Tennessee CTE

BioSTEM I

STEM Fields Exploration	1	Describe the dynamic interplay among science, technology, and engineering and math within living, earth-space, and physical systems. Differentiate between the terms biotechnology and biomedicine noting the impact that each has had on society. Explore the history and development of these scientific fields, as well as the roles that their associated industries have played in the areas of agriculture and food, health and medicine, the environment, research, and forensics. 1
	2	Explore several occupations within BioSTEM fields such as medical laboratory science, research science, food science, forensic science, and environmental science, and determine how various industries employ different kinds of data to meet their needs. Create an infographic to describe the many sources and types of data that these occupations use. 2
Perceptions and Future	3	Summarize research from professional journals or websites, textbooks, and/or newspaper articles surrounding an ethical issue related to biotechnology (i.e., the use of animals for lab testing, genetically modified organisms, or stem cell use). Debate the chosen topics presenting both sides of the issue. Discuss the moral, ethical, and legal responsibilities of researchers, policymakers, and other actors as they pertain to informing the public and ensuring the safety and well-being of affected populations. 3
	4	Develop an original idea for a new biotechnology product, and simulate a situation in which the product must be pitched to a prospective client. Create an informational packet to share during the presentation that includes the following items: definition and protection of intellectual property, type of patent, copyright issues and rules, trademarks, and breeders' rights for plants or animals. 4
	5	Develop an argumentative essay surrounding public perceptions and attitudes toward the use of biotechnology in society. Develop claims and counterclaims thoroughly based on facts from research, pointing out the strengths and weaknesses of each claim. Document information using appropriate industry terminology, including areas such as federal and international regulation and oversight, safety assessment, labeling of products, and impact on the economy. 5
Scientific Foundations	6	Review the structural organization of all living things at the cellular level. Summarize in an oral, written, or digital presentation how cellular organization influences scientific approaches in BioSTEM fields, with specific attention given to he various levels of eukaryotic organisms, cellular molecules, cell growth and eproduction, proteins, and nucleic acids. 6

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7 **Synthesize information from professional journals and/or websites, textbooks, and news articles to compare and contrast the structure and properties of the four macromolecules (carbohydrates, lipids, proteins, and nucleic acids). Describe in an informational artifact how the cell membrane structures may be manipulated to allow the passage of these macromolecules in a cell; relate how this knowledge is used by scientists and applied to BioSTEM research.** 7

Problem-Resolution Skills

8 **Research the terms engineering design and scientific inquiry. Compare and contrast the steps of the engineering design process to the steps of the scientific inquiry in a graphic illustration or presentation.** 8

9 **Evaluate a question to determine if it is testable and can produce empirical data. Plan an investigation that outlines the steps of the design process to collect, record, analyze, and evaluate data. For example:** 9

- a Given a set of symptoms, determine whether there is enough data to diagnose a medical condition as would a physician or nurse practitioner. (Science) 9.A
- b Determine what information an actuary would need to know in order to answer a research question about which factors (diet, air quality, soil contaminates, sedentary lifestyle etc.) are contributing the most to medical insurance claims in a region. (Mathematics) 9.B

10 **Given a real-world problem, identify several possible solutions using both the engineering design process and the scientific inquiry. For example:** 10

- a Research several treatment plans for a severe allergy sufferer as would a biochemist or biophysicist. (Science) 10.A
- b Explore commonly used methods to decrease carbon emissions in the environment. (Technology/Mathematics) 10.B

11 **Analyze solutions to a real-world problem collaboratively, to identify critical factors of the steps of the design process. Explain why these factors are critical. For example:** 11

- a Research types of prosthetics and submit a proposal for which one most effectively uses the design process in terms of feasibility, cost, safety, aesthetics, and durability like a biomedical engineer. (Science) 11.A
- b Research ways a chemical engineer performs tests and monitors performance of processes throughout the stages of production for manufacturing chemicals and products such as gasoline, synthetic rubber, plastics, detergents, cement, paper, and pulp. Submit a proposal for which one most effectively uses the design process in terms of factors like mixing, crushing, heat transfer, distillation, and drying. (Technology/Engineering) 11.B

Safety

12 **Review guidelines from governmental agencies such as the Office of Safety and Health Administration (OSHA) guidelines for medical and research laboratories, OSHA guidelines for Standard Precautions and personal protective equipment, Safety Data Sheets (MSDS) and storage of reagents and compounds, and**

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Environmental Protection Agency (EPA) laboratory guidelines. Compare and contrast the rules and regulations of each agency to develop clear expectations regarding the maintenance of safety in these laboratories. 12

13 **Develop a safety manual for a BioSTEM laboratory, specifically for a lab that is involved with processing or developing biomedical products. Include the following in the manual: safety guidelines, procedures for accident prevention and response, and steps for reporting and documenting hazards. Explain the industry standards to maintain aseptic and sterile procedures and luminary flow, as well as the purpose of biosafety cabinets. Draw on the standard operating procedures from agencies such as OSHA, EPA, and Centers for Disease Control and Prevention (CDC) when developing the manual.** 13

14 **Identify and explain the intended use of safety equipment available in the classroom. For example, demonstrate how to properly inspect, use, and maintain safe operating procedures with tools and equipment. Also demonstrate the use of safety glasses, gloves, fire extinguisher, shower and eyewash stations.** 14

Laboratory Foundations

15 **Understand principles of, and successfully perform skills related to the BioSTEM laboratory. Utilize appropriate tools and technology then document findings using domain specific terminology. Incorporate rubrics from textbooks, CTSO guidelines, or clinical standards of practice for the following:** 15

- a Correct use of a centrifuge 15.A
- b Accurate usage of balance or digital scales 15.B
- c Safe use of an autoclave 15.C
- d Accurate use of pH meter or strips 15.D
- e Accurate use of an inoculating loop for agar plate streaking 15.E
- f Accurate use and reading of glass or mercury thermometers 15.F

16 **Review the use of volume measuring devices commonly used by biotechnologists, such as pipettes, micropipettes, and glassware. Prepare solutions and appropriate media, then perform serial dilutions incorporating aseptic techniques.** 16

17 **Explain in depth the terms and phrases often heard in a BioSTEM laboratory and relate how these terms and practices are important in the safe development of BioSTEM products and services.** 17

- a Quality assurance 17.A
- b Quality control 17.B
- c Method validation 17.C
- d Appropriate documentation 17.D
- e Good manufacturing practices 17.E
- f Good laboratory practices. 17.F

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18 **Demonstrate the methods used in basic recordkeeping. Compare and contrast general methods and explain their design and functionalities including:** 18

- a Laboratory notebooks 18.A
- b Equipment logs 18.B
- c Disposal records 18.C
- d Quality assurance/control records 18.D

19 **In teams, apply qualitative and quantitative measures to analyze data and draw conclusions that are free of bias. Compare experimental evidence and conclusions with those drawn by others about the same testable question then communicate and defend scientific findings.** 19