BIOT 108: INTRO TO BIOTECHNOLOGY: REAL WORLD BIOLOGY APPLICATIONS

Citrus College Course Outline of Record

Heading	Value
Effective Term:	Fall 2024
Credits:	4
Total Contact Hours:	108
Lecture Hours :	54
Lab Hours:	54
Hours Arranged:	0
Outside of Class Hours:	108
Total Student Learning Hours:	216
Strongly Recommended:	Intermediate algebra or higher; ENGL 101.
District General Education:	B1. Natural Sciences - Life Sciences, B3. Natural Sciences - Laboratory
Transferable to CSU:	Yes
Transferable to UC:	Yes - Approved
Grading Method:	Standard Letter

Catalog Course Description

This course will serve as a general introduction to biology with a focus on biotechnology appropriate for a wide range of students, including non-majors. Topics will encompass the biology, business, and legal/ethical issues surrounding biotechnology. Lecture content will emphasize cell structure and function, molecular biology, genetic engineering, drug development, biofuels, and discussion of utilizing living systems to address current societal challenges. The laboratory provides students with expanded hands-on experience of biotechnology techniques and applications. 54 lecture hours, 54 lab hours.

Course Objectives

- Describe basic biological and chemical principles underlying biotechnology.
- Describe how the genome of an organism can be modified using current biotechnology tools.
- Explain evolution from a genetic perspective.
- Evaluate a recent development in the field of biotechnology from an ethical perspective.
- Perform experiments by following instructions/objectives and working collaboratively in teams.
- Demonstrate ability to safely use common laboratory equipment.
- Explain the importance of Good Laboratory Practice (GLP) and appropriate documentation.
- Prepare and analyze graphs of experimental data.
- Compose a laboratory protocol.
- Employ aseptic technique to culture cells and observe with light microscope.
- Demonstrate an understanding of the nature of scientific inquiry, especially the role of the scientific method.
- Demonstrate knowledge of a wide range of biotechnology applications to address societal challenges, including medical and environmental issues.
- Outline the major steps involved in drug discovery and FDA approval in the United States.
- Evaluate sources of scientific information.
- Define and distinguish among the four major classes of biological molecules.
- Compare and contrast structural and functional differences between prokaryotic and eukaryotic cells.
- Compare and contrast metabolic processes and activities in animal, plant and fungal cells.
- Articulate an understanding of central dogma and construct a flow diagram of gene expression from DNA to protein.
- Identify factors that regulate the expression of genes in a cell.
- Explain the effect of mutations on cell function and the role single nucleotide polymorphisms have on human health and disease.
- Apply knowledge of protein structure to explain activity of enzymes and sensitivity of proteins to environmental factors.
- Demonstrate an understanding of the seminal experiments that resulted in the first genetically-modified organisms and the birth of the biotechnology industry.
- Explain how living systems can be used to manufacture products.
- Demonstrate knowledge of basic upstream and downstream processing activities used in biomanufacturing.

Major Course Content

1. Scientific method and fostering scientific literacy
2. Characterizing life and its diversity
3. Biological molecules and their functions
   a. Carbohydrates
   b. Lipids
   c. Proteins
   d. Nucleic acids
4. Cellular organization
   a. Cell theory
   b. Prokaryotic cells: structure and function
   c. Eukaryotic cells: structure and function
5. Energy production
   a. Photosynthesis
   b. Cellular respiration/Fermentation
6. Reproduction
   a. Cell division
   b. Control of cell cycle and cancer
7. Gene expression
   a. DNA structure and function
   b. DNA replication and mutations
   c. Transcription
   d. Translation
   e. Mutations/Single nucleotide polymorphisms (SNPs)
   f. Regulation of gene expression/Epigenetics
8. Evolution

   a. Definition of evolution and natural selection
   b. Examples of evolution
9. Ecology
   a. Ecosystems
   b. Effects of human on natural systems
10. Biotechnology tools
   a. Recombinant DNA
   b. genomic and cDNAlibraries
   c. PCR
   d. Agarose gel electrophoresis
   e. DNA sequencing
   f. DNA microarrays
   g. SDS-PAGE/ELISA
   h. CRISPR-Cas9
   i. Stem cells and gene therapy (in vivo and ex vivo)
   j. Immune system stimulation/modulation
11. Applications of biotechnology
   a. Microbial
   b. Animal
   c. Agricultural/Plant
   d. Forensics
   e. Bioremediation
   f. Fuels/Industrial
   g. Medical/Pharmaceutical
12. Ethical, legal, and business aspects of biotechnology
   a. Regulatory oversight
   b. Drug development and approval process
   c. Intellectual property rights and patents

Lab Content

Scientific method

1. Constructing a hypothesis
2. Designing experiments
3. Data analysis and graphing
4. Communication of experimental results

Good Laboratory Practice (GLP)

1. Lab safety
2. Writing and following Standard Operating Procedures (SOPs)
3. Maintaining laboratory records/documentation

Metric system

1. Measurements
2. Unit conversions

Metrology

1. Use of micropipettes, glassware and other instruments for volume measurements
2. Use of balances for mass measurements
3. Use of spectrophotometers

Basic microbiology

1. Aseptic technique
2. Microbial culturing techniques
3. Use of light microscopes and hemocytometers

Chemistry for the biologist

1. Preparation and sterilization of solutions
2. Concentrations and dilutions
3. Use of pH meter

Biotechnology applications

1. Large-scale culture of microorganisms
2. Monitoring growth and metabolism of cells in culture
3. Extraction, separation and measurement of macromolecules from cultures
4. Analysis of macromolecule purity

Suggested Reading Other Than Required Textbook

Students will read popular science articles and authoritative websites describing recent biotechnology advancements and ethical considerations.

Examples of Required Writing Assignments

Students will write a laboratory protocol outlining the steps taken to perform an experiment of their own design. Students will work in groups to develop a strategy to communicate aspects of biotechnology to fellow citizens. Students will provide a written justification for their selected audience and communication modality.

Examples of Outside Assignments

Students will answer in-class and homework questions, such as: (1) Explain why antibiotic resistance is not a direct result of exposure to antibiotics. (2) How can microalgae be used to produce nutritional supplements? (3) Propose one way to use biotechnology approaches to address global climate change.

Instruction Type(s)

Lab, Lecture, Online Education Lecture

IGETC Area 5: Physical and Biological Sciences

5C. Science Laboratory, 5B. Biological Science