Fairfax Collegiate
2026 Summer Program
Biomedical Engineering Course Syllabus
Rising Grades 7-9

Course Description

Invent medical treatments and devices.

Extract DNA, investigate gene therapy, examine organ systems, and develop prosthetics. Print 3D medical parts.

Learn about biochemistry, DNA, protein synthesis, gene expression, genetic engineering, human cells, tissue structure, anatomy, and medical imaging.

Students understand how biology, engineering, and medicine work together to solve real-world problems. They employ scientific thinking, undergo creative challenges, and explore how living systems function at every scale. Through a blend of guided lessons, demonstrations, and collaborative activities, students build a clear foundation in the fundamentals of biomedical engineering.

At the end of the course, instructors upload photos and videos of class projects for families to access. Students leave with a stronger understanding of modern biomedicine and the confidence to continue exploring biology, engineering, and other STEM fields.

Learning Objectives

Course Goals	**Cellular Knowledge:** Students understand the parts of a cell, along with how DNA plays a role in protein synthesis. **Anatomy:** Students learn about the parts of the body and about how they interact to allow humans to function. **Engineering:** Students use 3D printing software to create plastic models using their new medical knowledge
Course Topics	**Basic Concepts of Biochemistry:** Students learn to describe elements, atoms, molecules, and compounds. They also learn about the different types of chemical reactions, chemical bonds, and macromolecules.

	Cell Physiology: Students learn about the different types of cells, and they learn to identify the different organelles of a cell. **Cell Cycle & Division:** Students learn to identify the different stages of the cell cycle, mitosis, and meiosis. **DNA Structure & Synthesis:** Students learn about the structure of DNA and the process of DNA replication. **Protein Synthesis & Gene Expression:** Students learn about the different types of RNA, transcription, and translation. Students also receive an overview of gene expression and gene therapy. **Tissue Structure:** Students learn about the four different types of tissue in the human body. **Human Anatomy:** Students receive an overview of basic organ systems in the human body. **Genetic Engineering:** Students learn about the role of plasmids and restriction enzymes in genetic engineering. Students also study the steps of gel electrophoresis and the polymerase chain reaction. **3D Printing:** Students learn about 3D printing and about its applications in modern medicine.

Course Schedule

Class Meeting 1	**Introduction to Course:** Students are introduced to the staff and other students with various icebreakers, and they begin to define biomedical engineering. **Basics of Biochemistry Lecture:** Students learn an overview of a variety of topics in chemistry, including elements, molecules, chemical reactions and bonds, and macromolecules.
Class Meeting 2	**Cell Physiology Lecture:** Students learn about cell theory, prokaryotes and eukaryotes, and they learn the different types of cell organelles. **Cell Cycle & Cell Division Activity:** Students learn the steps of the cell cycle and cell division (mitosis and meiosis), and they receive a brief overview of stem cells.
Class Meeting 3	**DNA Structure & Replication:** Students learn about the make-up of DNA and about how DNA is synthesized and replicated. **Gene Therapy:** Students explore beneficial examples and the ethical and safety concerns surrounding gene therapy. **DNA Extraction Activity:** Students learn how to extract DNA and then do so. **RNA & Protein Synthesis:** Students learn about RNA and the central dogma.
Class Meeting 4	**Genetic Engineering:** Students go over the definition and examples of genetic engineering, and they learn the role of plasmids and restriction enzymes. Students also review the steps of gel

	electrophoresis, bacterial transformation, and PCR. **Intro to Anatomy & Physiology:** Students receive a brief introduction to human anatomy & physiology
Class Meeting 5	**Tissue Structure:** Students learn about the four different types of tissue in the human body. **Organ Systems Overview:** Students receive a brief overview of the major organ systems in the human body. **Vaccines:** Students learn about how vaccines are made and how they work. **Presentations:** Students work individually or in pairs to research a topic and become an "expert". Students present what they learned to the class in a creative way.
Class Meeting 6	**Tissue Engineering:** Students discuss biomaterials, the cell types used in engineering, different types of scaffolds, and tissue engineering a human heart. **Anatomy of Heart/Circulatory System:** Students learn the basic anatomy of the human heart and the major steps of the circulatory system. **Dissection:** Students dissect cow and sheep heart, brain, liver, and eyes.
Class Meeting 7	**Prep for 3D Printing an Aortic Valve:** Students prepare to 3D print a heart valve. **3D Printing and Organ Scanning:** Students scan an organ model with the Digitizer and examine it in MakerBot Print software.
Class Meeting 8	**Biomechanics:** Students discuss sports biomechanics, biofluid mechanics, kinesiology, locomotion and gait, the musculoskeletal system, prosthesis, and crash testing. **Bioimaging:** Students discuss the electromagnetic spectrum, X-rays, CT imaging, MRI, ultrasound imaging, nuclear medicine, and optical imaging. **Prosthetics Activity:** Students discuss prosthetics and create their own prosthetic hand.
Class Meeting 9	**Prep for 3D Printing: Hip Replacement:** Students prepare to 3D print a human hip. **3D-Printing: Hip Replacement:** Students use TinkerCad to create and 3D print a model of a hip replacement. **Design a Broken Bone Cast:** Students design a cast for an elementary student who broke their fibula.
Class Meeting 10	**Biomedical Engineering Careers:** Students discuss career opportunities in the field of biomedical engineering. **Discussion - Ethics:** Students discuss ethical and legal issues in biomedical engineering. **Presentations:** Students work individually or in pairs to research a topic and become an "expert". Students present what they learned to the class in a creative way.