TMHS Biotechnology Curriculum Overview

OVERVIEW:

This course is designed to acquaint students with the diverse field of biotechnology. Topics will include a brief history of biotechnology, job opportunities in biotechnology, recombinant DNA and protein products, microbial biotechnology, plant biotechnology, medical biotechnology, and DNA fingerprinting and forensic analysis. Current ethical issues such as stem cell research and cloning will also be discussed.

This is a lab course. The laboratory component of this course provides students with basic skills used in biotechnology labs. The experiments performed will enhance and reflect the material that is covered in lecture. Students are expected to participate in all labs when they are scheduled, as most reagents are time sensitive; and students must follow all rules of laboratory safety, as reagents can be hazardous, and biotech lab equipment is costly.

COURSE OBJECTIVES:

The primary objective of this course is to provide an overview of the various aspects of biotechnology. At the end of the semester, students will:

-gain an appreciation for the rapid growth of biotechnology and the number of uses of biotechnology
-understand the chemistry and biology of DNA and proteins
-know the fundamental concepts of DNA isolation and analysis
-know the fundamental concepts of protein isolation and analysis
-be able to apply their knowledge of DNA and proteins to understanding the production of recombinant proteins
-understand the power of genetic analysis as a technology
-be familiar with basic operating procedures in any lab, including safety, documentation, experimental design, and data analysis and reporting.
-demonstrate the ability to write and speak effectively through written assignments, lab reports and discussions.

Unit name	Pacing *Number of weeks proposed*	Instructional Block *Number of lessons*	Standards and Scientific Practices
1. The Biotechnology Century and Its Workforce	5 weeks (ongoing)	14 lessons	Technology Standards (ongoing through all units): 1.1 Identify and explain the steps of the engineering design process: identify the problem, research the problem, develop possible solutions, select the best possible solution(s), construct prototypes and/or models, test and evaluate, communicate the solutions, and redesign.

			1.2 Understand that the engineering design process is used in the solution of problems and the advancement of society. Identify examples of technologies, objects, and processes that have been modified to advance society, and explain why and how they were modified. 1.3 Produce and analyze multi-view drawings (orthographic projections) and pictorial drawings (isometric, oblique, perspective), using various techniques. 1.4 Interpret and apply scale and proportion to orthographic projections and pictorial drawings (e.g., ¼" = 1'0", 1 cm = 1 m). 1.5 Interpret plans, diagrams, and working drawings in the construction of prototypes or models. <u>Chemistry Standards:</u> 7.1 Describe the process by which solutes dissolve in solvents. 7.2 Calculate concentration in terms of molarity. Use molarity to perform solution dilution and solution stoichiometry. -Discuss various job opportunities in the field of biotechnology -Set-up formal laboratory notebooks based on standards established and used in modern biotechnology/pharmaceutical companies -Practice using modern tools used in biotechnology -Make kab solutions using accurate and precise measurements
2. An Introduction to Genes and Genomes	4 weeks	10 lessons	<u>Biology Standards:</u> 2.1 Relate cell parts/organelles (plasma membrane, nuclear envelope, nucleus, nucleolus, cytoplasm, mitochondrion, endoplasmic reticulum, Golgi apparatus, lysosome, ribosome, vacuole, cell wall, chloroplast, cytoskeleton, centriole, cilium, flagellum, pseudopod) to their functions. Explain the role of cell membranes as a highly

			selective barrier (diffusion, osmosis, facilitated diffusion, active transport). 2.2 Compare and contrast, at the cellular level, the general structures and degrees of complexity of prokaryotes and eukaryotes. 3.1 Describe the basic structure (double helix, sugar/phosphate backbone, linked by complementary nucleotide pairs) of DNA, and describe its function in genetic inheritance. 3.2 Describe the basic process of DNA replication and how it relates to the transmission and conservation of the genetic code. Explain the basic processes of transcription and translation, and how they result in the expression of genes. Distinguish among the end products of replication, transcription, and translation. -Review topics in basic cell biology -Review the structure & function of DNA -Complete a lab activity to demonstrate how DNA can be extracted from living tissue
3. Recombinant DNA Technology and Genomics	4 weeks	10 lessons	SIS1. Make observations, raise questions, and formulate hypotheses. SIS2. Design and conduct scientific investigations. SIS3. Analyze and interpret results of scientific investigations. SIS4. Communicate and apply the results of scientific investigations. -Illustrate modern techniques used in creating recombinant DNA -Discuss ethical concerns surrounding the use of recombinant DNA in the modern world and for the future -Complete a lab activity to demonstrate how organisms can be genetically modified, by creating glow in the dark bacteria
4. Proteins as Products	4 weeks	10 lessons	SIS1. Make observations, raise questions, and formulate hypotheses.

			SIS2. Design and conduct scientific investigations. SIS3. Analyze and interpret results of scientific investigations. SIS4. Communicate and apply the results of scientific investigations. -Describe the structures and functions of proteins, as related to biotechnology -Compare & contrast techniques used to purify proteins -Summarize techniques used to sequence proteins -Complete a lab activity to demonstrate how proteins can be purified, by extracting proteins from glow in the dark bacteria
5. Plant Biotechnology	4 weeks	10 lessons	SIS1. Make observations, raise questions, and formulate hypotheses. SIS2. Design and conduct scientific investigations. SIS3. Analyze and interpret results of scientific investigations. SIS4. Communicate and apply the results of scientific investigations. -Describe modern plant biotechnologies, including the creation of genetically modified organisms (GMOs) -Discuss ethical concerns surrounding the use of GMOs in foods in the modern world and for the future -Complete a lab activity to determine the GMO content in common, prepared foods, through an experiment using PCR
6. DNA Fingerprinting and Forensic Analysis	4 weeks	10 lessons	SIS1. Make observations, raise questions, and formulate hypotheses. SIS2. Design and conduct scientific investigations.

			SIS3. Analyze and interpret results of scientific investigations. SIS4. Communicate and apply the results of scientific investigations. -Outline the history of forensic science -Describe various methods of DNA fingerprinting -Complete a lab activity to determine a suspect's guilt or innocence based on a DNA fingerprinting activity
	Total: 25 weeks		