Scope & Sequence

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| **Course Name:** Scientific Research and Design  **TSDS PEIMS Code:** 13037200 (First Time Taken)  13037210 (Second Time Taken)  13037220 (Third Time Taken) | | **Course Credit:** 1.0  **Course Requirements:** Recommended for students in Grades 11-12.  **Prerequisites:** Biology, Chemistry, Integrated Physics and Chemistry (IPC), or Physics. |
| **Course Description:** Scientific Research and Design is a broad-based course designed to allow districts and schools considerable flexibility to develop local curriculum to supplement any program of study or coherent sequence. The course has the components of any rigorous scientific or engineering program of study from the problem identification, investigation design, data collection, data analysis, formulation, and presentation of the conclusions. All of these components are integrated with the career and technical education emphasis of helping students gain entry-level employment in high-skill, high-wage jobs and/or continue their education. Students must meet the 40% laboratory and fieldwork requirement. This course satisfies a high school science graduation requirement. Students shall be awarded one credit for successful completion of this course. Students may take this course with different course content for a maximum of three credits. | | |
| **NOTE:** This is a suggested scope and sequence for the course content. This content will work with any textbook or instructional materials. If locally adapted, make sure all TEKS are covered. | | |
| **Total Number of Periods**  **Total Number of Minutes**  **Total Number of Hours** | 175 Periods  7875 Minutes  131.25 Hours | \*Schedule calculations based on 175/180 calendar days. For 0.5 credit courses, schedule is calculated out of 88/90 days. Scope and sequence allows additional time for guest speakers, student presentations, field trips, remediation, extended learning activities, etc. |

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| **Unit Number, Title, and Brief Description** | **# of Class Periods\***  (assumes 45-minute periods)  Total minutes per unit | **TEKS Covered**  **130.417. (c) Knowledge and skills** |
| **Unit 1: What is Science?**  To understand STEM (Science, Technology, Engineering, and Math) principles of technology, students must first understand what Science is. Career and technical education instruction provides content aligned with challenging academic standards and relevant technical knowledge and skills for students to further their education and succeed in current or emerging professions. In this unit, the student will define science and its limitations. The culminating activity for this unit will have students distinguish between scientific hypotheses and scientific theories and design and implement investigative procedures. | 16 Periods  720 Minutes | (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 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;  (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;  (D) distinguish between scientific hypotheses and scientific theories;  (E) plan and implement descriptive, comparative, and experimental 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. |
| **Unit 2: Laboratory and Field Investigations**  The STEM Career Cluster focuses on planning, managing, and providing scientific research and professional and technical services, including laboratory and testing services, and research and development services. In this unit, students will gather, organize, and measure various technological data using a variety of equipment. The culminating activity will have students evaluate the data and communicate their conclusions and inferences through various methods such as lab reports, labeled drawings, graphic organizers, journals, summaries, and oral reports. | 16 Periods  720 Minutes | (3) The student uses scientific methods and equipment during laboratory and field investigations. The student is expected to:  (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, micropipettors, hand lenses, Celsius thermometers, hot plates, lab notebooks or journals, timing devices, cameras, and meter sticks;  (G) analyze, evaluate, make inferences, and predict trends from data;  (H) identify and quantify causes and effects of uncertainties in measured data;  (I) organize and evaluate data and make inferences from data, including the use of tables, charts, and graphs; and  (J) communicate valid conclusions supported by the data through methods such as lab reports, labeled drawings, graphic organizers, journals, summaries, oral reports, and technology-based reports. |
| **Unit 3: Safety Precautions and Ethical Practices**  In this unit, students will comply with federal and state safety regulations. Students will identify and obey safety guidelines. The culminating activity will have students demonstrate appropriate safety and ethical procedures, including the proper disposal or recycling of materials. | 15 Periods  675 Minutes | (2) The student, for at least 40% of instructional time, conducts laboratory and field investigations using safe, environmentally appropriate, and ethical practices. The student is expected to:  (A) demonstrate safe practices during laboratory and field investigations; and  (B) demonstrate an understanding of the use and conservation of resources and the proper disposal or recycling of materials. |
| **Unit 4: Scientific Reasoning**  Scientific inquiry is the planned and deliberate investigation of the natural world. Scientific methods of investigation can be experimental, descriptive, or comparative. The method chosen should be appropriate to the question being asked. In this unit, students will use critical thinking, scientific reasoning, and problem solving to make informed decisions about information extracted from various sources such as news reports, articles and social media. The unit will culminate with an activity where students will explain the connections between science and future careers. | 16 Periods  720 Minutes | (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;  (B) communicate and apply scientific information extracted from various sources such as current events, news reports, published journal articles, and marketing materials;  (C) draw inferences based on data related to promotional materials for products and services;  (D) explain the impacts of the scientific contributions of a variety of historical and contemporary scientists on scientific thought and society;  (E) evaluate models according to their limitations in representing biological objects or events;  (F) research and describe the connections between science and future careers; and  (G) express and interpret relationships symbolically to make predictions and solve problems mathematically, including problems requiring proportional reasoning and graphical vector addition. |
| **Unit 5: Formulating hypotheses**  In this unit, students will examine hypotheses generated to guide a research process by evaluating the merits and feasibility of the hypotheses. | 16 Periods  720 Minutes | (5) The student formulates hypotheses to guide experimentation and data collection. The student is expected to:  (A) perform background research with respect to an investigative problem; and  (B) examine hypotheses generated to guide a research process by evaluating the merits and feasibility of the hypotheses. |
| **Unit 6: Analysis of Public Research**  In this unit, students will build upon the prior unit and perform functions such as identifying the scientific methodology used by researchers. The unit culminates with an activity in which students evaluate a prescribed research design to determine the purpose for each of the procedures performed. | 16 Periods  720 Minutes | (6) The student analyzes published research. The student is expected to:  (A) identify the scientific methodology used by a researcher;  (B) examine a prescribed research design and identify dependent and independent variables;  (C) evaluate a prescribed research design to determine the purpose for each of the procedures performed; and  (D) compare the relationship of the hypothesis to the conclusion. |
| **Unit 7: Investigative Designs**  Science, as defined by the National Academy of Sciences, is the "use of evidence to construct testable explanations and predictions of natural phenomena, as well as the knowledge generated through this process." This vast body of changing and increasing knowledge as described by physical, mathematical, and conceptual models. Students should know that some questions are outside the realm of science because they deal with phenomena that are not scientifically testable. In this unit, students will interact with the community and perform functions such as collaborating with scientific researchers or other members of the scientific community to complete a research project. Students will summarize their findings design procedures to test hypotheses. | 16 Periods  720 Minutes | (7) The student develops and implements 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;  (B) identify and manipulate relevant variables within research situations;  (C) use a control in an experimental process; and  (D) design procedures to test hypotheses. |
| **Unit 8: Data Examined**  A system is a collection of cycles, structures, and processes that interact. All systems have basic properties that can be described in terms of space, time, energy, and matter. Change and constancy occur in systems as patterns and can be observed, measured, and modeled. These patterns help to make predictions that can be scientifically tested. Students should analyze a system in terms of its components and how these components relate to each other, to the whole, and to the external environment. In this unit, students will perform functions such as differentiating between data and manipulating following the rules of significant digits. The culminating activity for this unit will have students present data tables reflecting trends and patterns and proportional relationships. | 16 Periods  720 Minutes | (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;  (B) record observations as they occur within an investigation;  (C) acquire, manipulate, and analyze data using appropriate equipment and technology, following the rules of significant digits;  (D) identify sources of random error and systematic error and differentiate between both types of error;  (E) report error of a set of measured data in various formats, including standard deviation and percent error;  (F) construct data tables to organize information collected in an experiment; and  (G) evaluate data using statistical methods to recognize patterns, trends, and proportional relationships. |
| **Unit 9: Filtering and Synthesis of Data**  Scientific decision-making is a way of answering questions about the natural world. Students should be able to distinguish between scientific decision-making methods (science methods) and ethical and social decisions that involve science (the application of scientific information). In this unit, students will participate in activities such as synthesizing and justifying conclusions supported by research data. The culminating activity for this unit will have students identify limitations within the research process and provide recommendations for additional research. | 16 Periods  720 Minutes | (9) The student knows how to synthesize valid conclusions from qualitative and quantitative data. The student is expected to:  (A) synthesize and justify conclusions supported by research data;  (B) consider and communicate alternative explanations for observations and results; and  (C) identify limitations within the research process and provide recommendations for additional research. |
| **Unit 10: Presenting the Facts**  Students will get real world experience in this unit as they present upon conclusions derived using materials such as charts, tables and graphs with the use of technology. The culminating activity for this unit will be for students to suggest alternative explanations from observations or trends evident within the data or from prompts provided by a review panel. | 16 Periods  720 Minutes | (10) The student communicates conclusions clearly and concisely to an audience of professionals. The student is expected to:  (A) construct charts, tables, and graphs using technology in order to facilitate data analysis and to communicate experimental results clearly and effectively, including oral presentation of original findings of a research project, to an audience of peers and professionals; and  (B) suggest alternative explanations from observations or trends evident within the data or from prompts provided by a review panel. |
| **Unit 11: Employability Skills**  This unit offers students basic technical skills necessary to fulfill careers in the workforce. In this unit, students are encouraged to expand their learning experiences through avenues such as STEM organizations and other leadership or extracurricular organizations. By connecting with these networks, students will be able to show their ability to cooperate, contribute, and collaborate as a member of a group in an effort to achieve a positive collective outcome in the field of technology. Through group activities, students will demonstrate interpersonal skills, such as: communication, cooperation, professionalism, efficiency and dependability. The unit culminates with a peer review evaluation and reflection upon skills needed for success in the workforce. | 16 Periods  720 Minutes | (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;  (B) show the ability to cooperate, contribute, and collaborate as a member of a group in an effort to achieve a positive collective outcome;  (C) present written and oral communication in a clear, concise, and effective manner;  (D) demonstrate time-management skills in prioritizing tasks, following schedules, and performing goal-relevant activities in a way that produces efficient results; and  (E) demonstrate punctuality, dependability, reliability, and responsibility in performing assigned tasks as directed. |