BIOMEDICAL SCIENCES PRE-PROFESSIONAL PROGRAMS

Completion of an Associate of Arts Liberal Arts Degree with an emphasis in Biomedical Sciences provides a solid foundation to pursue a Bachelor's Degree. Potential career paths for students pursuing a Biomedical Science degree include microbiologist, geneticist, epidemiologist, and family/general practitioners.

- Biomedical Sciences Pre-Professional Programs AA Degree (https://coursecatalog.tvcc.edu/pathways/health-sciences/biomedical-sciences-pre-professional-programs/biomedical-sciences-pre-professional-programs-aa/)

BIOL-1322. Nutrition and Diet Therapy. (3 Credits)
(3-3-0) This course is taken for academic credit. Students will earn an A, B, C, D, F, or W. Introduces general nutritional concepts in health and disease and includes practical applications of that knowledge. Special emphasis is given to nutrients and nutritional processes including functions, food sources, digestion, absorption and metabolism. Food safety, availability and nutritional information including food labels, advertising and nationally established guidelines are addressed.

BIOL-1406. Biology for Science Majors I. (4 Credits)
(4-3-3) (Core Area 030) This course is taken for academic credit. (Prerequisite Math 1314 or concurrent enrollment in higher-level math) Students will earn an A, B, C, D, F, or W. Fundamental principles of living organisms will be studied, including physical and chemical properties of life, organization, function, evolutionary adaptation and classification. Concepts of cytology, reproduction, genetics and scientific reasoning are included. A laboratory component is included that gives practical experience to material covered in class. Lab fee. Students may only receive credit for BIOL 1406 when taken with BIOL 1407 or any PHYS.

BIOL-1407. Biology for Science Majors II. (4 Credits)
(4-3-3) (Core Area 030) This course is taken for academic credit. (Prerequisite Math 1314 or concurrent enrollment in higher-level math). Students will earn an A, B, C, D, F, or W. The diversity and classification of life will be studied, including animals, plants, protists, fungi and prokaryotes. Special emphasis will be given to anatomy, physiology, ecology and evolution of plants and animals. A laboratory component is included that gives practical experience to material covered in class. Lab fee. Students may only receive credit for BIOL 1407 when taken with BIOL 1406 or any CHEM or any PHYS.

BIOL-1408. Biology for Non-Science Majors I. (4 Credits)
(4-3-3) (Core Area 030) This course is taken for academic credit. Students will earn an A, B, C, D, F, or W. Provides a survey of biological principles with an emphasis on humans, including chemistry of life, cells, structure, function, and reproduction. Laboratory activities will reinforce a survey of biological principles with an emphasis on humans, including chemistry of life, cells, structure, function, and reproduction. Lab fee. Students may only receive credit for BIOL 1408 when taken with BIOL 1409 or any CHEM or any PHYS.

BIOL-1409. Biology for Non-Science-Majors II. (4 Credits)
(4-3-3) (Core Area 030) This course is taken for academic credit. Students will earn an A, B, C, D, F, or W. Provides a survey of biological principles with an emphasis on humans, including evolution, ecology, plant and animal diversity, and physiology. Laboratory activities will reinforce a survey of biological principles with an emphasis on humans, including evolution, ecology, plant and animal diversity, and physiology. Lab fee. Students may only receive credit for BIOL 1409 when taken with BIOL 1408 or any CHEM or any PHYS.

BIOL-2401. Anatomy and Physiology I. (4 Credits)
(4-3-3) (Core Area 030) This course is taken for academic credit. Students will earn an A, B, C, D, F, or W. The first part of a two course sequence. It is a study of the structure and function of the human body including cells, tissues and organs of the following systems: integumentary, skeletal, muscular, nervous and special senses. Emphasis is on interrelationships among systems and regulation of physiological functions involved in maintaining homeostasis. A laboratory component is included that gives practical experience to material covered in class. Lab fee.

BIOL-2402. Anatomy and Physiology II. (4 Credits)
(4-3-3) (Core Area 030) This course is taken for academic credit. Students will earn an A, B, C, D, F, or W. The second part of a two-course sequence. It is a study of the structure and function of the human body including the following systems: endocrine, cardiovascular, immune, lymphatic, respiratory, digestive (including nutrition), urinary (including fluids and electrolyte balance) and reproductive (including human development and genetics). Emphasis is on interrelationships among systems and regulation of physiological functions involved in maintaining homeostasis. A laboratory component is included that gives practical experience to material covered in class. Lab fee.

BIOL-2404. Anatomy and Physiology (single-Semester) Course). (4 Credits)
(4-3-3) (Core Area 030) This course is taken for academic credit. Students will earn an A, B, C, D, F, or W. Study of the structure and function of human anatomy, including the neuroendocrine, integumentary, musculoskeletal, digestive, urinary, reproductive, respiratory and circulatory systems. A laboratory component is included that gives practical experience to material covered in class. Lab fee.

BIOL-2420. Microbiology for Non-Science Majors. (4 Credits)
(4-3-3) (Core Area 030) This course is taken for academic credit. Students will earn an A, B, C, D, F, or W. Covers basic microbiology and immunology and is primarily directed at pre-nursing, pre-allied health and non-science majors. It provides an introduction to historical concepts of the nature of microorganisms, microbial diversity, the importance of microorganisms and acellular agents in the biosphere, and their roles in human and animal diseases. Major topics include bacterial structure as well as growth, physiology, genetics, and biochemistry of microorganisms. Emphasis is on medical microbiology, infectious diseases and public health. A laboratory component is included that gives practical experience to material covered in class. Lab fee.

CHEM-1405. Introductory Chemistry I. (4 Credits)
(4-3-3) CORE AREA 030 This course is taken for academic credit. Students will earn an A, B, C, D, F, or W. Survey course introducing chemistry. Topics may include inorganic, organic, biochemistry, food/physiological chemistry and environmental/consumer chemistry. Designed for non-science and allied health students. A laboratory component is included that gives practical experience to material covered in class. Lab fee.

CHEM-1407. Introductory Chemistry II. (4 Credits)
(4-3-3) CORE AREA 030 This course is taken for academic credit. Students will earn an A, B, C, D, F, or W. A continuation of Chemistry 1405. Survey course introducing chemistry. Topics may include inorganic, organic, biochemistry, food/physiological chemistry, and environmental/consumer chemistry. A laboratory component is included that gives practical experience to material covered in class. Lab fee.

CHEM-1411. General Chemistry I. (4 Credits)
(4-3-3) CORE AREA 030 This course is taken for academic credit. (Prerequisite Math 1314 or equivalent academic preparation) Students will earn an A, B, C, D, F, or W. Fundamental principles of chemistry for majors in the sciences, health sciences and engineering; topics include measurements, fundamental properties of matter, states of matter, chemical reactions, chemical stoichiometry, periodicity of elemental properties, atomic structure, chemical bonding, molecular structure, solutions, properties of gases and an introduction to thermodynamics and descriptive chemistry. A laboratory component is included that gives practical experience to material covered in class. Lab fee.

CHEM-1412. General Chemistry II. (4 Credits)
(4-3-3) CORE AREA 030 This course is taken for academic credit. (Prerequisite CHEM 1411) Students will earn an A, B, C, D, F, or W. A continuation of CHEM 1411 with topics covering chemical equilibrium; phase diagrams and spectrometry; acid-base concepts; thermodynamics; kinetics; electrochemistry; nuclear chemistry; an introduction to organic chemistry and descriptive inorganic chemistry. A laboratory component is included that gives practical experience to material covered in class. Lab fee.

CHEM-2423. Organic Chemistry I. (4 Credits)
(4-3-3) CORE AREA 030 This course is taken for academic credit. (Prerequisite CHEM 1412) Students will earn an A, B, C, D, F, or W. Fundamental principles of organic chemistry will be studied, including the structure, bonding, properties, and reactivity of organic molecules; and properties and behavior of organic compounds and their derivatives. Emphasis is placed on organic synthesis and mechanisms. Includes study of covalent and ionic bonding, nomenclature, stereochemistry, structure and reactivity, reaction mechanisms, functional groups and synthesis of simple molecules. THIS COURSE IS INTENDED FOR STUDENTS IN SCIENCE OR PRE-PROFESSIONAL PROGRAMS. A laboratory component is included that gives practical experience to material covered in class. Lab fee.

PHYS-1401. College Physics I. (4 Credits)
(4-3-3) Core Area 030 This course is taken for academic credit. (Prerequisite: MATH 1314 and MATH 1316, OR MATH 2312) Students will earn an A, B, C, D, F, or W. Fundamental principles of physics, using algebra and trigonometry; the principles and applications of classical mechanics and thermodynamics, including harmonic motion, mechanical waves and sound, physical systems, Newton's Laws of Motion, and gravitation and other fundamental forces; with emphasis on problem solving. A laboratory component is included that gives practical experience to material covered in class. Lab fee.

PHYS-1402. College Physics II. (4 Credits)
(4-3-3) Core Area 030 This course is taken for academic credit. (Prerequisite: PHYS 1401) Students will earn an A, B, C, D, F, or W. Fundamental principles of physics, using algebra and trigonometry; the principles and applications of electricity and magnetism, including circuits, electrostatics, electromagnetism, waves, sound, light, optics and modern physics topics; with emphasis on problem solving. A laboratory component is included that gives practical experience to material covered in class. Lab fee.

PHYS-1415. Physical Science I. (4 Credits)
(4-3-3) Core Area 030 This course is taken for academic credit. Students will earn an A, B, C, D, F, or W. Course designed for non-science majors that surveys topics from physics, chemistry, geology, astronomy, and meteorology. A laboratory component is included that gives practical experience to material covered in class. Lab fee.

PHYS-1417. Physical Science II. (4 Credits)
(4-3-3) Core Area 030 This course is taken for academic credit. Students will earn an A, B, C, D, F, or W. Course designed for non-science majors that surveys topics from physics, chemistry, geology, astronomy and meteorology. A laboratory component is included that gives practical experience to material covered in class. Lab fee.

PHYS-2425. University Physics I. (4 Credits)
(4-3-3) Core Area 030 This course is taken for academic credit. (Prerequisite: MATH 2413) Students will earn an A, B, C, D, F, or W. Fundamental principles of physics, using calculus, for science, computer science and engineering majors; the principles and applications of classical mechanics, including harmonic motion, physical systems and thermodynamics; and emphasis on problem solving. A laboratory component is included that gives practical experience to material covered in class. Lab fee.

PHYS-2426. University Physics II. (4 Credits)
(4-3-3) Core Area 030 This course is taken for academic credit. (Prerequisite: PHYS 2425 and MATH 2414) Students will earn an A, B, C, D, F, or W. Principles of physics for science, computer science, and engineering majors, using calculus, involving the principles of electricity and magnetism, including circuits, electromagnetism, waves, sound light and optics. A laboratory component is included that gives practical experience to material covered in class. Lab fee.

What Biomedical Engineers Do (https://www.bls.gov/ooh/architecture-and-engineering/biomedical-engineers.htm#tab-2)

Biomedical engineers combine engineering principles with medical sciences to design and create equipment, devices, computer systems, and software.

Duties

Biomedical engineers typically do the following:

- Design biomedical equipment and devices, such as artificial internal organs, replacements for body parts, and machines for diagnosing medical problems
- Install, adjust, maintain, repair, or provide technical support for biomedical equipment
- Evaluate the safety, efficiency, and effectiveness of biomedical equipment
- Train clinicians and other personnel on the proper use of biomedical equipment
- Research the engineering aspects of the biological systems of humans and animals with life scientists, chemists, and medical scientists
- Prepare procedures, write technical reports, publish research papers, and make recommendations based on their research findings
- Present research findings to scientists, nonscientist executives, clinicians, hospital management, engineers, other colleagues, and the public

Biomedical engineers design instruments, devices, and software used in healthcare; develop new procedures using knowledge from many technical sources; or conduct research needed to solve clinical problems. They frequently work in research and development or quality assurance.

Biomedical engineers design electrical circuits, software to run medical equipment, or computer simulations to test new drug therapies. In addition, they design and build artificial body parts, such as hip and knee joints. In some cases, they develop the materials needed to make the replacement body parts. They also design rehabilitative exercise equipment.

The work of these engineers spans many professional fields. For example, although their expertise is based in engineering and biology, they often design computer software to run complicated instruments, such as three-dimensional x-ray machines. Alternatively, many of these engineers use their knowledge of chemistry and biology to develop new drug

therapies. Others draw heavily on math and statistics to build models to understand the signals transmitted by the brain or heart. Some may be involved in sales.

The following are examples of specialty areas within the field of biomedical engineering:

Bioinstrumentation uses electronics, computer science, and measurement principles to develop instruments used to diagnose and treat medical problems.

Biomaterials is the study of naturally occurring or laboratory-designed materials that are used in medical devices or as implantation materials.

Biomechanics involves the study of mechanics, such as thermodynamics, to solve biological or medical problems.

Clinical engineering applies medical technology to optimize healthcare delivery.

Rehabilitation engineering is the study of engineering and computer science to develop devices that assist individuals recovering from or adapting to physical and cognitive impairments.

Systems physiology uses engineering tools to understand how systems within living organisms, from bacteria to humans, function and respond to changes in their environment.

Some people with training in biomedical engineering become postsecondary teachers (https://www.bls.gov/ooh/education-training-and-library/postsecondary-teachers.htm).

Summary (https://www.bls.gov/ooh/architecture-and-engineering/biomedical-engineers.htm#tab-3)

- Biomedical Engineer
- 2021 Median Pay: $97,410 per year or $46.83 per hour
- Typical Entry-Level Education: Bachelor's degree
- Work Experience in Related Occupation: None
- On-the-job training: None
- Number of Jobs, 2021: 17,900
- Job Outlook 2021-31: 10% (Faster than average)
- Employment Change: 2021-31; 1,700

Work Environment (https://www.bls.gov/ooh/architecture-and-engineering/biomedical-engineers.htm#tab-3)

Most biomedical engineers work in manufacturing, universities, hospitals, and research facilities of companies and educational and medical institutions. They usually work full-time, and some work more than 40 hours per week.

How to Become a Biomedical Engineer (https://www.bls.gov/ooh/architecture-and-engineering/biomedical-engineers.htm#tab-4)

Biomedical engineers typically need a bachelor's degree in biomedical engineering or bioengineering or in a related engineering field. Some positions may require a graduate degree.

Pay (https://www.bls.gov/ooh/architecture-and-engineering/biomedical-engineers.htm#tab-5)

The median annual wage for bioengineers and biomedical engineers was $97,410 in May 2021.

Job Outlook (https://www.bls.gov/ooh/architecture-and-engineering/biomedical-engineers.htm#tab-6)

Employment of bioengineers and biomedical engineers is projected to grow 10 percent from 2021 to 2031, faster than the average for all occupations.

About 1,200 openings for bioengineers and biomedical engineers are projected each year, on average, over the decade. Many of those openings are expected to result from the need to replace workers who transfer to different occupations or exit the labor force, such as retiring.

State & Area Data (https://www.bls.gov/ooh/architecture-and-engineering/biomedical-engineers.htm#tab-7)

Explore resources for employment and wages by state and area for biomedical engineers.

Similar Occupations (https://www.bls.gov/ooh/architecture-and-engineering/biomedical-engineers.htm#tab-8)

Compare the job duties, education, job growth, and pay of biomedical engineers with similar occupations.

More Information, Including Links to O*NET (https://www.bls.gov/ooh/architecture-and-engineering/biomedical-engineers.htm#tab-9)

Learn more about biomedical engineers by visiting additional resources, including O*NET, a source on key characteristics of workers and occupations.

SUGGESTED CITATION:

Bureau of Labor Statistics, U.S. Department of Labor, *Occupational Outlook Handbook*, Biomedical Engineers, on the Internet at https://www.bls.gov/ooh/architecture-and-engineering/biomedical-engineers.htm (visited May 27, 2023).

TVCC has partnered with **Career Coach (https://tvcc.emsicc.com/?radius=&region=10%20Mile%20Radius%20from%20Athens%2C%20TX)** for students to discover majors and in-demand careers and education based on their interests!

- Career Assessment Profiler
- Interactive Career Catalog
- Browse TVCC's Pathways

Some careers in this field will require a bachelor's degree.

- TVCC's AA degrees are fully transferable to public universities in Texas. See an academic advisor or TVCC's university transfer webpage (https://www.tvcc.edu/Advisement/Category.aspx?z=72) for more information on this transfer opportunity.
- Many of TVCC's AAS degrees lead to an online Bachelor of Applied Arts and Sciences (BAAS) degree with participating universities. See an academic advisor or the BAAS transfer website (https://www.ntxccc.org/pathways/) for more information on this transfer opportunity.