

FOLSOM CORDOVA UNIFIED SCHOOL DISTRICT



Medical Biotechnology

Board Approval Date:	Course Length: 2 Semesters
Grading: A-F	Credits: 5 Credits per Semester
Proposed Grade Level(s): 9, 10, 11, 12	Subject Area: Life Science, Elective Elective Area (if applicable): Career Technical Education
Prerequisite(s): Biology of the Living Earth and Integrated Math 1	Corequisite(s): N/A
CTE Sector/Pathway: Health Science and Medical Technology / Biotechnology	
Intent to Pursue 'A-G' College Prep Status: Yes	
A-G Course Identifier: (d) Laboratory Science	
Graduation Requirement: No	
Course Intent: District Course Program (if applicable): CTE	

COURSE DESCRIPTION:

The major focus of Medical Biotechnology course is to train students in scientific concepts and laboratory research techniques currently used in the field of biotechnology. Students will be introduced to the major concepts from the areas of molecular biology, genetics and genomics, DNA/RNA technology, bioinformatics, recombinant technologies, and bioethics. Lessons will engage students in conducting laboratory experiments, collecting and analyzing real data, researching and communicating scientific information, and critically discussing the ethical and social issues surrounding the use of biotechnology in today's society. This course aims to produce technically sound scientists who can apply their newfound knowledge in an academic, commercial, or medical laboratory setting.

DETAILED UNITS OF INSTRUCTION:

Unit Number/Title	Unit Essential Questions	Examples of Formative Assessments	Examples of Summative Assessment
<p>1. Introduction to Biotechnology</p>	<p>What is biotechnology and who is involved? What are the necessary safety precautions in a biotechnology lab? How do we use lab equipment safely and properly? How do scientists perform calculations in order to determine the quantities of chemicals needed to prepare a solution? How do scientists use indicator solutions and standards to test for the presence of biologically important molecules, such as carbohydrates, lipids, proteins, and nucleic acids? What types of organisms and cells are studied in biotechnology facilities? How does the structure of molecules affect their characteristics?</p>	<p>*Daily warm-ups and vocabulary reflections *Career TED Talks - student presentations *Lab notebook checks *Scientific notation, significant figures, solutions, dilutions worksheets *Quiz: Lab safety, equipment, and scientific notation *Quiz: Measuring volumes and preparing solutions *Quiz: The raw materials of biotechnology - organisms and their components *Lab: Making solutions of differing mass/volume concentrations *Lab: Making dilutions of concentrated solutions *Lab: The effect of alcohol solutions on cell membranes *Lab: Micro pipetting exercise *Lab: Preparation of growth media for bacterial cultures *Molecular puzzles - macromolecules *Lab: Macromolecule indicator tests (Benedict, Iodine, Biuret) *Modeling mitosis and meiosis *Lab: Using a Compound Light Microscope to study cells *Lab: Morphology of cancer cell</p>	<p>*Unit exam comprised of multiple choice and short answer response questions covering major concepts from the unit *Cheese Production Lab Report: Students will compare the rates of cheese production using different culturing agents *Students will further plan and carry out an investigation to test the effects of different types of milk on curd formation</p>
<p>2. Genetic Testing and Screening</p>	<p>What is DNA and how has its discovery impacted society and science? How does DNA serve as</p>	<p>*Daily warm-ups and vocabulary reflections *Career TED Talks - student presentations</p>	<p>*Unit exam comprised of multiple choice and short answer response questions covering major</p>

	<p>the basis for all life processes? What are examples of basic techniques used to manipulate genetic material to diagnose genetic disorders?</p>	<ul style="list-style-type: none"> *Classroom discourse on case-studies *Lab notebook checks *Quiz: DNA structure, function, and protein synthesis *Quiz: Isolating and manipulating DNA *DNA structure and replication models *Modeling protein synthesis and mutations *Sample gel electrophoresis paper model *Lab: Casting agarose gels and dye electrophoresis *Activity: Restriction site prediction using NEBcutter *Lab: Restriction digestion and analysis of lambda DNA *Lab: Extracting DNA from human cells for PCR and sequencing 	<p>concepts from the unit *Patient Letter - Genetic Testing: Students will write a letter from the point of view of a genetics counselor providing an explanation of the biology behind the disease, a review of the patient's medical and family history, and a recommendation for or against genetic testing</p>
<p>3. Proteins Products in Biotechnology</p>	<p>How does the protein's amino acid sequence determine its shape and chemical properties? What is the role of naturally occurring proteins and recombinant proteins in biotechnology and medicine? What tools are used in the laboratory to detect and measure the concentration of a protein?</p>	<ul style="list-style-type: none"> *Daily warm-ups and vocabulary reflections *Career TED Talks - student presentations *Lab: Using indicators to test for the presence of protein in solution *Lab notebook checks *Modeling antibody structure *Investigating factors that affect enzyme activity graphs *Quiz: Natural and recombinant proteins in medicine *Lab: Using ELISA to diagnose HIV, Lyme disease, avian influenza (bird flu), or West Nile 	<p>*Unit exam comprised of multiple choice and short answer response questions covering major concepts from the unit *Engineering Challenge: Build a physical model of a short protein *ELISA Lab Abstract: Students will write and present an abstract of their work describing the lab's purpose, procedures, and a summary of their data and discoveries</p>
<p>4. Recombinant DNA Technology</p>	<p>What are the fundamental steps of a genetic engineering process?</p>	<ul style="list-style-type: none"> *Daily warm-ups and vocabulary reflections *Career TED Talks - student 	<p>*Unit exam comprised of multiple choice and short answer response</p>

	<p>How are genetically engineered products used in surgery, tissue replacement, and organ transplants?</p>	<p>presentations *Lab notebook checks *Quiz: Recombinant DNA *Activity: Plasmid mapping *Activity: Lambda phage three-dimensional model *Lab: Bacterial transformation using pAmylase2014 plasmid</p>	<p>questions covering major concepts from the unit *Bacterial transformation using pAmylase2014 plasmid formal lab report: Students will write a detailed analysis of their lab that is used to determine whether bacteria can express a recombinant plasmid containing genes for ampicillin resistance and amylase production *Students use mathematics and computation thinking in order to determine the transformation efficiency of their experiment, and propose possible sources of error *Genetic Engineering Design Challenge Presentation: Students will research current methods of DNA manipulation, choose a method they would experiment with if they were genetic engineers, and discuss how their method can be used in surgery, tissue replacement, or organ transplants</p>
<p>5. Bioinformatics and Genomics</p>	<p>How are DNA sequences compared to each other? Why is bioinformatics the future of biotechnology and medicine?</p>	<p>* Daily warm-ups and vocabulary reflections * Career TED Talks - student presentations * Lab notebook checks * Lab: Wikipedia vs. OMIM exercise * Lab: Making connections across species * Lab: Assessing scientific breakthroughs</p>	<p>*Unit exam comprised of multiple choice and short answer response questions covering major concepts from the unit *Engineering challenge: Students design a device that assists patients living with Charcot-Marie-Tooth Disease and improves their quality of</p>

		* Case Study: Seeking answers through genomics	life *Personalized Medicine Brochure: Students will design a brochure showcasing the hopes, breakthroughs and limits of personalized medicine
6. Ethical Issues in Medical Biotechnology	What ethical, social, and economic issues arise from advances in biotechnology?	* Daily warm-ups and vocabulary reflections * Career TED Talks - student presentations * Lab notebook checks * Quiz - Covering ethical issues in medical biotechnology presented by the students	*PowerPoint Presentation: Students will prepare a presentation on a bioethical issue surrounding the use of biotechnology and compare the benefits and harm that can be the result of the biotechnology innovation in both the research and application phases *Peer evaluation rubric of the presentation
7. Culminating Final Project	What are the current biotechnology innovations that are used to cure diseases? What are the benefits and harm that can be the result of biotechnology innovations in both the research and application phases and which course of action will result in the best outcomes?	* Daily warm-ups and vocabulary reflections * Career TED Talks - student presentations * Preliminary drafts of the corporate profile and infomercial	*Formal Project Presentation of the corporate profile and infomercial *Peer evaluation rubric of the presentation

ESSENTIAL STANDARDS:

Biotechnology Pathway Standards:

A1.0 Define and assess biotechnology and recognize the diverse applications and impact on society.

A2.0 Understand the ethical, moral, legal, and cultural Issues related to the use of biotechnology research and product development.

A3.0 Demonstrate competencies in the fundamentals of molecular cell biology, including deoxyribonucleic acid (DNA) and proteins and standard techniques for their purification and manipulation.

A4.0 Recognize basic concepts in cell biology and become familiar with the laboratory tools used for their

analysis.

A5.0 Integrate computer skills into program components.

A6.0 Implement use of the metric system, orders of magnitude, and the pH scale in preparation or reagents, analysis of data, and graphing.

A7.0 Understand the function of regulatory agencies for the biotechnology industry and the lasting impact of routine laboratory and communication practices on product development and manufacturing.

A8.0 Follow sustainable and safe practices with high regard for quality control.

A9.0 Understand that manufacturing represents inter-connectedness between science and production.

RELEVANT STANDARDS AND FRAMEWORKS, CONTENT/PROGRAM SPECIFIC STANDARDS:

Link to Common Core Standards (if applicable):

Educational standards describe what students should know and be able to do in each subject in each grade. In California, the State Board of Education decides on the standards for all students, from kindergarten through high school.

<https://www.cde.ca.gov/be/st/ss/documents/finalelaccsstandards.pdf>

Link to Framework (if applicable):

Curriculum frameworks provide guidance for implementing the content standards adopted by the State Board of Education (SBE). Frameworks are developed by the Instructional Quality Commission, formerly known as the Curriculum Development and Supplemental Materials Commission, which reviews and recommends textbooks and other instructional materials to be adopted by the SBE.

Link to Subject Area Content Standards (if applicable):

Content standards were designed to encourage the highest achievement of every student, by defining the knowledge, concepts, and skills that students should acquire at each grade level.

<https://www.cde.ca.gov/ci/ct/sf/documents/ctescrpflyer.pdf>

<https://www.cde.ca.gov/ci/ct/sf/documents/healthmedical.pdf>

<https://www.nextgenscience.org/search-standards>

Link to Program Content Area Standards (if applicable):

Program Content Area Standards applies to programs such as International Baccalaureate, Advanced Placement, Career and Technical Education, etc.

TEXTBOOKS AND RESOURCE MATERIALS:

Textbooks

Board Approved	Pilot Completion Date (If applicable)	Textbook Title	Author(s)	Publisher	Edition	Date
		N/A				

Other Resource Materials

Barnum, Susan R. *Biotechnology: An Introduction*. Brooks Cole, 2006.

Brown, Kirk J. *Biotechnology: A Laboratory Skills Course*. BioRad Press, 2011.

Daugherty, Ellyn. *Biotechnology: Science for the New Millennium*. Paradigm Publishing, Inc., 2017.

Daugherty, Ellyn. *Biotechnology Laboratory Manual*. Paradigm Publishing, Inc., 2017.

Supplemental Materials

Board approved supplemental materials (Including but not limited to: Film Clips, Digital Resources, Supplemental texts, DVDs, programs).