



Biomedical Engineering 7-9 Syllabus

Course Goals

1 Cellular Knowledge

Students understand the parts of a cell, along with how DNA plays a role in protein synthesis.

2 Anatomy

Students learn about the parts of the body and about how they interact to allow humans to function.

3 Engineering

Students use 3D printing software to create plastic models using their new medical knowledge

Course Topics

1 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.

2 Cell Physiology

Students learn about the different types of cells, and they learn to identify the different organelles of a cell.

3 Cell Cycle & Division

Students learn to identify the different stages of the cell cycle, mitosis, and meiosis.

4 DNA Structure & Synthesis

Students learn about the structure of DNA and the process of DNA replication.

5 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.

6 Tissue Structure

Students learn about the four different types of tissue in the human body.

7 Human Anatomy

Students receive an overview of basic organ systems in the human body.

8 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.

9 3D Printing

Students learn about 3D printing and about its applications in modern medicine.

Course Schedule

Day 1

Introduction

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.

Day 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 Lecture

Students learn the steps of the cell cycle and cell division (mitosis and meiosis), and they receive a brief overview of stem cells.

Day 3

DNA Structure & Replication

Students learn about the make-up of DNA and about how DNA is synthesized and replicated.

DNA Extraction Activity

Students learn how to extract DNA and then do so.

RNA & Protein Synthesis

Students learn about RNA and the central dogma.

Gene Therapy

Students explore beneficial examples and the ethical and safety concerns surrounding gene therapy.

Day 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

Day 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.

Day 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.

Day 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.

Day 8

Bioimaging

Students discuss the electromagnetic spectrum, X-rays, CT imaging, MRI, ultrasound imaging, nuclear medicine, and optical imaging.

Biomechanics

Students discuss sports biomechanics, biofluid mechanics, kinesiology, locomotion and gait, the musculoskeletal system, prosthesis, and crash testing.

Day 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.

Day 10

Discussion - Ethics

Students discuss ethical and legal issues in biomedical engineering.

Biomedical Engineering Careers

Students discuss career opportunities in the field of biomedical engineering.

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