**Course Title: Biotechnician 2a/2b**

**State: TX**
**State Course Title: Biotechnology II**
**Sate Course Code: 127.757**
**State Standards: Texas Essential Knowledge and Skills for Career Development and Career and Technical Education**
**Date of Standards: 2015**

| TEKS | 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 2A | Unit 1: Managing a Biotech Laboratory | Lesson 2 |
| (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 2A | Unit 1: Managing a Biotech Laboratory | Lesson 2 |
| (C) present written and oral communication in a clear, concise, and effective manner; | Biotechnician 2B | Unit 8: Planning Your Biotech Career | Lesson 1, 3 |
| (D) demonstrate time-management skills in prioritizing tasks, following schedules, and performing goal-relevant activities in a way that produces efficient results; and | Biotechnician 2B | Unit 7: Biotechnology Companies | Activity |
| (E) demonstrate punctuality, dependability, reliability, and responsibility in performing assigned tasks as directed. | Biotechnician 2B | Unit 8: Planning Your Biotech Career | Activity |
| **(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; and | Biotechnician 2A | Unit 1: Managing a Biotech Laboratory | Lesson 1 |
| (B) demonstrate an understanding of the use and conservation of resources and the proper disposal or recycling of materials. | Biotechnician 2A | Unit 1: Managing a Biotech Laboratory | Lesson 4 |
| **(3) The student uses scientific methods and equipment during laboratory and field investigations. The student is expected to:** | | | |

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| (A) know the definition of science and understand that it has limitations, as specified in subsection (b)(4) of this section; | Biotechnician 2A | Unit 2: Experimental Design | Lesson 1 |
| (B) know that scientific 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 2A | Unit 2: 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 may be subject to change as new areas of science and new technologies are developed; | Biotechnician 2A | Unit 2: Experimental Design | Lesson 1 |
| (D) distinguish between scientific hypotheses and scientific theories; | | | |
| (E) plan and implement investigative procedures, including making observations, asking well-defined questions, formulating testable hypotheses, identifying variables, selecting appropriate equipment and technology, and evaluating numerical answers for reasonableness; | Biotechnician 2A | Unit 2: Experimental Design | Activity |
| (F) collect and organize qualitative and quantitative data and make measurements with accuracy and precision using tools such as calculators, spreadsheet software, data-collecting probes, computers, standard laboratory glassware, microscopes, various prepared slides, stereoscopes, metric rulers, electronic balances, gel electrophoresis apparatuses, micro pipettors, hand lenses, Celsius thermometers, hot plates, lab notebooks or journals, timing devices, cameras, and meter sticks; | Biotechnician 2A | Unit 2: Experimental Design | Activity |
| (G) analyze, evaluate, make inferences, and predict trends from data; | Biotechnician 2A | Unit 2: Experimental Design | Activity |
| (H) identify and quantify causes and effects of uncertainties in measured data; | Biotechnician 2A | Unit 2: Experimental Design | Lesson 2 |
| (I) organize and evaluate data and make inferences from data, including the use of tables, charts, and graphs; and | Biotechnician 2B | Unit 5: Artificial Intelligence and Precision Medicine | Activity |
| (J) communicate valid conclusions supported by the data through various methods such as lab reports, labeled drawings, graphic organizers, journals, summaries, oral reports, and technology-based reports. | Biotechnician 2B | Unit 6: CRISPR and Agricultural Sciences | Activity |
| **(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:** | | | |

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| (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 2B | Unit 5: Artificial Intelligence and Precision Medicine | Activity |
| (B) communicate and apply scientific information extracted from various sources such as current events, news reports, published journal articles, and marketing materials; | Biotechnician 2B | Unit 2: Genetic Testing | Activity |
| (C) draw inferences based on data related to promotional materials for products and services; | Biotechnician 2B | Unit 6: CRISPR and Agricultural Sciences | Activity |
| (D) explain the impacts of the scientific contributions of a variety of historical and contemporary scientists on scientific thought and society; | Biotechnician 2B | Unit 1: Genetic Diseases and Gene Therapy | Lesson 1 |
| (E) evaluate models according to their limitations in representing biological objects or events; | Biotechnician 2B | Unit 3: The Era of Biological Drugs | Activity |
| (F) research and describe the connections between science and future careers; and | Biotechnician 2B | Unit 8: Planning Your Biotech Career | Lessons 1-4 |
| (G) express and interpret relationships symbolically to make predictions and solve problems mathematically, including problems requiring proportional reasoning and graphical vector addition. | Biotechnician 2A | Unit 2: Experimental Design | Lessons 2, 5 |
| **(5) The student formulates hypotheses to guide investigation and data collection. The student is expected to:** | | | |
| (A) perform background research with respect to an investigative problem; and | Biotechnician 2B | Unit 6: CRISPR and Agricultural Sciences | Activity |
| (B) examine hypotheses generated to guide a research process by evaluating the merits and feasibility of the hypotheses. | Biotechnician 2B | Unit 6: CRISPR and Agricultural Sciences | Activity |
| **(6) The student analyzes published research. The student is expected to:** | | | |
| (A) identify the scientific methodology used by a researcher; | Biotechnician 2A | Unit 2: Experimental Design | Lesson 1 |
| (B) examine a prescribed research design and identify dependent and independent variables; | Biotechnician 2A | Unit 2: Experimental Design | Lesson 2 |
| (C) evaluate a prescribed research design to determine the purpose for each of the procedures performed; and | Biotechnician 2A | Unit 2: Experimental Design | Lesson 2 |

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| (D) determine if the data and conclusion support the hypothesis. | Biotechnician 2A | Unit 2: Experimental Design | Lesson 2 |
| **(7) The student develops and implements appropriate investigative designs. The student is expected to:** | | | |
| (A) interact and collaborate with scientific researchers or other members of the scientific community to complete a research project; | Biotechnician 2A | Unit 4: Preparing Solutions | Activity |
| (B) identify and manipulate relevant variables within research situations; | Biotechnician 2A | Unit 4: Preparing Solutions | Activity |
| (C) use a control in an experimental process; and | Biotechnician 2A | Unit 4: Preparing Solutions | Activity |
| (D) design procedures to test hypotheses. | Biotechnician 2A | Unit 5: Bacteria in Biotechnology | Activity |
| **(8) The student collects, organizes, and evaluates qualitative and quantitative data obtained through experimentation. The student is expected to:** | | | |
| (A) differentiate between qualitative and quantitative data; | Biotechnician 2A | Unit 2: Experimental Design | Lesson 3 |
| (B) acquire, manipulate, and analyze data using appropriate equipment and technology, following the rules of significant digits; | Biotechnician 2A | Unit 8: Purification of Proteins | Activity |
| (C) identify sources of random error and systematic error and differentiate between both types of error; | | | |
| (D) report error of a set of measured data in various formats, including standard deviation and percent error; | Biotechnician 2A | Unit 3: The Spectrophotometer and the Microscope | Lesson 3 |
| (E) construct data tables to organize information collected in an experiment; | Biotechnician 2A | Unit 2: Experimental Design | Lesson 4 |
| (F) record observations as they occur within an investigation; and | Biotechnician 2A | Unit 5: Bacteria in Biotechnology | Activity |
| (G) evaluate data using statistical methods to recognize patterns, trends, and proportional relationships. | Biotechnician 2A | Unit 2: Experimental Design | Lesson 2 |
| **(9) The student knows how to synthesize valid conclusions from qualitative and quantitative data. The student is expected to:** | | | |

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| (A) synthesize and justify conclusions supported by research data; | Biotechnician 2B | Unit 6: CRISPR and Agricultural Sciences | Activity |
| (B) consider and communicate alternative explanations for observations and results; and | Biotechnician 2A | Unit 2: Experimental Design | Lesson 5 |
| (C) identify limitations within the research process and provide recommendations for additional research. | Biotechnician 2A | Unit 2: Experimental Design | Lesson 5 |
| **(10) The student communicates conclusions clearly and concisely to an audience of professionals. The student is expected to:** | | | |
| (A) communicate experimental results clearly and effectively, including oral presentation of original findings of a research project to an audience of peers and professionals; and | Biotechnician 2B | Unit 4: Personalized Medicine | Activity |
| (B) suggest alternative explanations from observations or trends evident within the data or from prompts provided by a review panel. | Biotechnician 2A | Unit 4: Preparing Solutions | Activity |
| **(11) The student explores assay design in the field of biotechnology. The student is expected to:** | | | |
| (A) define assay requirements and optimizations; | Biotechnician 2A | Unit 3: The Spectrophotometer and the Microscope | Lesson 5 |
| (B) perform statistical analysis on assay design and experimental data such as linearity, system sustainability, limit of detection, and R2 values; | Biotechnician 2A | Unit 3: The Spectrophotometer and the Microscope | Lesson 5 |
| (C) determine an unknown protein concentration using techniques such as a standard curve and a spectrophotometer; and | Biotechnician 2A | Unit 3: The Spectrophotometer and the Microscope | Lesson 5 |
| (D) use a colorimetric assay to evaluate enzyme kinetics. | Biotechnician 2A | Unit 3: The Spectrophotometer and the Microscope | Lesson 5 |
| **(12) The student explores protein expression systems in the field of biotechnology. The student is expected to:** | | | |
| (A) perform a recombinant protein production such as green fluorescent protein (GFP); | Biotechnician 2A | Unit 3: The Spectrophotometer and the Microscope | Lesson 2 |
| (B) isolate a protein from a biological sample using hydrophobic interaction column chromatography; and | Biotechnician 2A | Unit 3: The Spectrophotometer and the Microscope | Lesson 5 |
| (C) analyze protein purification methods using spectrophotometry, sodium dodecyl sulfate polyacrylamide gel electrophoresis (SDS-PAGE) and Western blotting. | Biotechnician 2A | Unit 3: The Spectrophotometer and the Microscope | Lessons 1, 2, 3, 5 |

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| **(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; | Biotechnician 2A | Unit 1: Managing a Biotech Laboratory | Lesson 2 |
| (B) analyze data and perform calculations and statistical analysis on results of quality-control samples such as trending of data; and | Biotechnician 2A | Unit 8: Purification of Proteins | Activity |
| (C) apply and create industry protocols such as standard operating procedures (SOPs) and validation forms. | Biotechnician 2A | Unit 1: Managing a Biotech Laboratory | Lesson 1 |
| **(14) 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 2A | Unit 4: Preparing Solutions | Lesson 5 |
| (B) prepare, dispense, and monitor physical properties of stock reagents, buffers, media, and solutions; | Biotechnician 2A | Unit 4: Preparing Solutions | Lessons 2, 5 |
| (C) calculate and prepare a dilution series; | Biotechnician 2A | Unit 4: Preparing Solutions | Lesson 4 |
| (D) determine acceptability and optimum conditions of reagents for experimentation; and | | | |
| (E) prepare multi-component solutions of given molarity or concentration and volume. | Biotechnician 2A | Unit 4: Preparing Solutions | Lesson 1 |