

# FOLSOM CORDOVA UNIFIED SCHOOL DISTRICT



## Advanced Medical Biotechnology

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

### COURSE DESCRIPTION:

Advanced Medical Biotechnology is a continuation to the course Medical Biotechnology. Students will deepen their understanding of the tools and techniques of DNA and protein manipulation and analysis. Obtained skills and knowledge can be applied in an academic, commercial, or a medical laboratory setting. 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.

## DETAILED UNITS OF INSTRUCTION:

Unit Number/Title	Unit Essential Questions	Examples of Formative Assessments	Examples of Summative Assessment
<b>1. Pharmaceutical Biotechnology</b>	How do scientists test the effectiveness of antibiotics and antimicrobials? What are the high-throughput screening methods used to discover drug activity?	<ul style="list-style-type: none"> <li>*Daily warm-ups and vocabulary reflections</li> <li>*Career TED Talks - student presentations</li> <li>*Lab notebook checks</li> <li>*Drug development and discovery - chart of recent FDA drug approvals</li> <li>*Uses of bacteria in biotechnology worksheet</li> <li>*Calculate bacterial growth rate</li> <li>*Model the spread of antibiotic resistance in a bacterial population.</li> <li>*Lab: Testing plant substances as potential medicines</li> <li>*Lab: Synthesis of aspirin</li> <li>*Modeling peptide synthesis using molecular puzzles</li> </ul>	<ul style="list-style-type: none"> <li>*Unit exam comprised of multiple choice and short answer response.</li> <li>questions covering major concepts from the unit.</li> <li>*Assay for antimicrobial activity: Students will plan an investigation in order to test plant extracts for antimicrobial activity.</li> <li>*Peptide therapies brochure: Students will design a brochure highlighting the different ways peptides are tested for therapeutic purposes.</li> </ul>
<b>2. Genetic Disease Detection</b>	How does genetic testing reveal information about a patient's risk of developing a disease or a disorder?	<ul style="list-style-type: none"> <li>*Daily warm-ups and vocabulary reflections</li> <li>*Career TED Talks - student presentations</li> <li>*Lab notebook checks</li> <li>*Reproductive genetic testing: Technology, access, and decision making fishbowl discussion</li> <li>*Aneuploidy &amp; chromosomal rearrangements worksheets</li> <li>*Chromosomal abnormalities paper models</li> <li>*Cytogenetics lab: karyotyping</li> <li>*Pedigree construction worksheets</li> <li>*Lab: In Search of the cancer gene</li> </ul>	<ul style="list-style-type: none"> <li>*Unit exam comprised of multiple choice and short answer response</li> <li>questions covering major concepts from the unit.</li> <li>*Patient Letter: Students will take on the role of a genetic counselor and compose a letter to the parents of their patient explaining their genetic findings and describe the implications of these chromosome results for their fetus/newborn.</li> <li>*Family Pedigree: Students will support an argument with evidence for their diagnosis of a woman and her five children</li> </ul>

<b>3. Infectious Disease Detection</b>	<p>How can we use DNA technology, antibodies, and vaccines in detecting infectious diseases?</p>	<ul style="list-style-type: none"> <li>*Daily warm-ups and vocabulary reflections</li> <li>*Career TED Talks - student presentations</li> <li>*Lab notebook checks</li> <li>*Immune system - cartoon strip</li> <li>*Lab: Detection of Mad Cow Disease</li> <li>*Lab: DNA screening for Smallpox</li> <li>*Lab: Identifying the Epstein Barr Virus using ELISA</li> <li>*Lab: ELISA assay for HIV, Lyme disease, avian influenza (bird flu), or West Nile virus</li> <li>*Activity: Quantitative ELISA</li> <li>*Lab: Western Blot Analysis of infected patients</li> </ul>	<ul style="list-style-type: none"> <li>*Unit exam comprised of multiple choice and short answer response questions covering major concepts from the unit.</li> <li>*Antigens and antibody models: Students will develop their own models of antigens and their complementary antibodies.</li> <li>*Antibodies in medical research and pharmaceutical production poster. Students will create a poster describing the use of antibodies in medical research applications.</li> <li>*Western Blot Analysis Medical Report: Students will write a formal medical report describing their experimental results and identifying infected patients.</li> </ul>
<b>4. CRISPR and Gene Editing Technology</b>	<p>How does CRISPR and CAS9 technologies and other gene editing techniques allow for precise and accurate editing of genetic code? Are there limitations when gene editing should be used?</p>	<ul style="list-style-type: none"> <li>*Daily warm-ups and vocabulary reflections</li> <li>*Career TED Talks - student presentations</li> <li>*Lab notebook checks</li> <li>*Recombinant DNA technology worksheets</li> <li>*Article and debate: “Tinkering with Nature: weighing the benefits and risks of genetically engineering animals”</li> <li>*Lab: Bacterial gene engineering CRISPR</li> <li>*KQED learn online discussion: Limitations of gene editing</li> </ul>	<ul style="list-style-type: none"> <li>*Unit exam comprised of multiple choice and short answer response questions covering major concepts from the unit</li> <li>*Gathering information to make informed choices about gene editing. Activity: Students will act as an elected official and research and compile information on a specific discussion topic surrounding gene editing and communicate their recommendations to the class using a multimedia presentation.</li> <li>*Company website: Students will choose a biotechnology company</li> </ul>

			currently using the CRISPR-Cas9 technology and create a free informative website about the company, describing how the technology works, and identifying how the technology helps cure a variety of genetic disorders and diseases.
<b>5. Bioinformatics and Genomics</b>	<p>What are the benefits and implications of knowing DNA sequences of humans and other organisms?</p> <p>How is DNA sequenced for research and clinical purposes and how does recent improvements increased the efficiency of the process?</p>	<p>*Daily warm-ups and vocabulary reflections</p> <p>*Career TED Talks - student presentations</p> <p>*Lab notebook checks</p> <p>*Lab: DNA Chips - genes to disease</p> <p>*Comparing mtDNA sequences to learn about human variation activity</p> <p>*Journal Article: Genetic diversity in the human population</p> <p>*Activity: 23andMe genotype and phenotype of lactose</p>	<p>*Unit exam comprised of multiple choice and short answer response questions covering major concepts from the unit.</p> <p>*Microarray Project: Students will design their own microarray in order to study gene expression in cells and tissues.</p>
<b>6. Ethical Issues in Medical Biotechnology</b>	<p>What ethical, social, and economic issues arise from advances in biotechnology?</p>	<p>*Daily warm-ups and vocabulary reflections</p> <p>*Career TED Talks - student presentations</p> <p>*Lab notebook checks</p> <p>*Quiz: Covering ethical issues in medical biotechnology presented by the students</p>	<p>*Multimedia presentation: Students will research and present ethical considerations surrounding the topics of gene therapy, prenatal testing, gene editing, bioterrorism, treatment affordability, and patient privacy.</p> <p>*Peer evaluation rubric of the presentation.</p>
<b>7. Culminating Final Project</b>	<p>What advances in stem cell research, regenerative medicine, pharmacology, 3D-bioprinting, and synthetic biology can lead</p>	<p>*Daily warm-ups and vocabulary reflections</p> <p>*Career TED Talks - student presentations</p> <p>*Lab notebook checks</p>	<p>*Formal project presentation and product: Students will work through a design process to create or improve a</p>

	to improved health care?	*Preliminary design proposal submitted for teacher approval *Preliminary outline of the marketing pitch submitted for teacher approval	medical innovation. *Students will showcase their designs using a model, a prototype, or a schematic and create a marketing plan to pitch their product to potential investors. *Peer evaluation rubric of the presentation.
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## **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/finaelaccsstandards.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**

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

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

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

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

**Supplemental Materials**

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

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