Alabama CTE

Biotechnology II: High School

Foundational Standards

1. **Incorporate safety procedures in handling, operating, and maintaining tools and machinery; handling materials; utilizing personal protective equipment; maintaining a safe work area; and handling hazardous materials and forces.** F.1
2. **Demonstrate effective workplace and employability skills, including communication, awareness of diversity, positive work ethic, problem-solving, time management, and teamwork.** F.2
3. **Explore the range of careers available in the field and investigate their educational requirements and demonstrate job-seeking skills including resume-writing and interviewing.** F.3
4. **Advocate and practice safe, legal, responsible, and ethical use of information and technology tools specific to the industry pathway** F.4
5. **Participate in a Career and Technical Student Organization (CTSO) to increase knowledge and skills and to enhance leadership and teamwork.** F.5
6. **Demonstrate effective infection control techniques as defined by the Centers for Disease Control and Prevention (CDC) and The Joint Commission guidelines.** F.6

Career Opportunities

1. **Outline the role of various departments in a biotechnology company, including research and development, quality assurance, quality control, and manufacturing.** 1

Biotechnology Industry

2. **Identify and describe the roles of regulatory agencies governing the manufacture and distribution of biotechnology-derived products.** 2
   - a Outline the processes of developing, manufacturing, and obtaining regulatory approval of biopharmaceuticals. 2.A
3. **Research and implement safety and quality control standards specific to the biotechnology industry.** 3
   - a Explain the purpose of Good Laboratory Practice (GLP), Good Clinical Practice (GCP), and Current Good Manufacturing Practice (CGMP). 3.A
   - b Explain how environmental monitoring is carried out in a controlled space. 3.B
   - c Identify, analyze, and explain the roles of documentation utilized in CGMP-compliant industries. 3.C

Technical Skills and Applications

4 **Demonstrate current techniques used in biotechnology labs.** 4

- a Differentiate among sterilization, decontamination, and disinfection; describe equipment and procedures for each; and explain when each process should be employed. 4.A
- b Demonstrate and explain methods of molecule and protein isolation, purification, and quantification using polyacrylamide gel. 4.B
- c Research and discuss methods of DNA isolation, purification, and quantification. 4.C
- d Use models to illustrate the transformation and transfection of organisms. 4.D
- e Model or utilize clustered regularly interspaced short palindromic repeats (CRISPR) in the lab setting to introduce genetic information into a genome. 4.E
- f Perform immunoassay using serial dilution. 4.F
- g Describe common stains used in the laboratory and explain when each is preferred. 4.G

Biochemistry

5 **Analyze and explain vital intracellular processes.** 5

- a Compare and contrast types of chemical bonds within cells. 5.A
- b Model the structures and explain the functions of molecules and macromolecules. 5.B
- c Compare and contrast aerobic and anaerobic respiration. 5.C
- d Use enzymes to modify reaction rates in the laboratory setting. 5.D

6 **Model the structure and describe the functions of proteins in an organism.** 6

Biological Systems

7 **Map and explain the response of the immune system in the body, beginning with the identification of a foreign antigen.** 7

Applied Mathematics in Biotechnology

8 **Prepare laboratory solutions, buffers, and media, performing necessary calculations, including serial dilutions, dilution ratios, molarity, and dilution factor.** 8

- a Calculate conversions within the metric system using scientific notation, significant digits, and decimals. 8.A
- b Calculate volume/volume (v/v) and weight/volume (w/v) of solutions. 8.B
- c Produce a graph by applying Beer's Law to generate a standard curve, plot data, and interpret results. 8.C
- d Calculate bacterial transformation efficiency. 8.D
- e Record time-sensitive laboratory data using the 24-hour clock. 8.E

Research and Scientific Method

9 Demonstrate use of the scientific method to document and analyze the results of a laboratory procedure. 9

- a Outline the characteristics of good experimental design, including the proper use of controls. 9.A
- b Collect, record, analyze, and interpret data, including statistical analysis. 9.B
- c Outline various ways of communicating scientific research, including peer-reviewed journals, exhibitions, laboratory notebooks, and live or online presentations. 9.C