Biology (B.A., B.S.)

The Biology Program at U.T. Dallas emphasizes the unifying molecular and cellular nature of organisms. At the center of the Biology undergraduate curriculum are the concepts and tools used by molecular and cell biologists to study the genes of prokaryotes and eukaryotes, to study the proteins and ribonucleic acids (RNA) encoded by these genes, and to study how the expression of these genes is regulated. Molecular and cell biology are rapidly changing fields and require a background in other disciplines such as chemistry, mathematics, physics, and computer sciences. Principles from these disciplines have to be merged to understand and apply new biotechnology and genetic engineering techniques. It is desirable for entering students to have a broad interest and background in the sciences.

Both B.S. and B.A. degrees are offered in Biology at U.T. Dallas. The B.S. degree is intended as preparation for scientific careers in biology or careers in the health professions. The B.A. degree is intended as a liberal arts biology major with less emphasis on calculus and more free hours for course work in other disciplines. Each degree offers a streamlined double major with Business Administration. A 5-year Fast Track B.S./M.S. Biology degree program is available, and a 7-year accelerated B.S./D.O. degree program is offered together with the UNT Health Science Center at the Fort Worth College of Osteopathic Medicine (UNTHSC/TCOM); see page 172.

Minors are offered in Biology, Biomolecular Structure, Microbiology, Molecular and Cell Biology, and Neurobiology.

Transfer Students

Students transferring into Biology at the junior level in either the B.S. or the B.A. program are expected to have completed courses equivalent to:

- Introductory Biology with lab, BIO 2301, 2302, and 2281
- General Chemistry with lab, CHM 1311, 1111, 1312, and 1112
- Organic Chemistry with lab, CHM 2323, 2123, 2325, and 2225
- Calculus, MATH 2417 and 2419 (B.S. or B.A. degree); or Applied Calculus, Math 1325, (B.A. degree only)
- Physics with lab, calculus-based PHYS 2325, 2125, 2326 and 2126 (B.S. or B.A. degree); or algebra-based PHYS 1301, 1101, 1302, 1102 (B.A. degree only)

Junior-level transfer students deficient in these lower-division requirements may satisfy the requirements with courses taken at U.T. Dallas; however, students deficient in the biology and chemistry requirements may be delayed in entering upper-division biology courses.

Bachelor of Arts or Bachelor of Science in Biology Degree Requirements (125 hours)

I. Core Curriculum Requirements1: 42 hours

A. Communication (6 hours)
   3 hours Communication (RHET 1302)
   3 hours Communication Elective (BIO 4337, BIO 4352 or NATS 4310)2
B. Social and Behavioral Sciences (15 hours)
   6 hours Government (GOVT 2305 and 2306)
   6 hours History (HST 1301 and 2301)
   3 hours Social and Behavioral Sciences Elective
C. Humanities and Fine Arts (6 hours)
   3 hours Fine Arts (AP 1301)
   3 hours Humanities (A&H 1301)
D. Mathematics and Quantitative Reasoning (6 hours)
   6 hours Calculus (MATH 2417 and 2419)-BA or BS ³ or Applied Calculus and Statistics (MATH 1325 and STAT 3332)-BA only
E. Science (9 hours)
   9 hours Chemistry (CHM 1311/1111, 1312/1112 and 2123)

¹ Curriculum Requirements can be fulfilled by other approved courses from accredited institutions of higher education. The courses listed in parenthesis are recommended as the most efficient way to satisfy both Core Curriculum and Major requirements at UT Dallas.

II. Major Requirements: 54 - 62 hours (54-56, B.A.; 62, B.S.)

Major Preparatory Courses (16-18 hours beyond Core Curriculum)

CHM 1311/1111, 1312/1112 General Chemistry I and II with lab
CHM 2323*/2123* and 2325/2225 Organic Chemistry I and II with lab
MATH 2417 and 2419 Calculus I and II (BA or BS)
   or MATH 1325 and STAT 3332 (BA only)
PHYS 3341 and 2125 Physics for BioScience I with lab(BA or BS)
   or PHYS 1301 and 1101 College Physics I with lab (BA only)
PHYS 3342 and 2126 Physics for BioScience II with lab (BA or BS)
   or PHYS 1302 and 1102 College Physics II with lab (BA only)

Major Core Courses (29-32 hours)

BIO 2301* and 2101* Introduction to Modern Biology I and workshop
BIO 2302* and 2102* Introduction to Modern Biology II and workshop
BIO 2281* Introductory Biology Laboratory
BIO 3301 and 3101 Classical and Molecular Genetics with workshop
BIO 3302 and 3102 Eukaryotic Molecular and Cell Biology with workshop
BIO 3361 and 3161 Biochemistry I with workshop
BIO 3362 and 3162 Biochemistry II with workshop
BIO 3380 Biochemistry Laboratory
BIO 4380 Cellular & Molecular Biology Laboratory (BS only)

Major Related Courses (9-12 hours)

9 hours upper-division BIO electives (BA only)
12 hours upper-division BIO electives (BS only)

² Biology majors may choose BIO 4337, BIO 4352, or NATS 4310 or another approved Biology elective to fulfill the Core Curriculum Communication Elective.

³ Six hours of Calculus are counted under Mathematics Core, and 2 hours of Calculus are counted as Major Preparatory Courses.

* Indicates a prerequisite class to be completed before enrolling for upper-division classes.

III. Elective Requirements: 21 - 29 hours

Advanced Electives

All students are required to take at least six hours of advanced electives outside their major field of study. These must be either upper-division classes or lower-division classes that have prerequisites. These may be satisfied with CHM 2323 and 2325, counted under Major Preparatory Courses.

Free Electives (21 hours for BS; 27-29 hours for BA)

All students must complete at least 51 hours of upper-division credit to graduate.
Minor in Biology

Course Requirements: 18 hours
BIO 2301 and 2101 Introduction to Modern Biology I and workshop
BIO 3301 and 3101 Classical and Molecular Genetics with workshop
BIO 3361 and 3161 Biochemistry I with workshop
Two BIO electives for majors

Minor in Biomolecular Structure

Course Requirements: 18 hours
CHM 2323 and 2325 Organic Chemistry I and II
BIO 3336 Protein and Nucleic Acid Structure
BIO 4461 Biophysical Chemistry
BIO 4261 Biomolecular Modeling
One approved BIO, CHM, CS, EE, MATH, or PHYS elective

Minor in Molecular and Cell Biology

Course Requirements: 18 hours
CHM 2323 and 2325 Organic Chemistry I and II
Four approved molecular and cell biology electives

Minor in Microbiology

Course Requirements: 18 hours
CHM 2323 and 2325 Organic Chemistry I and II
BIO 3335 Microbial Physiology
BIO 4340 Medical Microbiology
BIO 4351 Techniques in Medical Microbiology
One approved microbiology elective

Minor in Neurobiology

Course Requirements: 18 hours
CHM 2323 and 2325 Organic Chemistry I and II
NSC 4352 Cellular Neuroscience
NSC 4353 Neuroscience Laboratory Methods
NSC 4354 Integrative Neuroscience
Fast Track Baccalaureate/Master’s Degrees

U.T. Dallas undergraduate students with strong academic records, including at least 15 hours of upper-division Biology core courses, who intend to pursue graduate work in Biology at U.T. Dallas may apply for the Fast Track which involves taking selected graduate courses as an upper-division student. After admission to the graduate program, 15 hours of graduate courses with an earned grade of B or better can be used toward completion of the B.S. and to satisfy requirements for those courses at the graduate level. This program provides an opportunity to obtain the B.S. degree in Biology after 126 hours of work and an M.S. degree in Molecular and Cell Biology after an additional 27 hours of graduate course and research work. Interested students should contact the Biology undergraduate advisor well in advance of the senior year to prepare a degree plan taking maximal advantage of this 5-year Fast Track program.

The 7-Year B.S./D.O. Dual Degree Program

The Biology Program has recently developed an accelerated program that, in conjunction with the UNT Health Science Center at Fort Worth College of Osteopathic Medicine (UNTHSC/TCOM), would provide Biology majors the opportunity to earn both a Bachelor of Science degree from U.T. Dallas and a Doctor of Osteopathic Medicine degree in 7 years. Students enrolled in the program would take regular biology core courses at U.T. Dallas for the first three years and apply for admission to TCOM. However, progress towards the completion of a B.S. in Biology at U.T. Dallas does not ensure that the student will be admitted into TCOM. U.T. Dallas students in this program do not receive any special considerations from TCOM during the application process and must be accepted based upon their merit while at U.T. Dallas. After acceptance into TCOM, the student will spend the fourth year taking courses for credit towards a D.O. degree at TCOM. Once the student has successfully completed the first year at TCOM, the student will receive a Bachelor of Science degree in Biology from U.T. Dallas. Students interested in this program should contact the Biology undergraduate advisor or program coordinator.

Degree Planning

Upper-division biology courses taken at other institutions may be included as part of the degree plan subject to the provisions of the section on Transfer Admissions.

Biology electives may not include more than 3 hours of individual instruction (e.g., BIO 3390, BIO 3391, BIO 4302, BIO 4390, or BIO 4399) and not more than 9 hours (B.S.) or 6 hours (B.A.) of upper-division transfer credit.

Students planning a career in a particular allied health profession should consult the school they expect to attend to apprise themselves of the course requirements for admission.

Admission standards for medical and dental schools are set by the individual professional school, whose specific requirements should be reviewed with the help of the U.T. Dallas Health Professions Advisory Committee. Most professional schools prefer that admission applications be channeled through the Health Professions Advisory Committee.

Specified Course Descriptions

**A&H 1301 (HUMA 1301) Exploration of the Humanities** (3 semester hours) An introduction to the concept of cultural tradition through the study of selected works of literature, philosophy, music, and visual art. Emphasis on the relations
among various forms of cultural expression and developing students' ability to interpret complex artistic works in their historical, cultural, and intellectual contexts. General education core course. (3-0) S

AP 1301 (ARTS 1301) Exploration of the Arts (3 semester hours) This course introduces students to the physical and intellectual demands required of the author, the performer, and the visual artist. This introduction includes, but is not limited to, the student's production of a creative project as well as written assessments of art and performance. (3-0) Y

BIO 2101 Introduction to Modern Biology Workshop I (1 semester hour) Problem solving and discussion related to the subject matter in BIO 2301. Corequisite: concurrent enrollment in BIO 2301. (1-0) Y

BIO 2102 Introduction to Modern Biology Workshop II (1 semester hour) Problem solving and discussion related to the subject matter in BIO 2302. Corequisite: concurrent enrollment in BIO 2302. (1-0) S

BIO 2281 Introductory Biology Laboratory (2 semester hours) Experiments designed to illustrate the chemical nature of genes and gene expression. Among the topics to be introduced are biomolecular structure, enzymology, electron microscopy, cell biology, and the properties of DNA. Techniques include column chromatography, spectroscopy, cytochemistry, basic microbiological manipulations, gel electrophoresis of nucleic acids and proteins, the isolation of DNA, and computer-aided visualization of macromolecular structures. Prerequisite: BIO 2301 (also see prerequisites for BIO 2301). (1-4) Y

BIO 2301 Introduction to Modern Biology I (3 semester hours) Presentation of some of the fundamental concepts of modern biology, with an emphasis on the molecular and cellular basis of biological phenomena. Topics include the chemistry and metabolism of biological molecules, elementary classical and molecular genetics, and selected aspects of developmental biology, physiology (including hormone action), immunity, and neurophysiology. Prerequisites: General Chemistry I and II. Corequisite: concurrent enrollment in BIO 2101. (3-0) S

BIO 2302 Introduction to Modern Biology II (3 semester hours) Continuation of BIO 2301. The emphasis will be on evolution, biological diversity, physiology, and developmental biology. Corequisite: concurrent enrollment in BIO 2102. (3-0) S

BIO 3101 Classic and Molecular Genetics Workshop (1 semester hour) Problem solving and discussion related to the subject matter in BIO 3301. Corequisite: Concurrent enrollment in BIO 3301. (1-0) S

BIO 3102 Eukaryotic Molecular and Cell Biology Workshop (1 semester hour) Problem solving and discussion related to the subject matter in BIO 3302. Corequisite: Concurrent enrollment in BIO 3302. (1-0) S

BIO 3161 Biochemistry Workshop I (1 semester hour) Problem solving methodology in biochemistry; discussion of recent advances in areas related to the subject matter in BIO 3361. Corequisite: Concurrent enrollment in BIO 3361. (1-0) S

BIO 3162 Biochemistry Workshop II (1 semester hour) Problem-solving methodology in biochemistry; discussion of recent advances in areas related to the subject matter in BIO 3362. Corequisite: concurrent enrollment in BIO 3362. (1-0) Y

BIO 3301 Classical and Molecular Genetics (3 semester hours) The phenomenon of heredity, its cytological and molecular basis; gene expression and transfer of genetic information, with major focus on bacterial and model eukaryotic systems; genetic recombination and chromosome mapping; tetrad analysis; mutations and mutagenesis; genetic interactions; application of recombinant DNA techniques to genetic analysis. Prerequisites: BIO 2301 and Organic Chemistry I. Corequisite: concurrent enrollment in BIO 3101. (3-0) S

BIO 3302 Eukaryotic Molecular and Cell Biology (3 semester hours) Structural organization of eukaryotic cells; regulation of cellular activities; membranes and transport; cellular replication; examples of cell specialization such as blood (immunoglobulins) and muscle cells. Prerequisites: BIO 3301 and BIO 3361. Corequisite: concurrent enrollment in BIO 3102. (3-0) S

BIO 3361 Biochemistry I (3 semester hours) Structures and chemical properties of amino acids; protein purification and characterization; protein structure and thermodynamics of polypeptide chain folding; catalytic mechanisms, kinetics and regulation of enzymes; energetics of biochemical reactions; generation and storage of metabolic energy associated with carbohydrates; oxidative phosphorylation and electron transport mechanisms; photosynthesis. Prerequisites: Organic Chemistry I and II. Corequisite: concurrent enrollment in BIO 3161. (3-0) S

BIO 3362 Biochemistry II (3 semester hours) Breakdown and synthesis of lipids; membrane structure and function; nitrogen metabolism and fixation; nucleotide metabolism; structure and properties of nucleic acids; sequencing and genetic engineering; replication, transcription, and translation; chromosome structure; hormone action; biochemical basis of certain pathological processes. Prerequisite: BIO 3361 or its equivalent, or consent of instructor. Corequisite: concurrent enrollment in BIO 3162. (3-0) Y
**BIO 3380 Biochemistry Laboratory** (3 semester hours) Experiments with biological macromolecules: isolation of DNA and analysis by restriction-enzyme digestion, ionic properties and spectroscopic analysis of DNA and proteins, purification and characterization of enzymes. Techniques introduced include electrophoresis, viscosity, chromatography, centrifugation, titration of amino acids, and a variety of biochemical separation techniques. Prerequisite: BIO 3361. Suggested additional preparation: BIO 3301. (1-4) S

**BIO 4337 Seminal Papers in Biology** (3 semester hours) The development of ideas and concepts in selected areas of biology will be explored in a senior seminar format with oral presentations and written papers by students. Theoretical and experimental papers by seminal figures (e.g., Malthus, Darwin, Wallace, Mayr) will be used to trace early development in the areas of evolution, eukaryotic and phage genetics, bioenergetics, DNA and protein synthesis, biomembranes and transport. Satisfies the Advanced Writing Requirement for Biology majors. (3-0) S

**BIO 4352 Medical Applications of Cell Biology** (3 semester hours) Topics related to health and disease will be examined from a molecular and cellular perspective. Topics will vary but will be selected from new and developing applications of cell biology to cancer, heart disease, fat metabolism, mitochondrial disorders, aging, Alzheimer's, etc. Students are expected to participate actively in presentations. Prerequisite: BIO 3302 (3-0) T

**BIO 4380 Cell and Molecular Biology Laboratory** (3 semester hours) Techniques for the study of biological systems. Experiments include microscopy, the polymerase chain reaction, immunological techniques (precipitation reactions and ELISA assays), growth and characterization of laboratory cells, detection of cell-surface receptors, genetic mutations, control of gene expression, genetic recombination, and transformation of cells with recombinant plasmids. Prerequisites: BIO 3301, 3302, and 3380. (1-4) S

**CHM 1111 (CHEM 1111) General Chemistry Laboratory I** (1 semester hour) Introduction to the chemistry laboratory. Experiments are designed to demonstrate concepts covered in CHM 1311; including properties and reactions of inorganic substances, and elementary qualitative and quantitative analysis. (0-3) S

**CHM 1112 General Chemistry Laboratory II** (1 semester hour) A continuation of CHM 1111 demonstrating the concepts covered in CHM 1312, including acid-base chemistry, reaction kinetics, electrochemistry, polymers, and organic synthesis. Prerequisite: CHM 1111 or 1215. (0-3) S

**CHM 1311 (CHEM 1311) General Chemistry I** (3 semester hours) Introduction to elementary concepts of chemistry theory. The course emphasizes chemical reactions, the mole concept and its applications, and molecular structure and bonding. (3-0) S

**CHM 1312 (CHEM 1312) General Chemistry II** (3 semester hours) A continuation of CHM 1311 treating metals; solids, liquids, and intermolecular forces; chemical equilibrium; electrochemistry; organic chemistry; rates of reactions; and environmental, polymer, nuclear, and biochemistry. Prerequisite: CHM 1311 or 1315. (3-0) S

**CHM 2123 (CHEM 2123) Introductory Organic Chemistry Laboratory I** (1 semester hour) The experimental skills associated with organic functional group reactions. Prerequisite: CHM 2323 (may be taken concurrently). (0-4) S

**CHM 2225 (CHEM 2225) Introductory Organic Chemistry Laboratory II** (2 semester hours) Continuation of Organic Chemistry Laboratory I. Prerequisites: CHM 2323 and 2123; corequisite: CHM 2325. (0-8) S

**CHM 2323 (CHEM 2323) Introductory Organic Chemistry I** (3 semester hours) The covalent bond. Organic chemistry: aliphatic and aromatic compounds; covalent inorganic and organometallic compounds; a survey of the organic functional groups and their typical reactions; stereochemistry. The first course in organic chemistry. Satisfies the basic organic chemistry lecture requirements for pre-health profession students. Prerequisite: CHM 1312 or 1316. (3-0) S


**GOVT 2305 (GOVT 2305) Constitutional Foundations and Political Behavior in the U.S. and Texas** (3 semester hours) This course examines the evolution and current state of political behavior and public policy making in the U.S. and Texas. Topics discussed will include the constitutions, federalism, intergovernmental relations, voting, elections, political parties, public opinion, and interest groups. (Fulfills one-half of the legislative requirement of 6 hours of American government.) (3-0) S

**GOVT 2306 (GOVT 2306) Political Institutions in the U.S. and Texas** (3 semester hours) This course explores the primary institutions of U.S. and Texas government. It examines the bureaucracy as well as the executive, legislative, and
judicial branches of government at the state and federal level. (Fulfills one-half of the legislative requirement of 6 hours of American government.) (3-0) S

HST 1301 Themes and Ideas in American History (3 semester hours) An introduction to the methods of historical inquiry through the study of selected main themes in American history. A course designed to offer students an understanding of the historical and cultural context of America in the contemporary world. Fulfills one-half of the Texas legislative requirement for six hours in American history. (3-0) S

HST 2301 Issues in American History (3 semester hours) Readings, commentary, and discussion aimed at varying aspects of history and culture. Fulfills one-half of the Texas legislative requirement for six hours in American history. (3-0) Y

MATH 1325 (MATH 1325) Applied Calculus I (3 semester hours) Functions and graphs, differentiation, maxima and minima, exponential and logarithmic functions, integration, applications of integrals. Cannot be used to satisfy degree requirements or majors in the School of Engineering and Computer Science or major requirements in the School of Natural Sciences and Mathematics. Credit given for only one of MATH 1325 or 2417. Prerequisite: MATH 1314 or equivalent. (3-0) S

MATH 2417 (MATH 2417) Calculus I (4 semester hours) Functions, limits, continuity, differentiation; integration of function of one variable; logarithmic, exponential, and inverse trigonometric functions; techniques of integration, and applications. Three lecture hours and two discussion hours a week. Prerequisite: MATH 2312 or equivalent. (4-0) S

MATH 2419 Calculus II (MATH 2419) (4 semester hours) Continuation of MATH 2417. Improper integrals, sequences, infinite series, power series, parametric equations and polar coordinates, vectors, vector-valued functions, functions of several variables, partial derivatives and applications, multiple integration. Three lecture hours and two discussion hours a week. Prerequisite: MATH 2417. (4-0) S

NATS 4310 Advanced Writing in the Natural Sciences and Mathematics (3 semester hours) A writing-intensive course on questions or problems in natural sciences and mathematics; satisfies the advanced writing requirement for graduation. (3-0) S

PHYS 1101 (PHYS 1101) College Physics Laboratory (1 semester hour) A laboratory to accompany PHYS 1301. Corequisite: PHYS 1301 (0-3) Y

PHYS 1102 (PHYS 1102) College Physics Laboratory II (1 semester hour) A laboratory to accompany PHYS 1302. Corequisite: PHYS 1302. (0-3) Y

PHYS 1301 (PHYS 1301) College Physics I (3 semester hours) Algebra based basic physics. Topics include mechanics, heat and thermodynamics. Prerequisite: MATH 1314. (3-0) Y

PHYS 1302 (PHYS 1302) College Physics II (3 semester hours) Continuation of PHYS 1301. Topics include electricity and magnetism and optics. Prerequisites: PHYS 1301. (3-0) Y

PHYS 2125 (PHYS 2125) Physics Laboratory I (1 semester hour) Laboratory course to accompany PHYS 2325. Personal computer-based data presentation and curve fitting. Basic measurement concepts such as experimental uncertainty, mean, standard deviation, standard error, and error propagation will be covered. Corequisite: PHYS 2325. (0-3) Y

PHYS 2126 (PHYS 2126) Physics Laboratory II (1 semester hour) Laboratory course to accompany PHYS 2326. Builds on concepts of Physics Lab I. Will emphasize the use of an oscilloscope and measurements using simple circuits constructed in class. Corequisite: PHYS 2326. (0-3) Y

PHYS 2325 (PHYS 2325) Mechanics and Heat (3 semester hours) Calculus based. Basic physics including a study of space and time, kinematics, forces, energy and momentum, conservation laws, rotational motion, torques, harmonic oscillation, temperature and heat. Two lectures and one recitation session per week. Prerequisite: MATH 2417. Corequisite: PHYS 2125. (3-0) Y

PHYS 2326 (PHYS 2326) Electromagnetism and Waves (3 semester hours) Continuation of PHYS 2325. Topics include electrostatics and electromagnetics, electric field and potential, electric currents, magnetic fields, laws of Coulomb, Ampere, and Faraday, Maxwell's theory of propagation and optics. Two lectures and one recitation session per week. Prerequisites: PHYS 2325 and MATH 2419. Corequisite: PHYS 2126. (3-0) Y

PHYS 3341 Physics for Bio Science I (3 semester hours) Calculus based. Basic physics for pre-health science students. Topics include space and time, kinematics, forces, energy and momentum, conservation laws, rotation, thermodynamics, and kinetic theory. Focus is on biological applications. Prerequisite: MATH 2417. Must register for Physics Lab I. (PHYS 2125). (3-0) Y

PHYS 3342 Physics for Bio Science II (3 semester hours) Continuation of PHYS 3341. Topics include electrostatics and
electromagnetics, electric field and potential, electric currents, magnetic fields, laws of Coulomb, Ampere, and Faraday; Maxwell's theory of propagation, and optics. Focus is on biological applications. Prerequisites: PHYS 3341 and MATH 2419. Must register for Physics Lab II. (PHYS 2126) (3-0) Y

**RHET 1302 (ENGL 1302) Rhetoric** (3 semester hours) The course presents an integrated approach to writing, reading, and critical thinking by developing the grammatical, logical, and rhetorical skills necessary for university writing. All classes work in a computerized learning environment. Students are taught basic computer literacy and submit all work electronically and on paper. (3-0) S

**STAT 3332 Statistics for Life Sciences** (3 semester hours) Graphs, histograms, mean, median, standard deviation, Chebyshev's inequality, standardized scores, simple linear regression and correlation; basic rules of possibility, Bayes theorem, Normal; t, X², F, binomial and Poisson distributions; point estimation; hypothesis tests and confidence intervals for means, proportions regression coefficients, and correlation; one way ANOVA; Chi-square contingency tables. Applications in life sciences will be emphasized throughout the course. Prerequisite: MATH 1325 or above. (3-0) Y