and BIOL 112, or BIOL 107; BIOL 319 or approval of instructor.

BIOL 328 Plants and People  
Credits 3. 2 Lecture Hours. 3 Lab Hours.  
Development and uses of principal economically important plants of the world; plants and plant parts used in production of important commodities; vascular plants.  
Prerequisite: BIOL 101 or BIOL 111 or BIOL 112 or approval of instructor.
BIOL 335 Invertebrate Zoology  
Credits 4. 3 Lecture Hours. 3 Lab Hours.  
Morphology, taxonomy, natural history and phylogeny of invertebrate animals, with emphasis on biodiversity; class includes both lecture and lab. Labs include study of preserved material and demonstration of living animals in aquaria and terraria.  
Prerequisite: BIOL 112 or approval of instructor.

BIOL 344 Embryology  
Credits 4. 3 Lecture Hours. 3 Lab Hours.  
Introduction to general and comparative embryology; molecular and cellular mechanisms of development; genetics and early development of selected invertebrates (C. elegans, Drosophila and sea urchin) and emphasis on vertebrates (frog, fish, chick and mouse).  
Prerequisite: BIOL 213 or GENE 302.

BIOL 350 Computational Genomics  
Credits 3. 2 Lecture Hours. 2 Lab Hours.  
Hands-on approach to obtaining, organizing and analyzing genome-related data; emphasis on asking and answering biologically relevant questions by designing and performing experiments using computers; understanding biology from a computational perspective.  
Prerequisite: Junior or senior classification in life sciences, engineering, mathematics, chemistry.

BIOL 351 Fundamentals of Microbiology  
Credits 4. 3 Lecture Hours. 4 Lab Hours.  
Introduction to modern microbiology with emphasis on prokaryotes; includes microbial cell structure, function, and physiology; genetics, evolution, and taxonomy; bacteriophage and viruses; pathogenesis and immunity; and ecology and biotechnology; includes laboratory experience with microbial growth and identification.  
Prerequisites: BIOL 112; CHEM 227, and CHEM 237 or CHEM 231; or approval of instructor.

BIOL 352 Diagnostic Bacteriology  
Credits 4. 2 Lecture Hours. 6 Lab Hours.  
Practical experience in handling, isolation and identification of pathogenic microorganisms using biochemical tests and rapid identification techniques.  
Prerequisite: BIOL 206 or BIOL 351.

BIOL 357 Ecology  
Credits 3. 3 Lecture Hours.  
Analysis of ecosystems at organismal, population, interspecific and community levels. BIOL 358 is the laboratory for this lecture course.  
Prerequisite: BIOL 112 or approval of instructor.

BIOL 358 Ecology Laboratory  
Credit 1. 3 Lab Hours.  
Quantitative analyses of freshwater and terrestrial ecosystems; includes data sampling and presentation of results in written and oral formats; required fieldtrips; analysis of competition and predator-prey interactions using ecological models.  
Prerequisite: BIOL 357 or concurrent enrollment; junior or senior classification.

BIOL 388 Principles of Animal Physiology  
Credits 4. 3 Lecture Hours. 3 Lab Hours.  
Introduction to how animals function, including basics of neurophysiology, endocrinology, muscular, cardiovascular, respiratory, ommoregulatory, and metabolic physiology; broadly comparative in scope and encompassing adaptation of physiological systems to diverse environments; the laboratory stresses techniques used for monitoring and investigating physiological mechanisms and responses to environmental changes.  
Prerequisites: BIOL 112; CHEM 228.

BIOL 395 Directed Investigation in Bioinformatics  
Credits 2. 1 Lecture Hour. 2 Lab Hours.  
Second course of four in capstone research program in biology; conduct individual research projects utilizing bioinformatic tools.  
Prerequisite: BIOL 213 or approval of instructor.

BIOL 400 Tropical Ecology Costa Rica  
Credits 6. 2 Lecture Hours. 12 Lab Hours.  
Advanced field course taught at multiple field stations in Costa Rica; emphasis on biological, ecological, natural history and philosophical attributes of tropical ecosystems; includes planning and conducting a field-oriented research project, and presentation of results.  
Prerequisites: BIOL 300 and approval of instructor; junior or senior classification.

BIOL 401 Critical Writing in Biology  
Credit 1. 1 Lecture Hour.  
Reading scientific papers and writing short synopses of papers with a focus on learning how to think and write like a scientist; fills the current Writing Intensive “W” course requirement for biology.  
Prerequisites: BIOL 213 and BIOL 214; junior or senior classification.

BIOL 405 Comparative Endocrinology  
Credits 3. 3 Lecture Hours.  
Basic principles of endocrinology including structure and functions of hormones in vertebrates; hormonal control of growth, metabolism, ommoregulation, and reproduction; endocrine techniques and mechanism of hormone action.  
Prerequisites: BIOL 213 and CHEM 227; BIOL 320 or BIOL 388 strongly recommended.

BIOL 406/GENE 406 Bacterial Genetics  
Credits 3. 3 Lecture Hours.  
A problem oriented course surveying the manipulation and mechanisms of genetic systems in bacteria; recombination, structure and regulation of bacterial genes, plasmids and phages.  
Prerequisites: BIOL 351; GENE 302.  
Cross Listing: GENE 406/BIOL 406.

BIOL 413 Cell Biology  
Credits 3. 3 Lecture Hours.  
Structure, function, and biogenesis of cells and their components; interpretation of dynamic processes of cells, including protein trafficking, motility, signaling and proliferation.  
Prerequisites: BIOL 213 and BICH 410.

BIOL 414 Developmental Biology  
Credits 3. 3 Lecture Hours.  
Concepts of development in systems ranging from bacteriophage to the mammalian embryo; use of recombinant DNA technology and embryo engineering to unravel the relationships between growth and differentiation, morphogenesis and commitment, aging and cancer.  
Prerequisite: BIOL 413 or concurrent enrollment or approval of instructor.
BIOL 423 Cell Biology Laboratory
Credits 2. 1 Lecture Hour. 3 Lab Hours.
Modern methods of study of cell structure and cell function.
Prerequisites: BIOL 413 and BICH 412 or concurrent enrollment; approval of instructor.

BIOL 430 Biological Imaging
Credits 4. 3 Lecture Hours. 3 Lab Hours.
Still and video photography and photomicrography, computerbased digital image analysis and processing of biological images; theory and principles of light and electron microscopy including transmission and scanning electron microscopy; optical contrast methods for light microscopy including phase contrast, DIC, polarizing light and confocal laser scanning microscopy.
Prerequisite: Junior classification or approval of instructor.

BIOL 434/NRSC 434 Regulatory and Behavioral Neuroscience
Credits 3. 3 Lecture Hours.
Cell biology and biophysics of neurons; functional organization of the vertebrate nervous system; physiological basis of behavior.
Prerequisites: BIOL 213, BIOL 319, BIOL 388, NRSC 335/PSYC 335 or PSYC 335/NRSC 335.
Cross Listing: NRSC 434/BIOL 434.

BIOL 435 Laboratory for Regulatory and Behavioral Neuroscience
Credit 1. 3 Lab Hours.
Study of modern methods and tools used to investigate nervous system structure and function.
Prerequisite: Approval of instructor.

BIOL 437 Molecular and Human Medical Mycology
Credits 3. 3 Lecture Hours.
Principles of fungal pathogenesis, diagnosis and antifungal therapies, and relevant genetic and molecular tools for studying human pathogens and drug delivery.
Prerequisites: BIOL 351; junior or senior classification or approval of instructor.

BIOL 438 Bacterial Physiology
Credits 4. 4 Lecture Hours.
Structure and function of prokaryotic cells, with emphasis on evolutionary adaptations to different environmental, developmental, and pathogenic selections pressures; formation of teams and preparation of presentations on specific topics in microbiology.
Prerequisites: BIOL 351; BIOL 406/GENE 406 or concurrent enrollment; BICH 410, BICH 431/GENE 431 and GENE 302 strongly recommended.

BIOL 440 Marine Biology
Credits 4. 3 Lecture Hours. 3 Lab Hours.
Introduction to biology of common organisms inhabiting bays, beaches and near-shore oceanic waters with special reference to Gulf of Mexico biota; emphasis on classification, distribution, history, ecology, physiology, mutualism, predation, major community types and economic aspects of marine organisms.
Prerequisite: BIOL 112 or approval of instructor.

BIOL 445 Biology of Viruses
Credits 3. 3 Lecture Hours.
Structure, composition and life cycles of viruses; methods used to study viruses; their interaction with host cells; mechanisms of pathogenicity and cellular transformation; responses of the host to viral infection, and vaccine applications; in-depth study of the life cycles of the major classes of viruses and discussion of emerging viruses.
Prerequisite: BIOL 213 or BIOL 351 or approval of instructor.

BIOL 450/BICH 450 Genomics
Credits 4. 3 Lecture Hours. 3 Lab Hours.
The study of genomic data includes consideration of the logic behind the most important genomic approaches, as well as their capabilities and limitations in investigating biological processes; the science of accessing and manipulating genomic data; and practical applications, including development of an hypotheses-driven datamining experiment.
Prerequisites: BIOL 213, GENE 301 or GENE 302, BICH 431/GENE 431 or GENE 431/BICH 431; or BIOL 351; junior or senior classification or approval of instructor.
Cross Listing: BICH 450/BIOL 450.

BIOL 451 Bioinformatics
Credits 3. 3 Lecture Hours.
Introduction to the entire field of bioinformatics; theoretical background of computational algorithms, with an emphasis on application of computational tools related to modern molecular biological research.
Prerequisite: Junior or senior classification, or approval of instructor.

BIOL 452 Fungal Functional Genomics
Credits 4. 3 Lecture Hours. 4 Lab Hours.
Extensive research experience in eukaryotic molecular genetics using the fungus Neurospora crassa as the primary model system; analysis of Neurospora gene-deletion strain collection to examine the effects of genes on the organism's traits; introduction of molecular techniques for genome manipulation and analysis.
Prerequisite: Junior or senior classification in any life science major or approval of instructor.

BIOL 454 Immunology
Credits 3. 3 Lecture Hours.
Introduction to basic immunological concepts and principles of serology.
Prerequisite: BIOL 351 or equivalent or approval of instructor.

BIOL 455 Laboratory in Immunology
Credits 2. 6 Lab Hours.
Practical application of serological principles which include precipitation, agglutination and blood banking principles; techniques in tissue culture and hybridoma technology also included.
Prerequisite: BIOL 454 or registration therein.

BIOL 456 Medical Microbiology
Credits 3. 3 Lecture Hours.
Microbiology, epidemiology and pathology of human pathogens with an emphasis on bacterial agents.
Prerequisite: BIOL 351 or approval of instructor.

BIOL 461 Antimicrobial Agents
Credit 1. 1 Lecture Hour.
Understanding of antimicrobial agents, limitations of use, biosynthesis and regulation, and challenges in development as new therapeutics.
Prerequisites: BICH 410 or BICH 440 and BIOL 351 or VTPB 405.

BIOL 462/WFSC 462 Amazon River Tropical Biology
Credits 3. 3 Lecture Hours.
History, ecology, evolutionary-biology, geography and culture of the Amazon River and Rio Negro; exploration of the world's most bio-diverse river during a 10-day expedition from Manaus, Brazil; survey biota, record observations about the ecosystem, select research topics, development of presentations.
Prerequisites: BIOL 107, BIOL 112, BIOL 113, BIOL 357 or RENR 205; or approval of instructor.
Cross Listing: WFSC 462/BIOL 462.
BIOL 463 Epigenetic Mechanisms and Inheritance  
**Credits 3. 3 Lecture Hours.**  
Knowledge of chromatin structure, the mechanisms of chromatin inheritance and the consequences of heritable chromatin structures on gene expression; phenomenology, molecular underpinnings and evolutionary implications.  
**Prerequisite:** Junior or senior classification or approval of instructor.

BIOL 466 Principles of Evolution  
**Credits 3. 3 Lecture Hours.**  
Evolutionary patterns, mechanisms and processes at the organismal, chromosomal and molecular levels; modes of adaptation and the behavior of genes in populations.  
**Prerequisite:** GENE 302 or approval of instructor.

BIOL 467 Integrative Animal Behavior  
**Credits 3. 3 Lecture Hours.**  
Examines how behavior contributes to survival and reproduction, and how evolutionary history and ecological circumstance interact to shape the expression of behavior, focus on integrative nature of behavior; how the interaction of evolutionary processes, mechanistic constraints, and ecological demands determine behavioral strategies.  
**Prerequisite:** BIOL 214, BIOL 357, BIOL 388, BIOL 405, BIOL 434/NSRC 434, or BIOL 466, or approval of instructor.

BIOL 480 Departmental Colloquium  
**Credit 1. 1 Lecture Hour.**  
Attend presentations given by renowned scientists from various fields of biology; learn about new developments in science; stay abreast of current and trending research topics.  
**Prerequisites:** Senior classification; majors in BIOL, MICRO, BMCB and ZOOL.

BIOL 481 Seminar in Biology  
**Credit 1. 1 Lecture Hour.**  
Recent advances. Restricted to senior undergraduate majors in biology, microbiology, botany or zoology.

BIOL 484 Internship  
**Credits 0 to 4. 0-1 Other Hours.**  
Directed internship in a private firm or public agency to provide research experience appropriate to the student’s degree program and career objectives. May be taken two times.  
**Prerequisite:** Approval of internship agency and advising office.

BIOL 485 Directed Studies  
**Credits 1 to 12. 1 to 12 Other Hours.**  
Problems in various phases of plant, animal and bacteriological science.  
**Prerequisites:** Junior classification; approval of ranking professor in field chosen and Undergraduate Advising Office.

BIOL 487/VTPB 487 Biomedical Parasitology  
**Credits 4. 3 Lecture Hours. 2 Lab Hours.**  
Helminth and protozoan parasites of medical and veterinary importance; life cycles, morphology, taxonomic classification, economic and public health aspects and current topics in parasitic diseases.  
**Prerequisites:** BIOL 107 or BIOL 112; junior or senior classification or approval of instructor.  
**Cross Listing:** VTPB 487/BIOL 487.

BIOL 489 Special Topics in...  
**Credits 1 to 4. 1 to 4 Lecture Hours. 0 to 10 Lab Hours.**  
Selected topics in an identified area of biology. May be repeated once for credit.

BIOL 491 Research  
**Credits 0 to 4. 0 to 4 Other Hours.**  
Active research of basic nature under the supervision of a Department of Biology faculty member. May be taken two times. Registration in multiple sections of this course is possible within a given semester provided that the per semester credit hour limit is not exceeded.  
**Prerequisite:** Approval of departmental faculty member.

BIOL 493 Independent Bioinformatics Research  
**Credits 2. 1 Lecture Hour. 2 Lab Hours.**  
Third course of four in capstone research program in biology; continuation of research projects utilizing bioinformatic tools.  
**Prerequisite:** BIOL 395 or approval of instructor.

BIOL 495 Biology Capstone: Research Communication in the Life Sciences  
**Credits 2. 2 Lecture Hours.**  
Culmination of capstone research experience; formalization of research results in written and oral forms; introduction to primary genres or scientific writing; apply principles of rhetoric and composition to diverse methods of professional communication.  
**Prerequisite:** BIOL 452, BICH 464, BIOL 400, BIOL 493 or BIOL 491 or approval of instructor.

Microbiology  

MICR 289 Special Topics in...  
**Credits 1 to 4. 1 to 4 Lecture Hours.**  
Selected topics in an identified area of microbiology. May be repeated for credit.  
**Prerequisite:** Approval of instructor.

MICR 291 Research  
**Credits 1 to 4. 1 to 4 Other Hours.**  
Active research of basic nature under the supervision of a Department of Biology faculty member.  
**Prerequisites:** Freshman or sophomore classification and approval of instructor.

MICR 489 Special Topics in...  
**Credits 1 to 4. 1 to 4 Lecture Hours.**  
Selected topics in an identified area of microbiology. May be repeated once for credit.

MICR 491 Research  
**Credits 1 to 4. 1 to 4 Other Hours.**  
Active research of basic nature under the supervision of a Department of Biology faculty member.  
**Prerequisites:** Junior or senior classification and approval of instructor.

MICR 681 Seminar  
**Credit 1. 1 Lecture Hour.**  
Detailed reports on specific topics in field chosen. Students may register in up to but no more than three sections of this course in the same semester.

MICR 685 Directed Studies  
**Credits 1 to 6. 1 to 6 Other Hours.**  
Limited investigations in fields other than those chosen for thesis or dissertation.

MICR 689 Special Topics in...  
**Credits 1 to 4. 1 to 4 Lecture Hours.**  
Selected topics in an identified area of microbiology.
MICR 691 Research
Credits 1 to 12. 1 to 12 Other Hours.
Research for thesis or dissertation.

Zoology

ZOOL 289 Special Topics in...
Credits 1 to 4. 1 to 4 Lecture Hours.
Selected topics in an identified area of zoology. May be repeated for credit.
Prerequisite: Approval of instructor.

ZOOL 291 Research
Credits 1 to 4. 1 to 4 Other Hours.
Active research of basic nature under the supervision of a Department of Biology faculty member.
Prerequisites: Freshman or sophomore classification and approval of instructor.

ZOOL 489 Special Topics in...
Credits 1 to 4. 1 to 4 Lecture Hours.
Selected topics in an identified area of zoology. May be repeated once for credit.

ZOOL 491 Research
Credits 1 to 4. 1 to 4 Other Hours.
Active research of basic nature under the supervision of a Department of Biology faculty member.
Prerequisites: Junior or senior classification and approval of instructor.