**Course Title: Biotechnician 1a/1b**

**State: TX**
**State Course Title: Biotechnology I**
**Sate Course Code: 127.756**
**State Standards: Texas Essential Knowledge and Skills for Career Development and Career and Technical Education**
**Date of Standards: 2015**

| Standards | Course Title (a or b), if applicable, e.g. Game Design 1a | Unit Name(s) | Lesson(s) Numbers |
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| **(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:** | | | |
| (A) demonstrate knowledge of how to dress appropriately, speak politely, and conduct oneself in a manner appropriate for the profession; | Biotechnician 1b: Advancements in Biotechnology | Unit 7: Starting Your Job in the Industry | Lesson 1 |
| (B) show the ability to cooperate, contribute, and collaborate as a member of a group in an effort to achieve a positive collective outcome; | Biotechnician 1b: Advancements in Biotechnology | Unit 8: Scientific Communication in Biotechnology | Lesson 5 |
| (C) present written and oral communication in a clear, concise, and effective manner; | Biotechnician 1b: Advancements in Biotechnology | Unit 3: Biosafety and Sterility | Discussion 1 |
| (D) demonstrate time-management skills in prioritizing tasks, following schedules, and performing goal-relevant activities in a way that produces efficient results; and | Biotechnician 1b: Advancements in Biotechnology | Unit 8: Scientific Communication in Biotechnology | Activity 2 |
| (E) demonstrate punctuality, dependability, reliability, and responsibility in performing assigned tasks as directed. | Biotechnician 1b: Advancements in Biotechnology | Unit 7: Starting Your Job in the Industry | Lesson 1 |
| **(2) The student, for at least 40% of instructional time, conducts laboratory and field investigations using safe, environmentally appropriate, and ethical practices. These investigations must involve actively obtaining and analyzing data with physical equipment, but may also involve experimentation in a simulated environment as well as field observations that extend beyond the classroom. The student is expected to:** | | | |
| (A) demonstrate safe practices during laboratory and field investigations, including chemical, electrical, and fire safety, and safe handling of live and preserved organisms; | Biotechnician 1a: Introduction | Unit 2: Biotechnology Laboratory Safety | Lesson 1 |
| | Biotechnician 1a: Introduction | Unit 3: Biosafety and Sterility | Activity 1, Activity 2 |
| (B) demonstrate an understanding of the use and conservation of resources and the proper disposal or recycling of materials; | Biotechnician 1a: Introduction | Unit 2: Biotechnology Laboratory Safety | Lesson 1 |

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| (C) demonstrate appropriate safety procedures, guidelines, and chemical hygiene plan; | Biotechnician 1a: Introduction | Unit 2: Biotechnology Laboratory Safety | Lesson 3 |
| (D) maintain required safety training, including location and understanding of interpretation of safety data sheets; | Biotechnician 1a: Introduction | Unit 2: Biotechnology Laboratory Safety | Lesson 4 |
| (E) comply with federal and state safety regulations as specified by Occupational Safety and Health Administration (OSHA) and other regulatory agencies as appropriate; | Biotechnician 1a: Introduction | Unit 2: Biotechnology Laboratory Safety | Lesson 2 |
| (F) identify and obey safety symbols and signs; | Biotechnician 1a: Introduction | Unit 2: Biotechnology Laboratory Safety | Lesson 2 |
| (G) maintain clean and well organized work areas; | Biotechnician 1a: Introduction | Unit 2: Biotechnology Laboratory Safety | Lesson 1 |
| (H) dispose of equipment, glassware, and biologics according to laboratory policies; | Biotechnician 1a: Introduction | Unit 2: Biotechnology Laboratory Safety | Lesson 4 |
| (I) recognize common laboratory hazards; | Biotechnician 1a: Introduction | Unit 2: Biotechnology Laboratory Safety | Lesson 2 |
| (J) observe procedures for the safe use of instruments, gas cylinders, and chemicals; and | Biotechnician 1a: Introduction | Unit 2: Biotechnology Laboratory Safety | Lesson 3 |
| (K) maintain safety and personal protection equipment. | Biotechnician 1a: Introduction | Unit 2: Biotechnology Laboratory Safety | Lesson 4 |
| **(3) The student uses scientific methods and equipment during laboratory and field investigations. The student is expected to:** | | | |
| (A) know the definition of science and understand that it has limitations, as specified in subsection (b)(4) of this section; | | | |
| (B) know that hypotheses are tentative and testable statements that must be capable of being supported or not supported by observational evidence. Hypotheses of durable explanatory power which have been tested over a wide variety of conditions are incorporated into theories; | Biotechnician 1a: Introduction | Unit 8: Experimental Design | Lesson 1 |
| (C) know that scientific theories are based on natural and physical phenomena and are capable of being tested by multiple independent researchers. Unlike hypotheses, scientific theories are well-established and highly-reliable explanations, but they may be subject to change as new areas of science and new technologies are developed; | | | |
| (D) distinguish between scientific hypotheses and scientific theories; | | | |
| (E) plan and implement investigative procedures, including asking questions, formulating testable hypotheses, and selecting, handling, and maintaining appropriate equipment and technology | Biotechnician 1a: Introduction | Unit 8: Experimental Design | Activity 1 |
| (F) collect data individually or collaboratively, make measurements with precision and accuracy, record values using appropriate units, and calculate statistically relevant quantities to describe data, including mean, median, and range; | Biotechnician 1a: Introduction | Unit 8: Experimental Design | Activity 2 |

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| (G) demonstrate the use of course apparatus, equipment, techniques, and procedures; | Biotechnician 1a: Introduction | Unit 4: Biotechnology By The Numbers | Lesson 4 |
| (H) organize, analyze, evaluate, build models, make inferences, and predict trends from data; | Biotechnician 1a: Introduction | Unit 8: Experimental Design | Activity 2 |
| (I) perform calculations using dimensional analysis, significant digits, and scientific notation; and | Biotechnician 1a: Introduction | Unit 4: Biotechnology By The Numbers | Lesson 1 |
| (J) communicate valid conclusions using essential vocabulary and multiple modes of expression such as lab reports, labeled drawings, graphic organizers, journals, summaries, oral reports, and technology-based reports. | Biotechnician 1a: Introduction | Unit 8: Experimental Design | Activity 3 |
| **(4) The student uses critical thinking, scientific reasoning, and problem solving to make informed decisions within and outside the classroom. The student is expected to:** | | | |
| (A) in all fields of science, analyze, evaluate, and critique scientific explanations by using empirical evidence, logical reasoning, and experimental and observational testing, including examining all sides of scientific evidence of those scientific explanations, so as to encourage critical thinking; | Biotechnician 1b: Advancements in Biotechnology | Unit 1: Genetics and Beyond: Epigenetics | Activity 1, Activity 2 |
| (B) communicate and apply scientific information extracted from various sources such as current events, news reports, published journal articles, and marketing materials; | Biotechnician 1b: Advancements in Biotechnology | Unit 6: Biotechnology in Agriculture and the Environment | Activity 2 |
| (C) draw inferences based on data related to promotional materials for products and services; | Biotechnician 1b: Advancements in Biotechnology | Unit 2: Stem Cells: Hope for the Future | Activity 3 |
| (D) evaluate the impact of research and technology on scientific thought, society, and the environment; | Biotechnician 1a: Introduction | Unit 5: The Molecule of Life | Lessons 1-2 |
| (E) evaluate models according to their limitations in representing biological objects or events; | Biotechnician 1a: Introduction | Unit 7: Genomics and Precision Medicine | Activity 2 |
| (F) describe the connection between biotechnology and future careers; and | Biotechnician 1a: Introduction | Unit 1: Introduction to Biotechnology | Activity 3 |
| (G) research and describe the history of biotechnology and contributions of scientists. | Biotechnician 1a: Introduction | Unit 1: Introduction to Biotechnology | Lesson 2 |
| **(5) The student explores the emerging field of biotechnology. The student is expected to:** | | | |
| (A) define biotechnology and provide examples of biotechnology products such as recombinant proteins, fermented foods, biopharmaceuticals, and genetically modified foods; | Biotechnician 1a: Introduction | Unit 1: Introduction to Biotechnology | Lesson 1 |

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| (B) apply scientific processes and concepts outlined in the Texas essential knowledge and skills (TEKS) for Biology relevant to biotechnology, including all types of cells; cellular structures and functions; and viruses; | Biotechnician 1a: Introduction | Unit 6: Gene Expression | Lessons 1-3 |
| (C) explore applications of bioinformatics such as deoxyribonucleic acid (DNA) barcoding, phylogenetic relationships, and the use of online databases; | Biotechnician 1a: Introduction | Unit 8: Experimental Design | Lessons 3-4 |
| (D) research career opportunities in fields such as molecular, forensic, medical, regulatory, and agricultural biotechnology; | Biotechnician 1a: Introduction | Unit 1: Introduction to Biotechnology | Lesson 5 |
| (E) research the history of biotechnology and contributions of scientists; | Biotechnician 1a: Introduction | Unit 1: Introduction to Biotechnology | Activity 1 |
| (F) define bioethics and research applications of bioethics; | Biotechnician 1a: Introduction | Unit 1: Introduction to Biotechnology | Lesson 4 |
| (G) research applications in agricultural biotechnology such as tissue culturing, genetically modified foods, plant propagation, and hydroponics; and | Biotechnician 1b: Advancements in Biotechnology | Unit 6: Biotechnology in Agriculture and the Environment | Lessons 1-3 |
| (H) research applications in medical biotechnology such as vaccines, stem cells, microarrays, and pharmaceutical production. | Biotechnician 1b: Advancements in Biotechnology | Unit 2: Stem Cells: Hope for the Future | Lesson 2 |
| | Biotechnician 1a: Introduction | Unit 7: Genomics and Precision Medicine | Lesson 3 |
| **(6) The student summarizes biotechnology laboratory procedures and their applications in the biotechnology industry. The student is expected to:** | | | |
| (A) identify the major sectors of the biotechnology industry; | Biotechnician 1a: Introduction | Unit 1: Introduction to Biotechnology | Lesson 3 |
| (B) categorize the biotechnology laboratory procedures included in each sector; and | Biotechnician 1a: Introduction | Unit 3: Biosafety and Sterility | Lesson 1 |
| (C) compare the different applications used in biotechnology laboratory procedures of each sector. | Biotechnician 1b: Advancements in Biotechnology | Unit 5: Model Organisms | All Lessons Associated |
| **(7) The student understands the role of genetics in the biotechnology industry. The student is expected to:** | | | |
| (A) explain terms related to molecular biology including nucleic acids, nitrogen bases, amino acids, transcription, translation, polymerase, and protein synthesis; | Biotechnician 1a: Introduction | Unit 5: The Molecule of Life | Lessons 1-2 |
| (B) describe the structure and function of deoxyribonucleic acid (DNA) and ribonucleic acid (RNA) in cells and viruses; | Biotechnician 1a: Introduction | Unit 5: The Molecule of Life | Lesson 2 |

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| (C) compare and contrast the nitrogen bases of DNA and RNA; | Biotechnician 1a: Introduction | Unit 5: The Molecule of Life | Lesson 2 |
| (D) explain how nucleotides join together to form a DNA double helix; | Biotechnician 1a: Introduction | Unit 5: The Molecule of Life | Lesson 2 |
| (E) describe the DNA replication process in eukaryotic and prokaryotic cells | Biotechnician 1a: Introduction | Unit 5: The Molecule of Life | Lesson 5 |
| (F) illustrate the process of protein synthesis; and | Biotechnician 1a: Introduction | Unit 6: Gene Expression | Lesson 2, Activity 1, Activity 2, Activity 3 |
| (G) describe the structure and function of proteins, including 3D folding, enzymes, and antibodies. | Biotechnician 1a: Introduction | Unit 6: Gene Expression | Lessons 3, 5 |
| **(8) The student analyzes the importance of recombinant DNA technology and genetic engineering. The student is expected to:** | | | |
| (A) describe the fundamental steps in recombinant DNA technology; | Biotechnician 1b: Advancements in Biotechnology | Unit 3: Genetic Engineering: The Dawn of CRISPR | Lesson 2 |
| (B) explain how recombinant DNA technology is used to clone genes and create recombinant proteins; | Biotechnician 1b: Advancements in Biotechnology | Unit 3: Genetic Engineering: The Dawn of CRISPR | Lessons 3-4 |
| (C) explain the role of tissue cultures to genetic modification procedures; | | | |
| (D) describe plant- and animal-tissue culture procedures; | | | |
| (E) compare and contrast proper growing conditions for plant and animal tissue cultures; | | | |
| (F) explain the role of restriction enzymes; | Biotechnician 1b: Advancements in Biotechnology | Unit 3: Genetic Engineering: The Dawn of CRISPR | Lesson 2 |
| (G) distinguish among vectors commonly used in biotechnology for DNA insertion, including plasmids, retroviruses, and bacteriophages; and | Biotechnician 1b: Advancements in Biotechnology | Unit 7: Starting Your Job in the Industry | Lesson 3 |
| (H) explain the steps and components of the polymerase chain reaction. | Biotechnician 1a: Introduction | Unit 5: The Molecule of Life | Lesson 6 |
| **(9) The student examines federal, state, local, and industry regulations as related to biotechnology. The student is expected to:** | | | |
| (A) discuss the relationship between the local, state, and federal agencies responsible for regulation of the biotechnology industry; and | Biotechnician 1b: Advancements in Biotechnology | Unit 2: Stem Cells: Hope for the Future | Lesson 2 |

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| (B) analyze policies and procedures used in the biotechnology industry such as quality assurance, standard operating procedures (SOPs), Good Manufacturing Practices (GMPs), and International Organization for Standardization (ISO) quality systems. | Biotechnician 1b: Advancements in Biotechnology | Unit 7: Starting Your Job in the Industry | Lesson 5 |
| | Biotechnician 1a: Introduction | Unit 3: Biosafety and Sterility | Lessons 1-2 |
| **(10) The student performs standard biotechnology laboratory procedures. The student is expected to:** | | | |
| (A) identify and operate laboratory equipment, including a microscope, thermocycler, hood, pH meter, hot plate stirrer, balance, mixers, autoclave, power supply, micropipette, centrifuge, and electrophoresis unit; | Biotechnician 1a: Introduction | Unit 4: Biotechnology By The Numbers | Lesson 4 |
| (B) practice measuring volumes and weights to industry standards; | Biotechnician 1a: Introduction | Unit 4: Biotechnology By The Numbers | Lesson 3 |
| (C) analyze data and perform calculations and statistical analysis as it relates to biotechnology laboratory experiments; | Biotechnician 1a: Introduction | Unit 4: Biotechnology By The Numbers | Lesson 1 |
| (D) demonstrate proficiency pipetting techniques; | Biotechnician 1a: Introduction | Unit 4: Biotechnology By The Numbers | Lesson 3 |
| (E) identify microorganisms using staining methods such as the Gram stain, methylene-blue stain, and acid-fast staining; | | | |
| (F) document laboratory results; and | Biotechnician 1a: Introduction | Unit 5: The Molecule of Life | Activity 3 |
| (G) prepare a restriction digest and analyze results using gel electrophoresis. | Biotechnician 1a: Introduction | Unit 5: The Molecule of Life | Activity 1, Activity 2 |
| **(11) The student prepares solutions and reagents for the biotechnology laboratory. The student is expected to:** | | | |
| (A) demonstrate techniques for establishing and maintaining a sterile work area; | Biotechnician 1a: Introduction | Unit 3: Biosafety and Sterility | Lesson 3 |
| (B) prepare, dispense, and monitor physical properties of stock reagents, buffers, media, and solutions; | Biotechnician 1a: Introduction | Unit 4: Biotechnology By The Numbers | Lesson 2 |
| (C) calculate and prepare a dilution series; and | Biotechnician 1a: Introduction | Unit 4: Biotechnology By The Numbers | Lesson 2 |
| (D) determine optimum conditions of reagents for experimentation. | | | |
| **(12) The student performs advanced biotechnology laboratory procedures. The student is expected to:** | | | |
| (A) explain the importance of media components to the outcome of cultures; | | | |

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| (B) isolate, maintain, and store microbial cultures safely; | | | |
| (C) prepare seed inoculum; | | | |
| (D) perform plating techniques such as the Kirby-Bauer method; | | | |
| (E) analyze proteins using techniques such as enzyme-linked immunosorbent assay (ELISA), spectrophotometry, and sodium dodecyl sulfate polyacrylamide gel electrophoresis (SDS-PAGE); | Biotechnician 1a: Introduction | Unit 6: Gene Expression | Lesson 4 |
| (F) isolate a specific protein from a biological sample using chromatography; | Biotechnician 1a: Introduction | Unit 6: Gene Expression | Lesson 4 |
| (G) isolate nucleic acids and interpret gel electrophoresis results; | Biotechnician 1a: Introduction | Unit 5: The Molecule of Life | Lesson 4 |
| (H) perform a bacterial transformation and analyze gene expression; and | | | |
| (I) amplify a DNA sequence using the polymerase chain reactions. | Biotechnician 1a: Introduction | Unit 5: The Molecule of Life | Lesson 6 |
| **(13) The student conducts quality-control analysis while performing biotechnology laboratory procedures. The student is expected to:** | | | |
| (A) perform validation testing on laboratory reagents and equipment; and | Biotechnician 1b: Advancements in Biotechnology | Unit 7: Starting Your Job in the Industry | Lesson 4 |
| (B) analyze data and perform calculations and statistical analysis on results of quality-control samples such as trending of data. | | | |