ATTACHMENT
Text of Proposed New 19 TAC

Chapter 127. Texas Essential Knowledge and Skills for Career Development and Career and Technical Education

Subchapter C. Agriculture, Food, and Natural Resources

§127.30. Principles of Agriculture, Food, and Natural Resources (One Credit), Adopted 2024.

(a) Implementation. The provisions of this section shall be implemented by school districts beginning with the 2025-2026 school year.

(b) General requirements. This course is recommended for students in Grades 9-12. Students shall be awarded one credit for successful completion of this course.

(c) Introduction.

(1) 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.

(2) The Agriculture, Food, and Natural Resources Career Cluster focuses on the production, processing, marketing, distribution, financing, and development of agricultural commodities and resources, including food, fiber, wood products, natural resources, horticulture, and other plant and animal products and resources.

(3) In Principles of Agriculture, Food, and Natural Resources, students explore major areas of agriculture, food, and natural resources, including organizations, agribusiness leadership and communications, plant science, animal science, food science and technology, agricultural technology and mechanical systems, and environmental and natural resources. To prepare for careers in agriculture, food, and natural resources, students must attain academic knowledge and skills, acquire technical knowledge and skills related to the workplace, and develop knowledge and skills regarding career opportunities, entry requirements, and industry expectations. To prepare for success, students need opportunities to learn, reinforce, experience, apply, and transfer their knowledge and skills in a variety of settings.

(4) Students are encouraged to participate in extended learning experiences such as career and technical student organizations and other leadership or extracurricular organizations.

(5) Statements that contain the word "including" reference content that must be mastered, while those containing the phrase "such as" are intended as possible illustrative examples.

(d) Knowledge and skills.

(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:

(A) identify career development, education, and entrepreneurship opportunities in agriculture, food, and natural resources;

(B) identify and demonstrate interpersonal, problem-solving, and critical-thinking skills in agriculture, food, and natural resources;

(C) describe and demonstrate appropriate personal and occupational safety and health practices for the workplace;

(D) identify employers' expectations, including appropriate work habits, ethical conduct, and legal responsibilities;

(E) describe and demonstrate characteristics of good citizenship such as stewardship, advocacy, and community leadership; and

(F) identify training, education, and certification requirements for occupational choices in agriculture, food, and natural resources.

(2) The student develops a supervised agricultural experience program. The student is expected to:

(A) plan, propose, conduct, document, and evaluate a supervised agricultural experience program as an experiential learning activity;

(B) use appropriate record-keeping skills in a supervised agricultural experience program;

(C) participate in youth agricultural leadership opportunities;

(D) review and participate in a local program of activities; and

(E) create or update documentation of relevant agricultural experience such as community service, professional, or classroom experiences.

(3) The student identifies the impact of the agriculture industry in Texas and the United States. The student is expected to:

(A) identify top agricultural commodities, exports, and imports in Texas and the United States; and

(B) identify regions of commodity production such as corn, wheat, dairy, cattle, and cotton and explain the correlation between the region and the commodity.

(4) The student explains the historical, current, and future significance of the agriculture, food, and natural resources industry. The student is expected to:

(A) define agriculture and identify the sectors of the agriculture industry;

(B) analyze the impact agriculture, food, and natural resources have on society;

(C) identify and explain significant historical and current events that have impacted the agriculture industry;

(D) identify future scenarios, including potential global impacts for agriculture, food, and natural resources systems;

(E) describe how emerging technologies such as online mapping systems, drones, and robotics impact agriculture, food, and natural resources; and

(F) compare issues impacting agriculture, food, and natural resources such as biotechnology, employment, safety, environment, and animal welfare issues.

(5) The student understands opportunities for leadership development in student organizations within agriculture, food, and natural resources. The student is expected to:

(A) identify the history, structure, and development of and opportunities in the agriculture, food, and natural resources student organization(s);

(B) develop and demonstrate leadership and personal growth skills and collaborate with others to accomplish organizational goals and objectives; and

(C) demonstrate use of parliamentary procedures when conducting meetings.

(6) The student identifies opportunities for involvement in professional agricultural organizations. The student is expected to:

(A) discuss the role of agricultural organizations in formulating public policy;

(B) develop strategies for effective participation in agricultural organizations; and

(C) identify and discuss the purpose of various professional agricultural organizations.

(7) The student demonstrates skills related to agribusiness, leadership, and communications. The student is expected to:

(A) demonstrate written and oral communication skills appropriate for formal and informal situations such as prepared and extemporaneous presentations;

(B) identify and demonstrate effective customer service skills, including appropriate listening techniques and responses; and

(C) explain the impact of marketing and advertising on the agricultural industry.

(8) The student applies a scientific process to agriculture, food, and natural resources topics. The student is expected to:

(A) identify and discuss major innovations in the fields of agriculture, food, and natural resources;

(B) identify and select an important agricultural issue, question, or principle;

(C) develop and test a hypothesis for the selected topic;

(D) collect and analyze data for the selected agricultural issue, question, or principle; and

(E) present findings and conclusions based on research performed using scientific practices.

(9) The student applies problem-solving, mathematical, and organizational skills to maintain financial or logistical records. The student is expected to:

(A) identify the components of and develop a formal business plan for an agricultural enterprise; and

(B) develop, maintain, and analyze records for an agricultural enterprise.

(10) The student develops technical knowledge and skills related to plant and soil systems. The student is expected to:

(A) define plant and soil science and analyze the relevance of horticulture, agronomy, forestry, and floriculture;

(B) identify the components and properties of soils;

(C) describe the basic structure and functions of plant parts;

(D) identify and apply techniques related to plant germination, growth, and development; and

(E) identify and use tools, equipment, and personal protective equipment common to plant and soil systems.

(11) The student develops technical knowledge and skills related to animal systems. The student is expected to:

(A) define animal science and analyze the relevance of selection, production, and marketing in the industry;

(B) define the roles and benefits of animals in agriculture;

(C) identify basic external anatomy of animals in agriculture;

(D) identify and classify breeds of livestock; and

(E) identify and use tools, equipment, and proper handling techniques related to animal systems.

(12) The student describes the principles of food products and processing systems. The student is expected to:

(A) identify food products and processing systems;

(B) identify emerging technologies and trends in global food production;

(C) compare various food labels;

(D) discuss current issues in food production; and

(E) use tools, equipment, and personal protective equipment common to food products and processing systems.

(13) The student safely performs skills related to agricultural technology and mechanical systems. The student is expected to:

(A) identify the major disciplines of agricultural technology and mechanical systems;

(B) demonstrate basic measuring practices with accuracy;

(C) create a bill of materials and a technical drawing for a proposed agricultural engineering project;

(D) identify common building tools, materials, and fasteners; and

(E) identify and use tools, equipment, and personal protective equipment common to agricultural technology and mechanical systems.

(14) The student explains the principles of environmental and natural resources. The student is expected to:

(A) identify natural resources of economic importance to Texas agriculture;

(B) explain the relationship between agriculture and environmental and natural resources;

(C) identify and describe regulations and governmental programs related to environmental and natural resources, including water regulations, pesticide usage, and hunting and fishing laws;

(D) identify and compare alternative energy sources that stem from or impact environmental and natural resources; and

(E) identify and compare energy and water conservation methods.

§127.45. Professional Standards and Communication in Agribusiness (One Credit), Adopted 2024.

(a) Implementation. The provisions of this section shall be implemented by school districts beginning with the 2025-2026 school year.

(b) General requirements. This course is recommended for students in Grades 10-12. Recommended prerequisite: Principles of Agriculture, Food, and Natural Resources. Students shall be awarded one credit for successful completion of this course.

(c) Introduction.

(1) 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.

(2) The Agriculture, Food, and Natural Resources Career Cluster focuses on the production, processing, marketing, distribution, financing, and development of agricultural commodities and resources, including food, fiber, wood products, natural resources, horticulture, and other plant and animal products/resources.

(3) Professional Standards and Communication in Agribusiness focuses on leadership, communication, employer-employee relations, and problem solving as they relate to agribusiness. To prepare for careers in agribusiness systems, students must attain academic knowledge and skills, acquire technical knowledge and skills related to leadership development and communications in agriculture, and develop knowledge and skills regarding agricultural career opportunities, entry requirements, and industry expectations. To prepare for success, students need opportunities to learn, reinforce, apply, and transfer their knowledge and skills in a variety of settings.

(4) Students are encouraged to participate in extended learning experiences such as career and technical student organizations and other leadership or extracurricular organizations.

(5) Statements that contain the word "including" reference content that must be mastered, while those containing the phrase "such as" are intended as possible illustrative examples.

(d) Knowledge and skills.

(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:

(A) identify career development, education, and entrepreneurship opportunities in the field of agribusiness;

(B) identify and demonstrate interpersonal, problem-solving, and critical-thinking skills used in agriculture, food, and natural resources industries;

(C) describe and demonstrate appropriate personal and occupational safety and health practices for the workplace;

(D) identify employers' expectations, including appropriate work habits, ethical conduct, and legal responsibilities;

(E) describe and demonstrate characteristics of good citizenship such as stewardship, advocacy, and community leadership; and

(F) identify training, education, and certification requirements for occupational choices.

(2) The student develops a supervised agricultural experience program. The student is expected to:

(A) plan, propose, conduct, document, and evaluate a supervised agricultural experience program as an experiential learning activity;

(B) apply proper record-keeping skills as they relate to the supervised agricultural experience;

(C) participate in youth agricultural leadership opportunities;

(D) review and participate in a local program of activities; and

(E) create or update documentation of relevant agricultural experience such as community service, professional, or classroom experiences.

(3) The student analyzes the professional development skills needed to be an effective leader in agribusiness. The student is expected to:

(A) describe the importance of positive self-concept, social skills, and maintaining a professional image;

(B) identify various leadership styles;

(C) prepare personal resumes, letters of interest, employment applications, and follow-up communications related to the hiring process; and

(D) explain the interpersonal skills needed to work cooperatively with others from different cultures, genders, and backgrounds.

(4) The student evaluates employer and employee responsibilities for occupations in agriculture, food, and natural resources. The student is expected to:

(A) identify and discuss work-related and agribusiness-related ethics;

(B) identify and practice job interview skills; and

(C) outline complaint and appeal processes in the workplace.

(5) The student communicates effectively through various mediums with groups and individuals. The student is expected to:

(A) identify elements of communication such as accuracy, relevance, rhetoric, and organization in informal, group discussions; formal presentations; and business-related, technical communication;

(B) describe how the style and content of spoken language varies in different contexts and can influence the listener's understanding;

(C) evaluate aspects of presentations such as delivery, vocabulary, length, and purpose and modify based on audience;

(D) identify elements of appropriate professional communications in agribusiness such as correct usage of grammar and punctuation;

(E) demonstrate the importance of communicating factual and unbiased data and information obtained from reliable sources;

(F) identify and demonstrate effective nonverbal communication skills and listening strategies; and

(G) discuss the importance of relationships and group organization.

(6) The student understands the dynamics of group collaboration. The student is expected to:

(A) define the significance of personal and group goals;

(B) apply various leadership traits to solve problems when leading a group;

(C) discuss the importance of time management and teamwork;

(D) outline the steps in the decision-making and problem-solving processes; and

(E) demonstrate a working knowledge of parliamentary procedures.

(7) The student applies principles of design in visual media as they relate to agriculture. The student is expected to:

(A) explain the purpose of visual media;

(B) identify principles of design for visual media;

(C) create designs such as web design or print design for a targeted purpose in agribusiness; and

(D) interpret, evaluate, and justify artistic decisions in visual media related to agribusiness.

(8) The student demonstrates journalistic writing in agriculture. The student is expected to:

(A) differentiate between news, feature, and opinion writing;

(B) identify different forms of journalistic writing such as feature story, press release, and editorials; and

(C) create different forms of journalistic writing for a topic in agribusiness using the drafting process, including layout, selection, revisions, and editing.

(9) The student identifies new media being used in agriculture. The student is expected to:

(A) identify effective use of emerging technology in agricultural communications;

(B) propose a media campaign for an agricultural product or business;

(C) distinguish between appropriate and inappropriate uses of media; and

(D) practice digital citizenship.

(10) The student examines media laws and ethics related to agricultural communications. The student is expected to:

(A) define free speech, free press, defamation, and libel within communications;

(B) apply media laws to agricultural communications;

(C) identify and discuss ethical considerations related to media; and

(D) evaluate and practice safe, legal, and responsible use of communication technologies.

(11) The student examines crisis management and risk communication in agricultural communications. The student is expected to:

(A) differentiate between crisis and risk communication;

(B) create an outline for a crisis communication plan in agriculture; and

(C) analyze communication techniques, relevant communication networks, and organization communication strategies before, during, and after a crisis.

§127.46. Agribusiness Management and Marketing (One Credit), Adopted 2024.

(a) Implementation. The provisions of this section shall be implemented by school districts beginning with the 2025-2026 school year.

(b) General requirements. This course is recommended for students in Grades 10-12. Recommended prerequisite: Principles of Agriculture, Food, and Natural Resources. Students shall be awarded one credit for successful completion of this course.

(c) Introduction.

(1) 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.

(2) The Agriculture, Food, and Natural Resources Career Cluster focuses on the production, processing, marketing, distribution, financing, and development of agricultural commodities and resources, including food, fiber, wood products, natural resources, horticulture, and other plant and animal products/resources.

(3) Agribusiness Management and Marketing is designed to provide a foundation to agribusiness management and the free enterprise system. Instruction includes the use of economic principles such as supply and demand, budgeting, record keeping, finance, risk management, business law, marketing, and careers in agribusiness. To prepare for careers in agribusiness systems, students must attain academic skills and knowledge, acquire technical knowledge and skills related to agribusiness marketing and management and the workplace, and develop knowledge and skills regarding career opportunities, entry requirements, and industry expectations. To prepare for success, students need opportunities to learn, reinforce, apply, and transfer their knowledge and skills in a variety of settings.

(4) Students are encouraged to participate in extended learning experiences such as career and technical student organizations and other leadership or extracurricular organizations.

(5) Statements that contain the word "including" reference content that must be mastered, while those containing the phrase "such as" are intended as possible illustrative examples.

(d) Knowledge and skills.

(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:

(A) identify career and entrepreneurship opportunities for a chosen occupation in the field of agribusiness systems science and develop a plan for obtaining the education, training, and certifications required;

(B) model professionalism by continuously exhibiting appropriate work habits, solving problems, taking initiative, communicating effectively, listening actively, and thinking critically;

(C) model appropriate personal and occupational safety and health practices and explain the importance of established safety and health protocols for the workplace;

(D) analyze and interpret the rights and responsibilities, including ethical conduct and legal responsibilities, of employers and employees; and

(E) analyze the importance of exhibiting good citizenship and describe the effects of good citizenship on the development of home, school, workplace, and community.

(2) The student develops a supervised agricultural experience program. The student is expected to:

(A) plan, propose, conduct, document, and evaluate a supervised agricultural experience program as an experiential learning activity;

(B) use appropriate record-keeping skills in a supervised agricultural experience program;

(C) participate in youth agricultural leadership opportunities;

(D) review and participate in a local program of activities; and

(E) create or update documentation of relevant agricultural experience such as community service, professional, or classroom experiences.

(3) The student recognizes and explains roles within organizations, inter-organizational systems, and the larger environment. The student is expected to:

(A) identify how organizational systems affect performance and the quality of products and services related to agriculture, food, and natural resources;

(B) research and describe the global context of agricultural industries and careers;

(C) describe the nature and types of agribusiness organizations; and

(D) identify the sectors of agribusiness such as production, processing, and distribution.

(4) The student examines critical aspects of career opportunities in one or more agriculture, food, and natural resources careers. The student is expected to:

(A) research job descriptions for one or more careers in agriculture, food, and natural resources and analyze labor market trends for the selected career(s); and

(B) identify educational and credentialing requirements for one or more careers in agriculture, food, and natural resources.

(5) The student defines and examines agribusiness management and marketing and its importance to agriculture and the economy. The student is expected to:

(A) describe different roles and functions of management and leadership in agribusiness;

(B) analyze the impact of management and marketing on the production, processing, and distribution of agricultural products;

(C) identify key economic principles of free enterprise;

(D) explain the impact of key economic principles in agribusiness;

(E) analyze the economic opportunities of agribusiness in a selected market or region; and

(F) identify how agribusiness management and marketing impact consumer and market trends.

(6) The student explains the importance of maintaining records and budgeting in agribusiness. The student is expected to:

(A) maintain and analyze agribusiness records such as payroll, employee benefits, inventories, financial statements, and balance sheets to make informed business decisions;

(B) research and identify loan and financing opportunities in agribusiness;

(C) compare methods of capital resource acquisition as it pertains to agriculture; and

(D) apply a cost-benefit analysis to a budget for an agricultural business.

(7) The student describes issues related to government policy and seeks opportunities to eliminate barriers for all stakeholders. The student is expected to:

(A) analyze methods of decision making;

(B) identify and examine the effects of government policies and regulations in making management decisions;

(C) describe the role of human resources in ensuring equality in the workplace;

(D) identify employee rights and laws pertaining to the workplace; and

(E) identify the rights and responsibilities of land and property ownership such as uses, taxes, wills, and liabilities.

(8) The student describes the marketing of agricultural products. The student is expected to:

(A) describe the purpose and importance of marketing agricultural products;

(B) develop a marketing plan for an agricultural business or product;

(C) compare various agribusiness markets and influence factors;

(D) identify methods used in agriculture for managing risk; and

(E) identify and analyze trends in agricultural commodity markets.

(9) The student understands the efficiency aspects of agribusiness management. The student is expected to:

(A) develop agricultural management and financial documents using management software or information technology;

(B) identify components of and develop an agribusiness entrepreneurial plan;

(C) identify components of and develop an agribusiness financial management plan; and

(D) create and present an agriculture business proposal.

§127.47. Agricultural Leadership, Research, and Communications (One Credit), Adopted 2024.

(a) Implementation. The provisions of this section shall be implemented by school districts beginning with the 2025-2026 school year.

(b) General requirements. This course is recommended for students in Grades 10-12. Prerequisite: one credit from the courses in the Agriculture, Food, and Natural Resources Career Cluster. Recommended prerequisite: Principles of Agriculture, Food, and Natural Resources. Students shall be awarded one credit for successful completion of this course.

(c) Introduction.

(1) 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.

(2) The Agriculture, Food, and Natural Resources Career Cluster focuses on the production, processing, marketing, distribution, financing, and development of agricultural commodities and resources, including food, fiber, wood products, natural resources, horticulture, and other plant and animal products/resources.

(3) Agricultural Leadership, Research, and Communications focuses on challenging students to use higher level thinking skills, develop leadership abilities, and develop and communicate agricultural positions effectively with all stakeholders. To prepare for careers in agriculture, food, and natural resources, students must attain academic knowledge and skills, acquire technical knowledge and skills related to the workplace, and develop knowledge and skills regarding career opportunities, entry requirements, and industry expectations. To prepare for success, students need opportunities to learn, reinforce, apply, and transfer their knowledge and skills and applying technologies in a variety of settings.

(4) Students are encouraged to participate in extended learning experiences such as career and technical student organizations and other leadership or extracurricular organizations.

(5) Statements that contain the word "including" reference content that must be mastered, while those containing the phrase "such as" are intended as possible illustrative examples.

(d) Knowledge and skills.

(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:

(A) identify career and entrepreneurship opportunities for a chosen occupation in the field of agriculture and develop a plan for obtaining the education, training, and certifications required for the chosen occupation;

(B) model professionalism by continuously exhibiting appropriate work habits, solving problems, taking initiative, communicating effectively, listening actively, and thinking critically;

(C) model appropriate personal and occupational safety and health practices and explain the importance of established safety and health protocols for the workplace;

(D) analyze and interpret the rights and responsibilities, including ethical conduct and legal responsibilities, of employers and employees; and

(E) analyze the importance of exhibiting good citizenship and describe the effects of good citizenship on the development of home, school, workplace, and community.

(2) The student develops a supervised agricultural experience program. The student is expected to:

(A) plan, propose, conduct, document, and evaluate a supervised agricultural experience program as an experiential learning activity;

(B) use appropriate record-keeping skills in a supervised agricultural experience program;

(C) participate in youth agricultural leadership opportunities;

(D) review and participate in a local program of activities; and

(E) create or update documentation of relevant agricultural experience such as community service, professional, or classroom experiences.

(3) The student researches the qualities and characteristics of effective leaders within the agricultural industry. The student is expected to:

(A) identify past agricultural leaders, explain contributions made by the leaders, and define the impact of the contributions on the agricultural industry;

(B) compare characteristics of effective leaders and explain how these traits enabled them to enact meaningful change; and

(C) analyze and present the leadership skills of a present-day leader in the field of agriculture.

(4) The student describes organizational leadership structures at the local, state, and national levels. The student is expected to:

(A) identify agricultural or governmental leadership positions in the local community and at the state and national levels and explain and evaluate how individuals in leadership positions and decisions made by leadership impact the agricultural industry;

(B) define and analyze the processes by which laws, regulations, and policies are developed at the local, state, and national levels; and

(C) evaluate a recent law affecting agriculture, food, and natural resources and analyze the impact of that law on local agriculture.

(5) The student develops skills needed to participate effectively in an organizational meeting. The student is expected to:

(A) describe parliamentary laws, motions, and other procedures;

(B) apply parliamentary procedures to conduct organizational meetings;

(C) debate and discuss issues in a clear, concise, and professional manner;

(D) serve as presiding officer over an actual or mock organizational meeting; and

(E) analyze an organizational meeting such as a chapter, a district, an area, or a state meeting or a local board meeting and make recommendations to increase the meeting's overall efficiency and effectiveness.

(6) The student demonstrates an agriculture-related technical skill to stakeholders. The student is expected to:

(A) examine the components of an effective skills demonstration and create a list of essential characteristics;

(B) identify an agricultural skill, develop detailed instructions for performing that skill, and demonstrate the skill with proficiency;

(C) analyze the performance of a pre-identified skill and make recommendations to increase the performance for overall efficiency and effectiveness; and

(D) evaluate the relevance of real-world applications for the demonstration process.

(7) The student asks questions, identifies problems, and conducts investigations to answer questions in agriculture. The student is expected to:

(A) explain the importance of using scientific processes;

(B) ask questions and define problems based on observations or data;

(C) collect, organize, and analyze quantitative and qualitative data; and

(D) present findings and conclusions based on research performed using scientific processes.

(8) The student examines the use of logic in debate and analysis of current issues impacting the agricultural community. The student is expected to:

(A) identify the rules and responsibilities of the affirmative and negative positions in a debate;

(B) construct logical affirmative and negative cases in a debate using a variety of approaches; and

(C) present an argument free of logical fallacies on a current agricultural issue.

(9) The student examines an agricultural topic to develop an advocacy communication plan. The student is expected to:

(A) identify and research controversial areas of agriculture such as property rights, water rights, high fencing, cloning, and growth supplements;

(B) identify and analyze all sides of a controversial agricultural issue;

(C) develop an advocacy communication plan that addresses both supporting and opposing arguments; and

(D) present the advocacy communication plan to an audience.

(10) The student presents and communicates agricultural information using various media. The student is expected to:

(A) identify historical and current media outlets;

(B) research and write agricultural articles for publication in print media outlets;

(C) develop and record scripts for radio broadcasts or podcast productions to effectively communicate agricultural information using technology;

(D) develop scripts for video broadcasts and communicate agricultural information effectively using a video broadcast;

(E) examine and critique various media platforms; and

(F) communicate agricultural information in a responsible, professional manner via media.

(11) The student communicates agricultural information by means of presentations to groups of various sizes. The student is expected to:

(A) select appropriate tone, language, and content for an intended audience;

(B) plan, develop, and deliver effective presentations; and

(C) critique or self-critique agricultural presentations through an examination of logical structure, smooth transitions, accurate evidence, and well-chosen details.

(12) The student evaluates and critiques agricultural informational resources. The student is expected to:

(A) identify processes used in the evaluation of a variety of agricultural resources;

(B) evaluate agricultural resources for credibility, bias, and accuracy;

(C) compare and evaluate agricultural resources and make professional decisions using reliable methods of approach; and

(D) explain and defend decisions made in the evaluation of agricultural resources.

(13) The student understands the importance of agricultural education. The student is expected to:

(A) identify and examine historical and present-day agricultural education;

(B) identify and research individuals, governmental agencies, and advocacy groups that are responsible for agricultural information dissemination and education; and

(C) explain the importance of agricultural education.

§127.48. Equine Science (One-Half Credit), Adopted 2024.

(a) Implementation. The provisions of this section shall be implemented by school districts beginning with the 2025-2026 school year.

(b) General requirements. This course is recommended for students in Grades 10-12. Recommended prerequisite: Principles of Agriculture, Food, and Natural Resources. Students shall be awarded one-half credit for successful completion of this course.

(c) Introduction.

(1) 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.

(2) The Agriculture, Food, and Natural Resources Career Cluster focuses on the production, processing, marketing, distribution, financing, and development of agricultural commodities and resources, including food, fiber, wood products, natural resources, horticulture, and other plant and animal products/resources.

(3) In Equine Science, students acquire knowledge and skills related to the equine industry. Equine Science may address topics related to horses, donkeys, and mules. To prepare for careers in the field of animal science, students must enhance academic knowledge and skills, acquire knowledge and skills related to equine systems, and develop knowledge and skills regarding career opportunities, entry requirements, and industry expectations. To prepare for success, students need opportunities to learn, reinforce, apply, and transfer their knowledge and skills in a variety of settings.

(4) Students are encouraged to participate in extended learning experiences such as career and technical student organizations and other leadership or extracurricular organizations.

(5) Statements that contain the word "including" reference content that must be mastered, while those containing the phrase "such as" are intended as possible illustrative examples.

(d) Knowledge and skills.

(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:

(A) identify career development, education, and entrepreneurship opportunities in the field of equine science;

(B) identify and demonstrate interpersonal, problem-solving, and critical-thinking skills used in equine science;

(C) describe and demonstrate appropriate personal and occupational safety and health practices for the workplace;

(D) identify employers' expectations, including appropriate work habits, ethical conduct, and legal responsibilities;

(E) describe and demonstrate characteristics of good citizenship such as stewardship, advocacy, and community leadership; and

(F) identify training, education, and certification requirements for occupational choices.

(2) The student develops a supervised agricultural experience program. The student is expected to:

(A) plan, propose, conduct, document, and evaluate a supervised agricultural experience program as an experiential learning activity;

(B) use appropriate record-keeping skills as they relate to the supervised agricultural experience;

(C) participate in youth agricultural leadership opportunities;

(D) review and participate in a local program of activities; and

(E) create or update documentation of relevant agricultural experience such as community service, professional, or classroom experiences.

(3) The student analyzes the history, domestication, and selection of equine. The student is expected to:

(A) research and describe the history and evolution of equine;

(B) describe the impacts of equine industries such as racing, rodeos, equestrian therapy, and the global food market; and

(C) evaluate and select equine breeds based on purpose and conformation.

(4) The student explains the anatomy and physiology of equine. The student is expected to:

(A) explain the function of the skeletal, muscular, respiratory, reproductive, digestive, and circulatory systems of equine;

(B) identify and interpret ranges for healthy equine vital signs; and

(C) compare normal and abnormal behavior of equine such as emotional and physical.

(5) The student determines the nutritional requirements of equine. The student is expected to:

(A) compare the equine digestive system to the digestive systems of other species;

(B) identify and describe sources of nutrients and classes of feed for equine;

(C) identify and research vitamins, minerals, and feed additives for equine;

(D) formulate feed rations based on the nutritional requirements of equine; and

(E) identify and discuss equine feeding practices, grazing practices, and feed quality issues.

(6) The student understands how equine are affected by diseases and pests. The student is expected to:

(A) identify and describe how bacteria, fungi, viruses, genetics, and nutrition affect equine health;

(B) identify signs, symptoms, and prevention of equine diseases;

(C) identify parasites of equine and explain the signs, symptoms, treatment, and prevention of equine parasites; and

(D) discuss methods of administering equine medications and calculating dosage.

(7) The student analyzes the management of equine. The student is expected to:

(A) identify and select appropriate tools and equipment for grooming, riding, and training equine;

(B) identify and select appropriate tools and equipment for safe handling and restraining of equine;

(C) identify and select appropriate equine facilities such as housing, performance, veterinary, and reproduction;

(D) explain the procedures for breeding equine and caring for foals in accordance with industry standards;

(E) explain and demonstrate methods of identifying ownership of equine, including branding and tattooing;

(F) discuss effective equine management strategies such as financial planning, managing governmental regulations, and interpreting performance data; and

(G) explain methods of maintaining equine health and soundness such as hoof care and dental health.

(8) The student discusses issues affecting the equine industry. The student is expected to:

(A) describe biotechnology issues related to the equine industry;

(B) research and explain animal welfare policy pertaining to equine industries such as racing, rodeos, equestrian therapy, the global food market, and pharmaceutical research; and

(C) research and explain governmental regulations, environmental regulations, or current events that affect the equine industry.

§127.49. Livestock and Poultry Production (One Credit), Adopted 2024.

(a) Implementation. The provisions of this section shall be implemented by school districts beginning with the 2025-2026 school year.

(b) General requirements. This course is recommended for students in Grades 10-12. Prerequisite: a minimum of two credits with at least one course in a Level 2 or higher course from the Agriculture, Food, and Natural Resources Career Cluster. Recommended prerequisite: Principles of Agriculture, Food, and Natural Resources. Students shall be awarded one credit for successful completion of this course.

(c) Introduction.

(1) 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.

(2) The Agriculture, Food, and Natural Resources Career Cluster focuses on the production, processing, marketing, distribution, financing, and development of agricultural commodities and resources, including food, fiber, wood products, natural resources, horticulture, and other plant and animal products/resources.

(3) In Livestock and Poultry Production, students acquire knowledge and skills related to the livestock and poultry production industry. Livestock and Poultry Production may address topics related to beef cattle, dairy cattle, swine, sheep, goats, and poultry. To prepare for careers in the field of animal science, students must attain academic knowledge and skills, acquire knowledge and skills related to livestock and poultry systems and the workplace, and develop knowledge and skills regarding career opportunities, entry requirements, and industry expectations. To prepare for success, students need opportunities to learn, reinforce, apply, and transfer their knowledge and skills in a variety of settings.

(4) Students are encouraged to participate in extended learning experiences such as career and technical student organizations and other leadership or extracurricular organizations.

(5) Statements that contain the word "including" reference content that must be mastered, while those containing the phrase "such as" are intended as possible illustrative examples.

(d) Knowledge and skills.

(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:

(A) identify career development, education, and entrepreneurship opportunities in the field of livestock and poultry production;

(B) identify and demonstrate interpersonal, problem-solving, and critical-thinking skills used in livestock and poultry production;

(C) describe and demonstrate appropriate personal and occupational safety and health practices for the workplace;

(D) identify employers' expectations, including appropriate work habits, ethical conduct, and legal responsibilities;

(E) describe and demonstrate characteristics of good citizenship such as stewardship, advocacy, and community leadership; and

(F) identify training, education, and certification requirements for occupational choices.

(2) The student develops a supervised agricultural experience program. The student is expected to:

(A) plan, propose, conduct, document, and evaluate a supervised agricultural experience program as an experiential learning activity;

(B) use appropriate record-keeping skills as they relate to the supervised agricultural experience;

(C) participate in youth agricultural leadership opportunities;

(D) review and participate in a local program of activities; and

(E) create or update documentation of relevant agricultural experience such as community service, professional, or classroom experiences.

(3) The student analyzes the history, domestication, and selection of livestock and poultry. The student is expected to:

(A) research and describe the history, domestication, and evolution of livestock and poultry species;

(B) describe the impacts other industries such as entertainment, recreation and leisure, and exhibition of animals have on the livestock and poultry industry; and

(C) evaluate and select livestock and poultry breeds based on purpose and conformation.

(4) The student explains the anatomy and physiology of livestock and poultry species. The student is expected to:

(A) identify and explain the skeletal, muscular, respiratory, and circulatory systems of livestock and poultry;

(B) identify and interpret ranges for healthy livestock and poultry vital signs; and

(C) compare normal and abnormal behavior of livestock and poultry.

(5) The student determines nutritional requirements of livestock and poultry. The student is expected to:

(A) describe and compare the digestive systems of ruminant and non-ruminant animals;

(B) identify sources of nutrients and classes of feed for livestock and poultry;

(C) identify vitamins, minerals, and feed additives for livestock and poultry;

(D) formulate feed rations based on nutritional needs and economic factors for livestock and poultry;

(E) research and discuss feeding practices and feed quality issues for livestock and poultry;

(F) identify forage plants used for livestock grazing; and

(G) research and explain livestock and poultry grazing practices such as rotational grazing and deferred grazing.

(6) The student explains livestock and poultry genetics and reproduction. The student is expected to:

(A) describe and compare the reproductive systems of various livestock and poultry;

(B) identify and explain livestock and poultry breeding systems such as grading up, crossbreeding, linebreeding, and inbreeding;

(C) use Expected Progeny Differences (EPDs) to evaluate livestock production;

(D) research and explain current and emerging technologies in livestock and poultry reproduction such as cloning, embryo transfer, in vitro fertilization, and artificial insemination;

(E) use Punnett squares to predict phenotypes and genotypes of livestock offspring; and

(F) explain the relationship between body condition scores and reproductive efficiency for livestock and poultry.

(7) The student understands how livestock and poultry are affected by pests and diseases. The student is expected to:

(A) identify and describe how bacteria, fungi, viruses, genetics, and nutrition affect livestock and poultry health;

(B) identify signs, symptoms, and prevention of livestock and poultry diseases;

(C) identify parasites and explain the signs, symptoms, treatment, and prevention of livestock and poultry parasites; and

(D) calculate dosage and identify administration methods of livestock and poultry medications.

(8) The student analyzes the management skills needed for livestock and poultry production. The student is expected to:

(A) identify and select appropriate tools and equipment for safe handling and restraining of livestock and poultry;

(B) identify and select appropriate facilities for livestock and poultry such as housing, veterinary, and reproduction;

(C) evaluate and describe industry practices such as dehorning, castrating, docking, and vaccinating and sire, dam, and newborn care to maximize the efficiency of livestock and poultry; and

(D) explain and demonstrate methods of identifying ownership of livestock and poultry such as branding, ear tagging, ear notching, wing bands, and tattooing.

(9) The student examines the interrelationship of the factors impacting livestock and poultry production operations. The student is expected to:

(A) research and explain livestock and poultry biosecurity and waste management practices;

(B) create an effective financial management plan for a livestock and poultry production operation;

(C) analyze and discuss environmental regulations, governmental regulations, and animal welfare policies related to livestock and poultry production;

(D) analyze and describe the interrelationship between grain markets and the livestock and poultry industry;

(E) assess the impact of the United States livestock and poultry industry on world commodity markets;

(F) use charts, tables, data, or graphs to evaluate the efficiency of livestock and poultry production; and

(G) develop and present a livestock or poultry operation plan that includes health, reproduction, nutrition, and management practices necessary for maximum efficiency.

§127.50. Small Animal Management (One-Half Credit), Adopted 2024.

(a) Implementation. The provisions of this section shall be implemented by school districts beginning with the 2025-2026 school year.

(b) General requirements. This course is recommended for students in Grades 10-12. Recommended prerequisite: Principles of Agriculture, Food, and Natural Resources. Students shall be awarded one-half credit for successful completion of this course.

(c) Introduction.

(1) 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.

(2) The Agriculture, Food, and Natural Resources Career Cluster focuses on the production, processing, marketing, distribution, financing, and development of agricultural commodities and resources, including food, fiber, wood products, natural resources, horticulture, and other plant and animal products/resources.

(3) In Small Animal Management, students acquire knowledge and skills related to the small animal management industry. Small Animal Management may address topics related to small animals such as dogs and cats, rabbits, pocket pets, amphibians, reptiles, and birds. To prepare for careers in the field of animal science, students must enhance academic knowledge and skills, acquire knowledge and skills related to small animal systems, and develop knowledge and skills regarding career opportunities, entry requirements, and industry expectations. To prepare for success, students need opportunities to learn, reinforce, apply, and transfer knowledge and skills in a variety of settings.

(4) Students are encouraged to participate in extended learning experiences such as career and technical student organizations and other leadership or extracurricular organizations.

(5) Statements that contain the word "including" reference content that must be mastered, while those containing the phrase "such as" are intended as possible illustrative examples.

(d) Knowledge and skills.

(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:

(A) identify career development, education, and entrepreneurship opportunities in the field of small animal management;

(B) identify and demonstrate interpersonal, problem solving, and critical thinking skills used in small animal management;

(C) describe and demonstrate appropriate personal and occupational safety and health practices for the workplace;

(D) identify employers' expectations, including appropriate work habits, ethical conduct, and legal responsibilities;

(E) describe and demonstrate characteristics of good citizenship such as stewardship, advocacy, and community leadership; and

(F) identify training, education, and certification requirements for occupational choices.

(2) The student develops a supervised agricultural experience program. The student is expected to:

(A) plan, propose, conduct, document, and evaluate a supervised agricultural experience program as an experiential learning activity;

(B) use appropriate record-keeping skills as they relate to the supervised agricultural experience;

(C) participate in youth agricultural leadership opportunities to create a well-rounded experience program;

(D) review and participate in a local program of activities; and

(E) create or update documentation of relevant agricultural experience such as community service, professional, or classroom experiences.

(3) The student analyzes the history, domestication, and importance of small animal ownership. The student is expected to:

(A) research and explain the history, domestication, and purpose of small animals;

(B) identify and discuss the influence small animals have on society;

(C) describe the economic impact of the small animal industry;

(D) describe the responsibilities and benefits of small animal ownership;

(E) explain services small animals provide to society such as medical, support, research, and working; and

(F) research and discuss the environmental and governmental regulations related to small animal ownership.

(4) The student understands the hazards associated with working in the small animal industry. The student is expected to:

(A) explain and demonstrate safe practices, including the proper use of personal protective equipment (PPE), when working with small animals;

(B) identify zoonotic diseases that can be transmitted by small animals;

(C) describe sanitation methods used to prevent the spread of disease in small animals; and

(D) locate, interpret, and implement safety data sheets (SDS) for handling chemicals.

(5) The student evaluates current topics in small animal rights and animal welfare. The student is expected to:

(A) analyze current issues in animal rights and animal welfare;

(B) research and report important persons, organizations, and groups involved in the animal rights movement; and

(C) create and discuss a timeline of legislation related to animal welfare.

(6) The student explains anatomy and physiology of small animals. The student is expected to:

(A) identify and explain the skeletal, muscular, respiratory, reproductive, digestive, and circulatory systems for each species studied;

(B) identify and interpret ranges for healthy small animal vital signs; and

(C) compare normal and abnormal behavior of small animals.

(7) The student analyzes the care and management skills for a variety of small animals. The student is expected to:

(A) identify and discuss the impact physical characteristics have on the management practices for each species studied;

(B) identify and compare the breeds and types of each species studied;

(C) discuss the ownership identification methods, habitat, housing, and equipment needs for each species studied;

(D) identify nutritional requirements for each species studied;

(E) explain health maintenance for each species studied, including prevention and control of diseases and parasites;

(F) describe and practice methods of handling for each species studied;

(G) discuss basic grooming procedures for each species studied; and

(H) identify copulation, gestation, parturition, and weaning practices for each species studied.

(8) The student examines the interrelationship of the factors impacting small animal ownership. The student is expected to:

(A) develop and present a small animal ownership plan that includes health, reproduction, nutrition, and management practices; and

(B) research and create a financial plan for small animal operation or ownership.

§127.51. Veterinary Science (One Credit), Adopted 2024.

(a) Implementation. The provisions of this section shall be implemented by school districts beginning with the 2025-2026 school year.

(b) General requirements. This course is recommended for students in Grades 11 and 12. Prerequisite: Equine Science, Small Animal Management, or Livestock Production. Students shall be awarded one credit for successful completion of this course.

(c) Introduction.

(1) 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.

(2) The Agriculture, Food, and Natural Resources Career Cluster focuses on the production, processing, marketing, distribution, financing, and development of agricultural commodities and resources, including food, fiber, wood products, natural resources, horticulture, and other plant and animal products/resources.

(3) Veterinary Science covers topics relating to veterinary practices, including practices for large and small animal species. To prepare for careers in the field of animal science, students must attain academic knowledge and skills, acquire technical knowledge and skills related to animal systems and the workplace, and develop knowledge and skills regarding career opportunities, entry requirements, and industry expectations. To prepare for success, students need opportunities to learn, reinforce, apply, and transfer knowledge and skills and technologies in a variety of settings.

(4) Students are encouraged to participate in extended learning experiences such as career and technical student organizations and other leadership or extracurricular organizations.

(5) Statements that contain the word "including" reference content that must be mastered, while those containing the phrase "such as" are intended as possible illustrative examples.

(d) Knowledge and skills.

(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:

(A) identify career, education, and entrepreneurship opportunities for a chosen occupation in the field of veterinary science and develop a plan for obtaining the education, training, and certifications required;

(B) model professionalism by continuously exhibiting appropriate work habits, solving problems, taking initiative, communicating effectively, listening actively, and thinking critically;

(C) model appropriate personal and occupational safety and health practices and explain the importance of established safety and health protocols for the workplace;

(D) analyze and interpret the rights and responsibilities, including ethical conduct and legal responsibilities, of employers and employees; and

(E) analyze the importance of exhibiting good citizenship and describe the effects of good citizenship on the development of home, school, workplace, and community.

(2) The student develops a supervised agricultural experience program. The student is expected to:

(A) plan, propose, conduct, document, and evaluate a supervised agricultural experience program as an experiential learning activity;

(B) use appropriate record-keeping skills as they relate to the supervised agricultural experience;

(C) participate in youth agricultural leadership opportunities;

(D) review and participate in a local program of activities; and

(E) create or update documentation of relevant agricultural experience such as community service, professional, or classroom experiences.

(3) The student understands safety and health practices associated with working in veterinary medicine. The student is expected to:

(A) explain the importance of safe practices when working with animals such as handling, restraint, and proper use of tools and equipment;

(B) identify and discuss transmission and prevention of zoonotic diseases in large and small animal species;

(C) describe sanitation methods to prevent the spread of pathogens and maintain asepsis in sterile environments;

(D) locate, interpret, and implement safety data sheets (SDS) for handling chemicals;

(E) demonstrate and explain safe usage of clinical tools and equipment; and

(F) perform proper disposal of sharps and biohazards.

(4) The student understands current topics, professional ethics, and laws that relate to veterinary medicine. The student is expected to:

(A) research and discuss historical events, trends, and issues that have impacted veterinary medicine;

(B) analyze veterinary medical ethics, including animal rights and animal welfare; and

(C) explain policies and procedures in veterinary medicine that reflect local, state, and federal laws.

(5) The student evaluates effective management approaches and marketing strategies to determine their importance to the success of veterinary practices such as clinics and hospitals. The student is expected to:

(A) describe how the human-animal bond impacts veterinary practices when working with clients and their animals;

(B) identify and demonstrate skills needed to communicate effectively with clients and veterinary professionals;

(C) identify marketing strategies and explain how marketing affects the success of a veterinary practice; and

(D) research and discuss how electronic technology such as computer programs, medical records, hospital-to-hospital communication, and tablets is used in a veterinary practice.

(6) The student communicates the importance of medical terminology, evaluates veterinary terms to discover their meanings, and demonstrates the ability to use terms correctly. The student is expected to:

(A) analyze Greek and Latin prefixes, suffixes, and roots to determine the meaning of veterinary terms;

(B) identify, pronounce, and spell veterinary terms appropriately; and

(C) use directional anatomy terms appropriately for large and small animal species.

(7) The student understands proper animal handling as it relates to characteristics and behavior. The student is expected to:

(A) identify animal breeds according to characteristics;

(B) identify and compare normal and abnormal behavior within and among various animal species; and

(C) identify and discuss correct handling and restraint protocols for large and small animal species such as muzzling, lateral recumbency, sternal recumbency, jugular venipuncture, and haltering.

(8) The student explains anatomy and physiology of animals. The student is expected to:

(A) identify the parts and functions of the skeletal, muscular, respiratory, circulatory, digestive, endocrine, and nervous systems for large and small animal species; and

(B) describe the interrelationship among animal body systems.

(9) The student determines the importance of animal nutrition in maintaining a healthy animal. The student is expected to:

(A) identify sources of nutrients and classes of feeds for large and small animal species;

(B) identify feed additives for large and small animal species and describe how additives affect the food supply;

(C) analyze dietary needs and feed-quality issues for large and small animal species and their effect on feeding practices; and

(D) research and compare the nutritional value of feeds for large and small animal species such as prescription, commercial, homemade, fad diets, and raw diets.

(10) The student evaluates an animal's health during a clinical examination. The student is expected to:

(A) describe the characteristics and signs of a healthy and an unhealthy animal;

(B) identify ranges for healthy vital signs for large and small animal species such as temperature, pulse, respiration, hydration, and capillary refill time;

(C) demonstrate the proper procedures for obtaining vital signs for large and small animal species and interpret vital sign measurements to determine the health of the animal;

(D) describe effects of age, stress, and environmental factors on vital signs of animals;

(E) explain procedures for physical examinations for large and small animal species;

(F) explain the anatomical regional approach to assess an animal's health;

(G) apply mathematical skills to calculate weight and linear body measurement for large and small animal species and to convert between measurement systems; and

(H) analyze tables, charts, and graphs to interpret large and small animal patient and clinical data.

(11) The student analyzes how diseases and parasites affect animal health. The student is expected to:

(A) describe the process of immunity and disease transmission for large and small animal species;

(B) identify and describe pathogens for large and small animal species and the diseases they cause;

(C) describe the effects that diseases have on various body systems for large and small animal species;

(D) identify parasites for large and small animal species using common and scientific names;

(E) describe life cycles of parasites found in large and small animal species;

(F) explain how parasites found in large and small animal species are transmitted and explain the effects on the host;

(G) describe parasitic diagnostic procedures for large and small animal species; and

(H) describe treatment protocols for parasites found in large and small animal species.

(12) The student examines various aspects of veterinary laboratory procedures. The student is expected to:

(A) explain the procedures used in collecting, handling, and preparing fecal, blood, and urine specimens for large and small animal species;

(B) explain veterinary procedures used in examining fecal, blood, and urine specimens; and

(C) analyze and compare normal and abnormal results obtained in veterinary laboratory procedures.

(13) The student analyzes technical veterinary procedures and skills. The student is expected to:

(A) explain the care, maintenance, and use of equipment and instruments found in veterinary practices;

(B) interpret and prepare a veterinary medical record, adhering to client and patient confidentiality;

(C) explain and demonstrate routine animal care skills such as administering medications, nail trimming, bathing, dipping, grooming, ear cleaning, expressing anal sacs, dental care, placing a tail tie, and ownership identification methods;

(D) explain and demonstrate therapeutic care for large and small animal species such as patient observation, maintaining and administering fluids, applying and removing bandages, removing sutures, caring for open wounds, and providing hydrotherapy physical therapy;

(E) describe emergency protocols and first aid procedures for large and small animal species, including cardiopulmonary resuscitation, control of bleeding, and signs of shock; and

(F) research and compare veterinary care of specialty patients, including newborns, orphans, geriatric animals, recumbent animals, and animals with disabilities.

(14) The student identifies and discusses surgical-assisting procedures and skills. The student is expected to:

(A) explain the veterinary protocol for pre-surgical and post-surgical care of a patient;

(B) identify tools and equipment used in veterinary surgical procedures;

(C) describe methods used in the preparation, sterilization, and opening of surgery packs; and

(D) describe veterinary surgical procedures such as spaying, castration, dehorning, docking, dental prophylaxis, and tooth extraction.

(15) The student identifies imaging equipment and understands how to safely operate and maintain equipment. The student is expected to:

(A) research and explain the parts and function of imaging equipment such as an ultrasonograph, endoscope, electrocardiograph, and radiograph;

(B) explain safety, maintenance, and operation procedures of imaging equipment;

(C) demonstrate patient restraint and positioning methods used for imaging purposes of large and small animal species; and

(D) differentiate between the images from various imaging equipment.

(16) The student identifies veterinary pharmacology procedures and skills. The student is expected to:

(A) identify veterinary medications according to their classification, schedule, form, routes of administration, and methods of administration;

(B) explain handling, storage, distribution, protocols, and laws for veterinary medications, including controlled substances;

(C) calculate dosage for large and small animal species using factors such as concentration of drug, weight of animal, and prescribed dosage;

(D) prepare a veterinary prescription label with identifiers that are required by the United States Food and Drug Administration;

(E) identify and explain the equipment and instruments used to safely administer medications for large and small animal species; and

(F) research and present emerging trends in veterinary pharmacology such as internet pharmacies, herbal supplements, organic labeling, and extra-label and off-label use of medications.

§127.52. Advanced Animal Science (One Credit), Adopted 2024.

(a) Implementation. The provisions of this section shall be implemented by school districts beginning with the 2025-2026 school year.

(b) General requirements. This course is recommended for students in Grades 11 and 12. Prerequisites: Biology and Chemistry or Integrated Physics and Chemistry (IPC); Algebra I and Geometry; and either Small Animal Management, Equine Science, or Livestock Production. Recommended prerequisite: Veterinary Science. 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.

(c) Introduction.

(1) 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.

(2) The Agriculture, Food, and Natural Resources Career Cluster focuses on the production, processing, marketing, distribution, financing, and development of agricultural commodities and resources, including food, fiber, wood products, natural resources, horticulture, and other plant and animal products/resources.

(3) Advanced Animal Science examines the interrelatedness of human, scientific, and technological dimensions of animal production, including canine, feline, bovine, equine, caprine, porcine, ovine, poultry, and lagomorpha production. Instruction is designed to allow for the application of scientific and technological aspects of animal science through field and laboratory experiences. To prepare for careers in the field of animal science, students must attain academic knowledge and skills, acquire knowledge and skills related to animal systems, and develop knowledge and skills regarding career opportunities, entry requirements, and industry standards. To prepare for success, students need opportunities to learn, reinforce, apply, and transfer their knowledge and skills in a variety of settings.

(4) Nature of science. 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 is 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.

(5) Scientific hypotheses and theories. Students are expected to know that:

(A) hypotheses are tentative and testable statements that must be capable of being supported or not supported by observational evidence. Hypotheses of durable explanatory power that have been tested over a wide variety of conditions are incorporated into theories; and

(B) 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.

(6) Scientific inquiry. Scientific inquiry is the planned and deliberate investigation of the natural world using scientific and engineering practices. Scientific methods of investigation are descriptive, comparative, or experimental. The method chosen should be appropriate to the question being asked. Student learning for different types of investigations include descriptive investigations, which involve collecting data and recording observations without making comparisons; comparative investigations, which involve collecting data with variables that are manipulated to compare results; and experimental investigations, which involve processes similar to comparative investigations but in which a control is identified.

(A) Scientific practices. Students should be able to ask questions, plan and conduct investigations to answer questions, and explain phenomena using appropriate tools and models.

(B) Engineering practices. Students should be able to identify problems and design solutions using appropriate tools and models.

(7) Science and social ethics. Scientific decision making is a way of answering questions about the natural world involving its own set of ethical standards about how the process of science should be carried out. Students should be able to distinguish between scientific decision-making methods (scientific methods) and ethical and social decisions that involve science (the application of scientific information).

(8) Science consists of recurring themes and making connections between overarching concepts. Recurring themes include systems, models, and patterns. All systems have basic properties that can be described in 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, while models allow for boundary specification and provide tools for understanding the ideas presented. 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.

(9) Students are encouraged to participate in extended learning experiences such as career and technical student organizations and other leadership or extracurricular organizations.

(10) Statements that contain the word "including" reference content that must be mastered, while those containing the phrase "such as" are intended as possible illustrative examples.

(d) Knowledge and skills.

(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:

(A) identify career and entrepreneurship opportunities for a chosen occupation in the field of animal science and develop a plan for obtaining the education, training, and certifications required;

(B) model professionalism by continuously exhibiting appropriate work habits, solving problems, taking initiative, communicating effectively, listening actively, and thinking critically;

(C) model appropriate personal and occupational safety and health practices and explain the importance of established safety and health protocols for the workplace;

(D) analyze and interpret the rights and responsibilities, including ethical conduct and legal responsibilities of employers and employees; and

(E) analyze the importance of exhibiting good citizenship and describe the effects of good citizenship on the development of home, school, workplace, and community.

(2) Scientific and engineering practices. The student, for at least 40% of instructional time, asks questions, identifies problems, and plans and safely conducts classroom, laboratory, and field investigations to answer questions, explain phenomena, or design solutions using appropriate tools and models. The student is expected to:

(A) ask questions and define problems based on observations or information from text, phenomena, models, or investigations;

(B) apply scientific practices to plan and conduct descriptive, comparative, and experimental investigations and use engineering practices to design solutions to problems;

(C) use appropriate safety equipment and practices during laboratory, classroom, and field investigations as outlined in Texas Education Agency-approved safety standards;

(D) use appropriate tools such as dissection equipment, standard laboratory glassware, microscopes, various prepared slides, measuring devices, micropipettors, hand lenses, thermometers, hot plates, laboratory notebook, timing devices, cameras, Petri dishes, laboratory incubators, models, diagrams, and samples of biological specimens, syringes, needles, scalpels, microscopes slides, cover slips, artificial insemination equipment, and drench gun;

(E) collect quantitative data using the International System of Units (SI) and qualitative data as evidence;

(F) organize quantitative and qualitative data using calculators, computers, software, laboratory notebook, recordkeeping system, and reliable sources;

(G) develop and use models to represent phenomena, systems, processes, or solutions to engineering problems; and

(H) distinguish between scientific hypotheses, theories, and laws.

(3) Scientific and engineering practices. The student analyzes and interprets data to derive meaning, identify features and patterns, and discover relationships or correlations to develop evidence-based arguments or evaluate designs. The student is expected to:

(A) identify advantages and limitations of models such as their size, scale, properties, and materials;

(B) analyze data by identifying significant statistical features, patterns, sources of error, and limitations;

(C) use mathematical calculations to assess quantitative relationships in data; and

(D) evaluate experimental and engineering designs.

(4) Scientific and engineering practices. The student develops evidence-based explanations and communicates findings, conclusions, and proposed solutions. The student is expected to:

(A) develop explanations and propose solutions supported by data and models and consistent with scientific ideas, principles, and theories;

(B) communicate explanations and solutions individually and collaboratively in a variety of settings and formats; and

(C) engage respectfully in scientific argumentation using applied scientific explanations and empirical evidence.

(5) Scientific and engineering practices. The student knows the contributions of scientists and recognizes the importance of scientific research and innovation on society. The student is expected to:

(A) analyze, evaluate, and critique scientific explanations and solutions by using empirical evidence, logical reasoning, and experimental and observational testing so as to encourage critical thinking by the student;

(B) relate the impact of past and current research on scientific thought and society, including research methodology, cost-benefit analysis, and contributions of diverse scientists as related to the content; and

(C) research and explore resources such as museums, libraries, professional organizations, private companies, online platforms, and mentors employed in a science, technology, engineering, and mathematics (STEM) field in order to investigate STEM careers.

(6) The student develops a supervised agricultural experience program. The student is expected to:

(A) plan, propose, conduct, document, and evaluate a supervised agricultural experience program as an experiential learning activity;

(B) use appropriate record-keeping skills in a supervised agricultural experience program;

(C) participate in youth agricultural leadership opportunities;

(D) review and participate in a local program of activities; and

(E) create or update documentation of relevant agricultural experience such as community service, professional, or classroom experiences.

(7) The student analyzes the history, domestication, and evaluation of animals, including canine, feline, bovine, equine, caprine, porcine, ovine, poultry, and lagomorphs. The student is expected to:

(A) research and describe the history, including evolution, domestication, and introduction of species to countries, of canine, feline, bovine, equine, caprine, porcine, ovine, poultry, and lagomorphs;

(B) analyze and describe how changes in the global food market impact the animal production industry; and

(C) evaluate breeds of canine, feline, bovine, equine, caprine, porcine, ovine, poultry, and lagomorph based on purpose and conformation.

(8) The student defines how an organism grows and how specialized cells, tissues, and organs develop. The student is expected to:

(A) compare cells to show specialization of structure and function;

(B) explain cell division, including mitosis and meiosis;

(C) explain cell differentiation in the development of tissues and organs; and

(D) identify and explain the biological levels of organization in animals.

(9) The student examines and compares anatomy and physiology in animals. The student is expected to:

(A) compare the external anatomy of canine, feline, bovine, equine, caprine, porcine, ovine, poultry, and lagomorphs;

(B) identify the anatomical structures and physiological functions of the skeletal, muscular, circulatory, genitourinary, respiratory, nervous, immune, and endocrine systems of canine, feline, bovine, equine, caprine, porcine, ovine, poultry, and lagomorphs; and

(C) investigate and describe the interrelationship among animal body systems.

(10) The student understands the anatomical structures and physiological functions of the digestive system to determine nutritional requirements of ruminant and non-ruminant animals. The student is expected to:

(A) describe the structures and functions of the digestive systems of canine, feline, bovine, equine, caprine, porcine, ovine, poultry, and lagomorphs;

(B) identify and describe sources of nutrients and classes of feeds for canine, feline, bovine, equine, caprine, porcine, ovine, poultry, and lagomorphs;

(C) identify and describe the feed additives and supplements used to meet the nutritional requirements of canine, feline, bovine, equine, caprine, porcine, ovine, poultry, and lagomorphs;

(D) formulate rations based on different nutritional requirements, including age, gestation, lactation, sex, and purpose, for canine, feline, bovine, equine, caprine, porcine, ovine, poultry, and lagomorphs;

(E) analyze feeding practices in relation to nutritional requirements, including age, gestation, lactation, sex, and purpose, for canine, feline, bovine, equine, caprine, porcine, ovine, poultry, and lagomorphs;

(F) analyze feed quality issues and determine their effect on the health of canine, feline, bovine, equine, caprine, porcine, ovine, poultry, and lagomorphs;

(G) research and compare the nutritional value of feeds for all species discussed;

(H) identify forage plants used for livestock grazing and analyze the protein levels of each; and

(I) research grazing practices such as rotational grazing and deferred grazing and explain the advantages and disadvantages of each using the scientific and engineering design process.

(11) The student understands the principles of molecular genetics and heredity. The student is expected to:

(A) explain Mendel's laws of inheritance and predict genotypes and phenotypes of offspring using a Punnett square;

(B) use a Punnett square and assign alleles to justify genotype and phenotype predictions;

(C) identify the parts of the nucleotide and differentiate between the nucleotides found in deoxyribonucleic acid (DNA) and ribonucleic acid (RNA); and

(D) explain the functions of DNA and RNA.

(12) The student applies the principles of reproduction and breeding to animal improvement. The student is expected to:

(A) describe and compare reproductive anatomy of canine, feline, bovine, equine, caprine, porcine, ovine, poultry, and lagomorphs;

(B) analyze and compare reproductive cycles and phases of canine, feline, bovine, equine, caprine, porcine, ovine, poultry, and lagomorphs;

(C) correlate the reproductive cycles and phases to animal behavior;

(D) research breeding systems, including grading up, crossbreeding, linebreeding, and inbreeding, and explain the advantages and disadvantages of each using the scientific and engineering design process; and

(E) research breeding methods, including embryo transfer, artificial insemination, and natural mating, and explain the advantages and disadvantages of each using the scientific and engineering design process.

(13) The student analyzes how diseases and parasites affect animal health. The student is expected to:

(A) examine how factors such as geographic location, age, genetic composition, and inherited diseases influence the health of canine, feline, bovine, equine, caprine, porcine, ovine, poultry, and lagomorphs;

(B) describe the process of immunity and disease transmission of canine, feline, bovine, equine, caprine, porcine, ovine, poultry, and lagomorphs;

(C) identify and describe pathogens and the diseases they cause in canine, feline, bovine, equine, caprine, porcine, ovine, poultry, and lagomorphs;

(D) describe the effects that diseases have on various body systems of canine, feline, bovine, equine, caprine, porcine, ovine, poultry, and lagomorphs;

(E) research and explain the methods of prevention and control for diseases of canine, feline, bovine, equine, caprine, porcine, ovine, poultry, and lagomorphs;

(F) identify parasites of canine, feline, bovine, equine, caprine, porcine, ovine, poultry, and lagomorphs using common and scientific names;

(G) describe the life cycles of various parasites and relate them to animal health issues;

(H) explain how parasites are transmitted and the effect they have on canine, feline, bovine, equine, caprine, porcine, ovine, poultry, and lagomorphs;

(I) conduct or simulate parasite diagnostic tests; and

(J) explain the methods of prevention, control, and treatment of parasites of canine, feline, bovine, equine, caprine, porcine, ovine, poultry, and lagomorphs.

(14) The student discusses livestock market readiness and harvesting methods. The student is expected to:

(A) explain the stages of animal growth and development and how they relate to market readiness;

(B) evaluate market class and grades of livestock;

(C) compare harvesting methods for various species using the scientific and engineering design process;

(D) research and describe federal and state meat inspection standards such as safety, hygiene, and quality control standards;

(E) identify wholesale and retail cuts of meat and correlate to major muscle groups; and

(F) research animal by-products and explain their impact on society.

(15) The student explores methods of marketing animals and animal products. The student is expected to:

(A) compare various methods of animal marketing such as auction, contract sales, private treaty, internet sales, value-based, and exhibition of various animals;

(B) describe methods of marketing animal products such as farmers market, direct sales, wholesale, and retail;

(C) research and evaluate the effectiveness of various strategies and campaigns such as Beef: It's What's For Dinner, Certified Angus Beef, Pork: The Other White Meat, Got Milk?, Beef Check Off, Man's Best Friend, Cat Cafes, Goat Yoga, and Farm to Plate to market animal products based on consumption patterns and consumer preferences; and

(D) research and evaluate the effectiveness of various labeling options to market animal products such as organic, farm-raised, hormone-free, cage-free, grass-fed, antibiotic-free, and non-GMO labels based on consumption patterns and consumer preferences.

(16) The student demonstrates an understanding of policies and current issues in animal science. The student is expected to:

(A) investigate and discuss the use of biotechnology and biosecurity in the animal science industry;

(B) identify governmental regulations and policies such as environmental and animal welfare and research the impacts on animal production; and

(C) identify and research a current issue in scientific animal agriculture and design a protocol to address the issue using the scientific and engineering design process.

§127.53. Floral Design (One Credit), Adopted 2024.

(a) Implementation. The provisions of this section shall be implemented by school districts beginning with the 2025-2026 school year.

(b) General requirements. This course is recommended for students in Grades 9-12. Recommended prerequisite: Principles of Agriculture, Food, and Natural Resources. This course satisfies the fine arts graduation requirement. Students shall be awarded one credit for successful completion of this course.

(c) Introduction.

(1) 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.

(2) The Agriculture, Food, and Natural Resources Career Cluster focuses on the production, processing, marketing, distribution, financing, and development of agricultural commodities and resources, including food, fiber, wood products, natural resources, horticulture, and other plant and animal products/resources.

(3) Floral Design is designed to develop students' ability to identify and demonstrate the elements and principles of floral design as well as develop an understanding of the management of floral enterprises. Through the analysis of artistic floral styles and historical periods, students develop respect for the traditions of and appreciation for the contributions of diverse cultures. Students respond to and analyze floral designs, thus contributing to the development of lifelong skills of making informed judgments and evaluations. To prepare for careers in floral design, students must attain academic knowledge and skills, acquire technical knowledge and skills related to horticultural systems, and develop knowledge and skills regarding career opportunities, entry requirements, and industry expectations. To prepare for success, students need opportunities to learn, reinforce, apply, and transfer their knowledge and skills and technologies in a variety of settings.

(4) Floral Design follows the four basic fine arts strands of foundations: observation and perception; creative expression; historical and cultural relevance; and critical evaluation and response to provide broad, unifying structures for organizing the knowledge and skills students are expected to acquire. Each strand is of equal value and may be presented in any order throughout the year. Students rely on personal observations and perceptions, which are developed through increasing visual literacy and sensitivity to surroundings, communities, memories, imaginings, and life experiences as sources for thinking about, planning, and creating original floral art. Students communicate their thoughts and ideas with innovation and creativity. Through floral design, students challenge their imaginations, foster critical thinking, collaborate with others, and build reflective skills. While exercising meaningful problem-solving skills, students develop the lifelong ability to make informed judgments.

(5) Students are encouraged to participate in extended learning experiences related to floral design such as career and technical student organizations and other leadership or extracurricular organizations.

(6) Statements that contain the word "including" reference content that must be mastered, while those containing the phrase "such as" are intended as possible illustrative examples.

(d) Knowledge and skills.

(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:

(A) identify career and entrepreneurship opportunities for a chosen occupation in the field of floral design and develop a plan for obtaining the education, training, and certifications required;

(B) model professionalism by continuously exhibiting appropriate work habits, solving problems, taking initiative, communicating effectively, listening actively, and thinking critically;

(C) model appropriate personal and occupational safety and health practices and explain the importance of established safety and health protocols for the workplace;

(D) analyze and interpret the rights and responsibilities, including ethical conduct and legal responsibilities, of employers and employees; and

(E) analyze the importance of exhibiting good citizenship and describe the effects of good citizenship on the development of home, school, workplace, and community.

(2) The student develops a supervised agricultural experience program. The student is expected to:

(A) plan, propose, conduct, document, and evaluate a supervised agricultural experience program as an experiential learning activity;

(B) use appropriate record-keeping skills in a supervised agricultural experience program;

(C) participate in youth agricultural leadership opportunities;

(D) review and participate in a local program of activities; and

(E) create or update documentation of relevant agricultural experience such as community service, professional, or classroom experiences.

(3) The student identifies elements and principles of design in floral art in both historical and current contexts. The student is expected to:

(A) identify the historical trends and characteristics of floral art as they relate to current industry practices;

(B) identify design elements in floral art, including color, texture, form, line, space, pattern, size, and fragrance;

(C) identify design principles in floral art, including rhythm, balance, proportion, dominance, contrast, harmony, and unity;

(D) identify the ancillary concepts of design principles such as emphasis, focal area, repetition, transition, opposition, and variation; and

(E) compare the forms and functions of flowers and foliage, including form, mass, line, and filler.

(4) The student demonstrates elements and principles through the creation of floral designs using flowers and plants. The student is expected to:

(A) create and evaluate floral arrangements using cut flowers, including arrangements using bud vases, and round, symmetrical, and asymmetrical designs;

(B) prepare and evaluate floral designs using permanent botanicals such as homecoming mums;

(C) design and create corsages and boutonnieres;

(D) construct floral designs for specific holidays and cultural occasions such as weddings and funerals;

(E) create interiorscapes using the elements and principles of floral design;

(F) apply proper wiring and taping techniques to materials used in the industry; and

(G) demonstrate safe and proper usage of floral design tools.

(5) The student makes informed judgments about personal designs and the designs of others. The student is expected to:

(A) interpret, evaluate, and justify artistic decisions in the design of personal arrangements;

(B) construct a physical or electronic portfolio of personal floral artwork to provide evidence of learning; and

(C) interpret and evaluate design elements and principles in floral arrangements of others.

(6) The student demonstrates contemporary designs and creativity in the floral industry by developing floral design skills. The student is expected to:

(A) identify and classify specialty floral items for a variety of occasions;

(B) evaluate and appraise floral designs; and

(C) create specialty designs to expand artistic expression.

(7) The student recognizes the current industry management and business practices of floral enterprises. The student is expected to:

(A) identify and classify flowers, foliage, and plants used in floral design;

(B) use temperature, preservatives, and cutting techniques to extend the vase life of floral materials;

(C) identify tools, chemicals, and equipment used in floral design;

(D) determine the needs of indoor plants such as fertilizing, lighting, pruning, and watering based on the condition of the plant;

(E) identify common pests and diseases that affect the floral industry;

(F) identify management techniques of pests and diseases in the floral industry, including the safe use of pesticides;

(G) create cost-effective floral designs;

(H) apply pricing and order-processing skills to meet various budgets and needs; and

(I) identify packaging, distribution, and setup logistics in the floral industry.

(8) The student understands botany and physiology and how they relate to floral design and interiorscapes. The student is expected to:

(A) analyze the structure and functions of indoor plants used in the floral industry; and

(B) identify the structure and functions of flowers used in the floral industry.

§127.54. Horticultural Science (One Credit), Adopted 2024.

(a) Implementation. The provisions of this section shall be implemented by school districts beginning with the 2025-2026 school year.

(b) General requirements. This course is recommended for students in Grades 10-12. Prerequisites: at least one credit in a course from the Agriculture, Food, and Natural Resources Career Cluster. Recommended prerequisite: Principles of Agriculture, Food, and Natural Resources. Students shall be awarded one credit for successful completion of this course.

(c) Introduction.

(1) 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.

(2) The Agriculture, Food, and Natural Resources Career Cluster focuses on the production, processing, marketing, distribution, financing, and development of agricultural commodities and resources, including food, fiber, wood products, natural resources, horticulture, and other plant and animal products/resources.

(3) In Horticultural Science, students develop an understanding of common horticultural management practices as they relate to food and ornamental plant production. To prepare for careers in horticultural industry systems, students must attain academic knowledge and skills, acquire technical knowledge and skills related to horticulture and the workplace, and develop knowledge and skills regarding career opportunities, entry requirements, and industry expectations. To prepare for success, students need opportunities to learn, reinforce, apply, and transfer knowledge and skills in a variety of settings.

(4) Students are encouraged to participate in extended learning experiences such as career and technical student organizations and other leadership or extracurricular organizations.

(5) Statements that contain the word "including" reference content that must be mastered, while those containing the phrase "such as" are intended as possible illustrative examples.

(d) Knowledge and skills.

(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:

(A) identify career and entrepreneurship opportunities in the field of plant science and develop a plan for obtaining the education, training, and certifications required;

(B) model professionalism by continuously exhibiting appropriate work habits, solving problems, taking initiative, communicating effectively, listening actively, and thinking critically;

(C) model appropriate personal and occupational safety and health practices and explain the importance of established safety and health protocols for the workplace;

(D) analyze and interpret the rights and responsibilities, including ethical conduct and legal responsibilities, of employers and employees; and

(E) analyze the importance of exhibiting good citizenship and describe the effects of good citizenship on the development of home, school, workplace, and community.

(2) The student develops a supervised agricultural experience program. The student is expected to:

(A) plan, propose, conduct, document, and evaluate a supervised agricultural experience program as an experiential learning activity;

(B) use appropriate record-keeping skills in a supervised agricultural experience program;

(C) participate in youth agricultural leadership opportunities;

(D) review and participate in a local program of activities; and

(E) create or update documentation of relevant agricultural experience such as community service, professional, or classroom experiences.

(3) The student understands the history and progression of the horticulture industry. The student is expected to:

(A) trace how relevant historical advancements in the horticulture industry relate to current industry practices;

(B) identify and describe different disciplines of horticulture such as arboriculture, floriculture, olericulture, pomology, viticulture, turf management, and ornamental horticulture;

(C) identify and research emerging technology in the horticulture industry;

(D) identify current trends in the horticulture industry; and

(E) compare types of horticulture industries in the different regions of Texas.

(4) The student identifies plant structures and their functions and needs. The student is expected to:

(A) classify horticultural plants by their common and scientific names;

(B) describe functional differences in plant structures, including roots, stems, flowers, leaves, and fruit;

(C) identify pollination factors affecting plants and trees such as access to pollinators, wind, and hand pollination;

(D) compare monocots and dicots;

(E) analyze environmental needs of plants, including light, water, and nutrients; and

(F) identify the components of a fertilizer label.

(5) The student develops technical knowledge and skills associated with the production of horticultural plants. The student is expected to:

(A) classify horticultural plants based on taxonomy;

(B) identify classifications of plants, including annuals, perennials, biennials, and evergreens, based on growing cycles;

(C) identify horticultural plants based on their physical characteristics;

(D) compare the reproduction of flowering and non-flowering horticultural plants;

(E) select appropriate tools and equipment for production of horticultural plants;

(F) demonstrate safe and appropriate use of tools and equipment; and

(G) identify maintenance practices for hand tools, power tools, and equipment.

(6) The student understands plant propagation techniques and growing methods. The student is expected to:

(A) identify asexual propagation methods for horticultural plants, including cuttings, grafting, budding, layering, and tissue culture;

(B) propagate horticultural plants using asexual methods such as cuttings, grafting, budding, layering, and tissue culture;

(C) manipulate the germination of seeds using various methods such as mechanical scarification, chemical scarification, and heat and cold treatments;

(D) compare various soil-based growing media; and

(E) identify soilless growing methods used in the horticulture industry.

(7) The student manages and controls common pests, diseases, and deficiencies of horticultural plants. The student is expected to:

(A) identify and manage common horticultural pests, diseases, and deficiencies;

(B) identify and manage common weeds that impact horticultural production;

(C) develop a plan for disease control using integrated pest management;

(D) apply proper sanitation methods to prevent the spread of pests;

(E) demonstrate safe and proper practices in selecting, applying, storing, and disposing of chemicals; and

(F) review and explain the parts of a pesticide label.

(8) The student understands the concepts of ornamental plants and landscape design. The student is expected to:

(A) compare landscaping methods that account for environmental variables such as water availability, soil type, light availability, and climate;

(B) identify and select plants, including bedding plants, shrubs, trees, and turf grasses, for landscapes based on United States Department of Agriculture (USDA) hardiness zones;

(C) design a landscape using design elements and principles; and

(D) compare sustainability practices such as planting native plants, water conservation, and irrigation technology used in a landscape.

(9) The student demonstrates business skills used in the horticulture industry. The student is expected to:

(A) identify opportunities for entrepreneurship in the horticulture industry;

(B) identify practices to maintain business relationships;

(C) demonstrate correct procedures for handling customer sales transactions;

(D) calculate pricing to maximize profit for wholesale and retail settings;

(E) develop a plan to market horticultural products and services; and

(F) formulate a budget for a horticultural enterprise.

§127.55. Greenhouse Operation and Production (One Credit), Adopted 2024.

(a) Implementation. The provisions of this section shall be implemented by school districts beginning with the 2025-2026 school year.

(b) General requirements. This course is recommended for students in Grades 10-12. Recommended prerequisite: Principles of Agriculture, Food, and Natural Resources. Students shall be awarded one credit for successful completion of this course.

(c) Introduction.

(1) 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.

(2) The Agriculture, Food, and Natural Resources Career Cluster focuses on the production, processing, marketing, distribution, financing, and development of agricultural commodities and resources, including food, fiber, wood products, natural resources, horticulture, and other plant and animal products/resources.

(3) Greenhouse Operation and Production is designed for students to develop an understanding of greenhouse production techniques and practices. To prepare for careers in horticultural and controlled environment agricultural systems, students must attain academic knowledge and skills, acquire technical knowledge and skills related to horticultural systems and the workplace, and develop knowledge and skills regarding career opportunities, entry requirements, and industry expectations. To prepare for success, students need opportunities to learn, reinforce, apply, and transfer their knowledge and skills and technologies in a variety of settings.

(4) Students are encouraged to participate in extended learning experiences such as career and technical student organizations and other leadership or extracurricular organizations.

(5) Statements that contain the word "including" reference content that must be mastered, while those containing the phrase "such as" are intended as possible illustrative examples.

(d) Knowledge and skills.

(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:

(A) identify career development, education, and entrepreneurship opportunities in the field of greenhouse operation and production;

(B) identify and demonstrate interpersonal, problem-solving, and critical-thinking skills used in greenhouse operation and production;

(C) describe and demonstrate appropriate personal and occupational safety and health practices for the workplace;

(D) identify employers' expectations, including appropriate work habits, ethical conduct, and legal responsibilities;

(E) describe and demonstrate characteristics of good citizenship such as stewardship, advocacy, and community leadership; and

(F) identify training, education, and certification requirements for occupational choices.

(2) The student develops a supervised agricultural experience program. The student is expected to:

(A) plan, propose, conduct, document, and evaluate a supervised agricultural experience program as an experiential learning activity;

(B) use appropriate record-keeping skills in a supervised agricultural experience program;

(C) participate in youth agricultural leadership opportunities;

(D) review and participate in a local program of activities; and

(E) create or update documentation of relevant agricultural experience such as community service, professional, or classroom experiences.

(3) The student understands the history and progress of the greenhouse industry. The student is expected to:

(A) trace the relevant historical advancements in the greenhouse industry such as developments in construction materials and use of technology and describe the impact of these advancements on current industry practices;

(B) research and identify emerging technologies in the greenhouse industry; and

(C) analyze current trends in the greenhouse industry.

(4) The student identifies and investigates different greenhouse structures, interior layout, and construction factors. The student is expected to:

(A) compare greenhouse styles and construction materials;

(B) compare and select greenhouse coverings;

(C) analyze the costs associated with greenhouse construction;

(D) identify factors to consider when constructing a greenhouse such as greenhouse orientation and access to electricity, roads, drainage, water, and plumbing;

(E) identify additional growing structures such as cold frames and hotbeds;

(F) design a layout of essential areas of a greenhouse such as receiving, storage, seedling propagation, crop production, harvest, sanitation, packaging, labeling, and distribution areas;

(G) describe the adaptation of greenhouse concepts to plant production in controlled environments such as indoor vertical farms and freight containers;

(H) differentiate between passive and controlled greenhouses; and

(I) analyze greenhouse operation regulations enacted by regulatory agencies such as the Texas Department of Agriculture, the United States Department of Agriculture, and local agencies.

(5) The student identifies and assesses environmental conditions within the greenhouse. The student is expected to:

(A) describe various environmental factors controlled in the greenhouse;

(B) determine and calculate factors used in heating and cooling a greenhouse;

(C) describe the effects of greenhouse climate conditions such as ventilation, carbon dioxide generation, and humidity on plant growth in the greenhouse;

(D) explore the importance of light characteristics on the production of greenhouse crops; and

(E) compare open and closed environmental systems in the greenhouse such as irrigation, lighting, climate control, carbon dioxide injection, and fertilization.

(6) The student identifies, operates, and maintains greenhouse environmental and mechanical controls. The student is expected to:

(A) explain how to operate and maintain heating, cooling, and ventilation systems in a greenhouse;

(B) explain how to operate and maintain electrical systems in a greenhouse;

(C) explain how to operate and maintain various water systems in a greenhouse;

(D) explain how to operate lighting systems in a greenhouse; and

(E) illustrate and describe the integration of automated control systems such as lighting, cooling, irrigation, fertigation, and carbon dioxide injection.

(7) The student identifies and classifies plants used in greenhouse production. The student is expected to:

(A) classify plants commonly used in greenhouses based on taxonomic systems;

(B) identify and compare plant anatomical structures and functions for plant identification; and

(C) analyze plant classifications based on cropping schedules and market demand for greenhouse crops.

(8) The student identifies and investigates greenhouse crop production factors. The student is expected to:

(A) identify and explain the chemical and physical differences in greenhouse media components;

(B) compare greenhouse growing mixes for factors, including drainage and nutrient-holding capacity;

(C) compare different containers, benches, and production equipment used in greenhouses;

(D) evaluate different methods of watering greenhouse crops based on the type of crop, stage of development, cost-effectiveness, and weather;

(E) analyze the effect of nutrients on greenhouse plant growth;

(F) diagnose common nutrient deficiency symptoms found in greenhouse crops; and

(G) develop fertilization plans that address greenhouse crop needs and environmental impacts.

(9) The student propagates greenhouse crops. The student is expected to:

(A) analyze different methods of propagating greenhouse crops using sexual and asexual propagation methods;

(B) propagate greenhouse crops using sexual and asexual methods;

(C) investigate and explain physiological conditions that affect plant propagation; and

(D) analyze the effects of plant growth regulators on plant growth and development.

(10) The student investigates pest and disease identification and control methods in the greenhouse environment. The student is expected to:

(A) identify and classify common diseases, insects, pathogens, and weeds in the greenhouse;

(B) identify essential components of an integrated pest management plan in controlling an insect, pathogen, or weed problem;

(C) identify appropriate greenhouse pesticide application techniques and equipment; and

(D) analyze pesticide labeling and safety data sheets.

(11) The student performs greenhouse management business procedures. The student is expected to:

(A) identify and develop effective marketing strategies to market greenhouse crops to increase profits;

(B) develop appropriate methods for preparing greenhouse crops for various means of transport;

(C) analyze materials, labor, and administrative costs related to greenhouse production;

(D) analyze methods used to maintain crop quality during marketing and transport; and

(E) prepare a production schedule for a greenhouse crop from establishment to market within a specific timeline.

§127.56. Viticulture (One Credit), Adopted 2024.

(a) Implementation. The provisions of this section shall be implemented by school districts beginning with the 2025-2026 school year.

(b) General requirements. This course is recommended for students in Grades 10-12. Prerequisites: at least one credit in a course from the Agriculture, Food, and Natural Resources Career Cluster. Recommended prerequisite: Principles of Agriculture, Food and Natural Resources. Students shall be awarded one credit for successful completion of this course.

(c) Introduction.

(1) 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.

(2) The Agriculture, Food, and Natural Resources Career Cluster focuses on the production, processing, marketing, distribution, financing, and development of agricultural commodities and resources, including food, fiber, wood products, natural resources, horticulture, and other plant and animal products/resources.

(3) Viticulture is a course designed to provide students with the academic and technical knowledge and skills that are required to pursue a career related to vineyard operations, grape cultivation, and related industries that contribute to the Texas economy. Students in Viticulture develop an understanding of grape production techniques and practices while emphasizing environmental science related to production decisions. To prepare for success, students need opportunities to learn, reinforce, experience, apply, and transfer their knowledge and skills in a variety of settings.

(4) Students are encouraged to participate in extended learning experiences such as career and technical student organizations and other leadership or extracurricular organizations.

(5) Statements that contain the word "including" reference content that must be mastered, while those containing the phrase "such as" are intended as possible illustrative examples.

(d) Knowledge and skills.

(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:

(A) identify career and entrepreneurship opportunities for a chosen occupation in the field of viticulture and develop a plan for obtaining the education, training, and certifications required;

(B) model professionalism by continuously exhibiting appropriate work habits, solving problems, taking initiative, communicating effectively, listening actively, and thinking critically;

(C) model appropriate personal and occupational safety and health practices and explain the importance of established safety and health protocols for the workplace;

(D) analyze and interpret the rights and responsibilities, including ethical conduct and legal responsibilities, of employers and employees; and

(E) analyze the importance of exhibiting good citizenship and describe the effects of good citizenship on the development of home, school, workplace, and community.

(2) The student develops a supervised agricultural experience program. The student is expected to:

(A) plan, propose, conduct, document, and evaluate a supervised agricultural experience program as an experiential learning activity;

(B) use appropriate record-keeping skills in a supervised agricultural experience program;

(C) participate in youth agricultural leadership opportunities;

(D) review and participate in a local program of activities; and

(E) create or update documentation of relevant agricultural experience such as community service, professional, or classroom experiences.

(3) The student understands the history and progression of the viticulture industry. The student is expected to:

(A) trace how relevant historical advancements in viticulture relate to current industry practices;

(B) research and identify emerging technology in the viticulture industry; and

(C) identify current trends in the viticulture industry.

(4) The student explains the production cycle and basic physiology of grapevines. The student is expected to:

(A) describe asexual propagation techniques used in the production of domesticated grapes;

(B) identify the major vegetative and reproductive structures of grapevines;

(C) explain the role of rootstock in grapevine production;

(D) describe the annual vegetative growth and reproductive cycle of grapevines;

(E) explain how environmental conditions influence grapevine vegetative and reproductive growth; and

(F) describe the use of training systems in vineyard production.

(5) The student analyzes vineyard design and development. The student is expected to:

(A) identify the site characteristics required for successful vineyard production;

(B) evaluate the soil and climatic characteristics of a potential vineyard site to determine if it is suitable for vineyard production;

(C) identify and research successful vineyards in other parts of the world with soil and climatic characteristics similar to local conditions; and

(D) develop a vineyard design and installation plan.

(6) The student evaluates technology and practices used for vineyard frost protection. The student is expected to:

(A) describe the environmental conditions that lead to plant cold injury;

(B) identify frost damage in grapevines and effective frost damage mitigation techniques;

(C) differentiate advection and radiation frost events;

(D) evaluate passive frost protection techniques employed in vineyards;

(E) evaluate active frost protection techniques employed in vineyards; and

(F) analyze the cost effectiveness of frost protection systems.

(7) The student demonstrates vineyard management techniques. The student is expected to:

(A) identify and demonstrate safe and appropriate usage of vineyard tools;

(B) describe dormant pruning of grapevines as an effective method for minimizing crop loss due to frost;

(C) identify grapevine-training techniques such as spur and cane pruning; and

(D) explain the use of technology in modern vineyard production systems such as drones, robotics, and smart irrigation.

(8) The student develops an integrated pest management plan for vineyards. The student is expected to:

(A) identify common insect pests and diseases found in vineyards;

(B) identify common animal pests that are problematic in vineyards;

(C) evaluate the components of integrated pest management used in vineyards;

(D) explain cultural practices for vineyard pest control; and

(E) describe the safe and effective use of pesticides in vineyards, ensuring compliance with federal and state regulations.

(9) The student examines soil properties and soil fertility as they relate to vineyard production systems. The student is expected to:

(A) explain the concepts of soil type, soil texture, and basic soil chemistry;

(B) identify the essential nutrients required by grapevines;

(C) describe the relationship between soil properties and fertility;

(D) calculate the fertilizer needs of grapevines;

(E) develop and present a vineyard fertilization plan; and

(F) identify the practices of organic vineyards.

(10) The student evaluates water requirements of vineyards and associated climatic factors. The student is expected to:

(A) evaluate grapevine water requirements;

(B) compare grape varieties that thrive in local soil and weather conditions;

(C) analyze the influence of soil properties and climate on vineyard water usage;

(D) describe irrigation strategies used in vineyards;

(E) identify the water resources required for vineyards;

(F) describe methods used to determine soil moisture; and

(G) calculate the irrigation needs of vineyards based on soil and climate.

§127.57. Advanced Floral Design (One Credit), Adopted 2024.

(a) Implementation. The provisions of this section shall be implemented by school districts beginning with the 2025-2026 school year.

(b) General requirements. This course is recommended for students in Grades 11 and 12. Prerequisite: Floral Design. Recommended prerequisite: Principles of Agriculture, Food, and Natural Resources. Students shall be awarded one credit for successful completion of this course.

(c) Introduction.

(1) 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.

(2) The Agriculture, Food, and Natural Resources Career Cluster focuses on the production, processing, marketing, distribution, financing, and development of agricultural commodities and resources, including food, fiber, wood products, natural resources, horticulture, and other plant and animal products/resources.

(3) In Advanced Floral Design, students gain advanced knowledge and skills specifically needed to enter the workforce as floral designers or as freelance floral event designers, with an emphasis on specialty designs and occasion-specific designs and planning. Students are also prepared to enter postsecondary certification or degree programs in floral design or special events design. Students build on the knowledge base from Floral Design and are introduced to more advanced floral design concepts. In addition, students gain knowledge of the design elements and planning techniques used to produce unique specialty floral designs that support the goals and objectives of an occasion or event.

(4) Students are encouraged to participate in extended learning experiences such as career and technical student organizations and other leadership or extracurricular organizations.

(5) Statements that contain the word "including" reference content that must be mastered, while those containing the phrase "such as" are intended as possible illustrative examples.

(d) Knowledge and skills.

(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:

(A) identify career and entrepreneurship opportunities for a chosen occupation in the field of floral design and develop a plan for obtaining the education, training, and certifications required;

(B) model professionalism by continuously exhibiting appropriate work habits, solving problems, taking initiative, communicating effectively, listening actively, and thinking critically;

(C) model appropriate personal and occupational safety and health practices and explain the importance of established safety and health protocols for the workplace;

(D) analyze and interpret the rights and responsibilities, including ethical conduct and legal responsibilities, of employers and employees; and

(E) analyze the importance of exhibiting good citizenship and describe the effects of good citizenship on the development of home, school, workplace, and community.

(2) The student develops a supervised agricultural experience program. The student is expected to:

(A) plan, propose, conduct, document, and evaluate a supervised agricultural experience program as an experiential learning activity;

(B) use appropriate record-keeping skills in a supervised agricultural experience program;

(C) participate in youth agricultural leadership opportunities;

(D) review and participate in a local program of activities; and

(E) create or update documentation of relevant agricultural experience such as community service, professional, or classroom experiences.

(3) The student understands advanced floral design elements and principles. The student is expected to:

(A) describe floral materials using advanced botanical terminology;

(B) identify the symbolic meaning of flowers and plants used in floral design such as love, friendship, courage, and innocence;

(C) compare the characteristics of contemporary floral design styles such as abstract, assemblage, asymmetrical, Biedermeier, cascade/waterfall, hedgerow, parallel, synergistic, submerged, topiary, and vegetative;

(D) illustrate ideas for arrangements using contemporary floral design styles from direct observation, experience, and imagination;

(E) identify various basing design techniques, including layering, terracing, pavé, clustering, and pillowing; and

(F) identify advanced focal-emphasis design techniques, including grouping, banding, binding, shadowing, sequencing, framing, zoning, and parallelism.

(4) The student demonstrates advanced design techniques using fresh and permanent floral designs. The student is expected to:

(A) plan and design fresh flower and permanent botanical arrangements using various contemporary design styles such as abstract, assemblage, asymmetrical, Biedermeier, cascade/waterfall, hedgerow, parallel, synergistic, submerged, topiary, and vegetative;

(B) design and evaluate floral designs that exhibit various basing design techniques such as layering, terracing, pavé, clustering, and pillowing; and

(C) design and evaluate floral designs using advanced focal-emphasis design techniques such as grouping, banding, binding, shadowing, sequencing, framing, zoning, and parallelism.

(5) The student describes effective design planning and the processes used to create floral designs for specific occasions and events. The student is expected to:

(A) develop proper planning techniques in floral design;

(B) identify and execute the steps of effective planning used to design floral arrangements for specific occasions such as weddings and funerals;

(C) analyze and discuss contingency factors when planning large-volume floral designs; and

(D) identify effective consultation practices to determine customers' expectations for design, including budget.

(6) The student applies key floral design elements and principles to enhance the experience of specific occasions and events. The student is expected to:

(A) identify floral design terminology used for specific occasions, including weddings and funerals;

(B) apply elements and principles of floral design to wedding and funeral arrangements such as bouquets, boutonnieres, corsages, sprays, and pedestal arrangements;

(C) describe current floral design trends;

(D) use and maintain floral design tools; and

(E) create examples of appropriate occasion-specific floral designs from direct observation, experience, and imagination.

(7) The student demonstrates effective planning of occasion-specific floral designs from the conceptual stage through completion. The student is expected to:

(A) conduct a floral design consultation to gather details, including occasion, budget, formality, and theme;

(B) evaluate and select floral arrangements that achieve the objectives and budget expectations of an occasion;

(C) develop a proposal that showcases floral arrangements appropriate for the selected occasion;

(D) develop a production schedule that allows sufficient time for the design, creation, installation, and disassembly of floral arrangements;

(E) develop a procurement plan to ensure necessary resources are obtained within a specified budget and timeframe; and

(F) implement and evaluate a floral design plan through completion.

(8) The student demonstrates business management and merchandising skills necessary for floral design and freelance floral event design professionals. The student is expected to:

(A) calculate mark-up of floral products and design services;

(B) evaluate the cost-effectiveness and profitability of pricing policies;

(C) develop and negotiate contracts for floral services;

(D) formulate a floral budget, including per-item total costs;

(E) demonstrate proper customer service skills for a floral business;

(F) identify business relationships with a variety of vendors such as wedding venues, funeral homes, wholesale florists, and wire services; and

(G) analyze basic marketing principles and procedures used in the floral industry such as displays and advertisements.

(9) The student explains the significance of professional organizations to the floral design industry. The student is expected to:

(A) identify industry-related professional organizations; and

(B) describe the benefits of participating in professional floral organizations and earning industry-based certifications.

§127.58. Advanced Plant and Soil Science (One Credit), Adopted 2024.

(a) Implementation. The provisions of this section shall be implemented by school districts beginning with the 2025-2026 school year.

(b) General requirements. This course is recommended for students in Grades 11 and 12. Prerequisites: Biology; either Chemistry or Integrated Physics and Chemistry (IPC); Algebra I; Geometry; and either Horticultural Science, Greenhouse Operation and Production, or Floral Design. Recommended prerequisite: Principles of Agriculture, Food, and Natural Resources. 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.

(c) Introduction.

(1) 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.

(2) The Agriculture, Food, and Natural Resources Career Cluster focuses on the production, processing, marketing, distribution, financing, and development of agricultural commodities and resources, including food, fiber, wood products, natural resources, horticulture, and other plant and animal products/resources.

(3) Advanced Plant and Soil Science provides a way of learning about the natural world. In this course, students learn how plant and soil science has influenced a vast body of knowledge, that there are still applications to be discovered, and that plant and soil science is the basis for many other fields of science. To prepare for careers in plant and soil science, students must attain academic knowledge and skills, acquire technical knowledge and skills related to plant and soil science and the workplace, and develop knowledge and skills regarding career opportunities, entry requirements, and industry expectations. To prepare for success, students need opportunities to learn, reinforce, apply, and transfer their knowledge and skills and technologies in a variety of settings.

(4) Nature of science. 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 is 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.

(5) Scientific hypotheses and theories. Students are expected to know that:

(A) hypotheses are tentative and testable statements that must be capable of being supported or not supported by observational evidence. Hypotheses of durable explanatory power that have been tested over a wide variety of conditions are incorporated into theories; and

(B) 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.

(6) Scientific inquiry. Scientific inquiry is the planned and deliberate investigation of the natural world using scientific and engineering practices. Scientific methods of investigation are descriptive, comparative, or experimental. The method chosen should be appropriate to the question being asked. Student learning for different types of investigations include descriptive investigations, which involve collecting data and recording observations without making comparisons; comparative investigations, which involve collecting data with variables that are manipulated to compare results; and experimental investigations, which involve processes similar to comparative investigations but in which a control is identified.

(A) Scientific practices. Students should be able to ask questions, plan and conduct investigations to answer questions, and explain phenomena using appropriate tools and models.

(B) Engineering practices. Students should be able to identify problems and design solutions using appropriate tools and models.

(7) Science and social ethics. Scientific decision making is a way of answering questions about the natural world involving its own set of ethical standards about how the process of science should be carried out. Students should be able to distinguish between scientific decision-making methods (scientific methods) and ethical and social decisions that involve science (the application of scientific information).

(8) Science consists of recurring themes and making connections between overarching concepts. Recurring themes include systems, models, and patterns. All systems have basic properties that

can be described in 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, while models allow for boundary specification and provide tools for understanding the ideas presented. 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.

(9) Students are encouraged to participate in extended learning experiences such as career and technical student organizations and other leadership or extracurricular organizations.

(10) Statements that contain the word "including" reference content that must be mastered, while those containing the phrase "such as" are intended as possible illustrative examples.

(d) Knowledge and skills.

(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:

(A) identify career and entrepreneurship opportunities for a chosen occupation in the field of plant science and develop a plan for obtaining the education, training, and certifications required;

(B) model professionalism by continuously exhibiting appropriate work habits, solving problems, taking initiative, communicating effectively, listening actively, and thinking critically;

(C) model appropriate personal and occupational safety practices and explain the importance of established safety and health protocols for the workplace;

(D) analyze and interpret the rights and responsibilities, including ethical conduct and legal responsibilities, of employers and employees; and

(E) analyze the importance of exhibiting good citizenship and describe the effects of good citizenship on the development of home, school, workplace, and community.

(2) Scientific and engineering practices. The student, for at least 40% of instructional time, asks questions, identifies problems, and plans and safely conducts classroom, laboratory, and field investigations to answer questions, explain phenomena, or design solutions using appropriate tools and models. The student is expected to:

(A) ask questions and define problems based on observations or information from text, phenomena, models, or investigations;

(B) apply scientific practices to plan and conduct descriptive, comparative, and experimental investigations and use engineering practices to design solutions to problems;

(C) use appropriate safety equipment and practices during laboratory, classroom, and field investigations as outlined in Texas Education Agency-approved safety standards;

(D) use appropriate tools such as microscopes, measuring equipment, sensors, plant propagation tools, soil testing kits, and calculators;

(E) collect quantitative data using the International System of Units (SI) and qualitative data as evidence;

(F) organize quantitative and qualitative data using graphs and charts;

(G) develop and use models to represent phenomena, systems, processes, or solutions to engineering problems; and

(H) distinguish between scientific hypotheses, theories, and laws.

(3) Scientific and engineering practices. The student analyzes and interprets data to derive meaning, identify features and patterns, and discover relationships or correlations to develop evidence-based arguments or evaluate designs. The student is expected to:

(A) identify advantages and limitations of models such as their size, scale, properties, and materials;

(B) analyze data by identifying significant statistical features, patterns, sources of error, and limitations;

(C) use mathematical calculations to assess quantitative relationships in data; and

(D) evaluate experimental and engineering designs.

(4) Scientific and engineering practices. The student develops evidence-based explanations and communicates findings, conclusions, and proposed solutions. The student is expected to:

(A) develop explanations and propose solutions supported by data and models and consistent with scientific ideas, principles, and theories;

(B) communicate explanations and solutions individually and collaboratively in a variety of settings and formats; and

(C) engage respectfully in scientific argumentation using applied scientific explanations and empirical evidence.

(5) Scientific and engineering practices. The student knows the contributions of scientists and recognizes the importance of scientific research and innovation on society. The student is expected to:

(A) analyze, evaluate, and critique scientific explanations and solutions by using empirical evidence, logical reasoning, and experimental and observational testing so as to encourage critical thinking by the student;

(B) relate the impact of past and current research on scientific thought and society, including research methodology, cost-benefit analysis, and contributions of diverse scientists as related to the content; and

(C) research and explore resources such as museums, libraries, professional organizations, private companies, online platforms, and mentors employed in a science, technology, engineering, and mathematics (STEM) field in order to investigate STEM careers.

(6) The student develops a supervised agricultural experience program. The student is expected to:

(A) plan, propose, conduct, document, and evaluate a supervised agricultural experience program as an experiential learning activity;

(B) use appropriate record-keeping skills in a supervised agricultural experience program;

(C) participate in youth agricultural leadership opportunities;

(D) review and participate in a local program of activities; and

(E) create or update documentation of relevant agricultural experience such as community service, professional, or classroom experiences.

(7) The student understands interrelationships between plants, soil, and people in historical and current contexts. The student is expected to:

(A) research and document major historical milestones of plants and soil in human civilization;

(B) explain how humans have influenced plant selection and how plant selection has influenced civilization's development;

(C) analyze the effect of soil properties on settlement of civilizations and migration; and

(D) investigate and explain how plants have shaped major world economies.

(8) The student identifies how plants grow and how specialized cells, tissues, and organs develop. The student is expected to:

(A) describe the unique structure and function of organelles in plant cells;

(B) explain the growth and division of plant cells;

(C) compare cells from different parts of the plant, including roots, stems, flowers, and leaves, to show specialization of structures and functions; and

(D) illustrate the levels of cellular organization in plants.

(9) The student develops a knowledge of plant anatomy and functions. The student is expected to:

(A) describe the structure and function of plant parts, including roots, stems, leaves, flowers, fruits, and seeds;

(B) compare the anatomy of monocots and dicots;

(C) compare the various propagation methods for plants; and

(D) identify the functions of modified plant structures such as tubers, rhizomes, pseudo stems, and pitchers.

(10) The student develops an understanding of plant physiology and nutrition. The student is expected to:

(A) explain the metabolic process of photosynthesis and cellular respiration;

(B) describe the role of mineral nutrition in the soil for plant development;

(C) identify the essential nutrients in soil; and

(D) describe the role of macronutrients and micronutrients in plants.

(11) The student analyzes soil science as it relates to plant and human activity. The student is expected to:

(A) explain soil formation;

(B) investigate and document the properties of soils, including texture, horizons, structure, color, parent materials, and fertility;

(C) identify and classify soil orders;

(D) explain methods of soil conservation such as crop rotation, mulching, terracing, cover cropping, and contour plowing;

(E) describe the application of soil mechanics to buildings, landscapes, and crop production;

(F) research and explain soil management practices such as tillage trials and sustainable soil management practices;

(G) practice and explain soil evaluations related to experiential activities such as land judging;

(H) evaluate and determine soil health through soil testing; and

(I) analyze concepts of soil ecology.

(12) The student maps the process of soil formation influenced by weathering, including erosion processes due to water, wind, and mechanical factors influenced by climate. The student is expected to:

(A) illustrate the role of weathering in soil formations;

(B) distinguish between chemical weathering and mechanical weathering;

(C) identify geological formations that result from differing weathering processes; and

(D) describe the role of biotic factors in soil formation.

(13) The student explains the relationship of biotic and abiotic factors within habitats and ecosystems and their effects on plant ecology. The student is expected to:

(A) identify and define plant populations, ecosystems, communities, and biomes;

(B) distinguish between native and introduced plants in an ecosystem;

(C) investigate and describe characteristics of native and introduced plants;

(D) make observations and compile data about fluctuations in abiotic cycles;

(E) describe the effects of fluctuations in abiotic cycles on local ecosystems; and

(F) debate the impact of human activity such as pest control, hydroponics, monoculture planting, and sustainable agriculture on ecosystems.

(14) The student evaluates components of plant science as they relate to crop production and advancements. The student is expected to:

(A) analyze the genetics and evolution of various crops;

(B) identify and classify plants according to taxonomy;

(C) identify characteristics related to seed quality, including mechanical damage, viability, and grade;

(D) identify plant pests and diseases using laboratory equipment such as microscopes, test kits, and technology;

(E) investigate and evaluate plant management practices, including germination tests, plant spacing trials, and fertilizer tests;

(F) analyze trends in crop species and varieties grown locally in Texas and the United States and how trends affect producers and consumers; and

(G) investigate and identify recent advancements in plant and soil science such as biotechnology, artificial intelligence, and drone, infrared, and sensor technologies.

(15) The student describes the relationship between resources within environmental systems. The student is expected to:

(A) summarize and evaluate methods of land use and management;

(B) identify sources, quality, and conservation of water in plant production;

(C) explore and describe conservation practices such as rainwater collection, water-conserving irrigation systems, and use of biofuels;

(D) analyze and evaluate the economic significance and interdependence of components of the environment;

(E) debate the impact of human activity and technology on soil health and plant productivity;

(F) research and summarize the impact of natural disasters on soil health and plant productivity; and

(G) explain how regional changes in the environment may have a global effect.

(16) The student describes the dynamics of soil on watersheds and its effects on plant growth and production. The student is expected to:

(A) identify and record the characteristics of a local watershed such as average annual rainfall, runoff patterns, aquifers, location of water basins, and surface reservoirs; and

(B) analyze the impact of floods, drought, irrigation, urbanization, and industrialization in a watershed.

(17) The student analyzes plant and soil science as it relates to plant and soil relationships affecting the production of food, fiber, and other economic crops. The student is expected to:

(A) explain the importance and interrelationship of soil and plants; and

(B) compare soil and plants in agricultural and urban settings.

(18) The student demonstrates skills related to the human, scientific, and technological dimensions of crop production and the resources necessary for producing domesticated plants. The student is expected to:

(A) describe the growth and development of major agricultural crops in Texas such as cotton, corn, sorghum, sugarcane, wheat, and rice;

(B) apply principles of genetics and plant breeding to plant production;

(C) illustrate the development of new crop varieties that are developed over time;

(D) design and conduct investigations to test principles of genetics; and

(E) identify and test alternative growing methods such as hydroponics and aquaponics used in plant production.

§127.86. Practicum in Agriculture, Food, and Natural Resources (Two Credits), Adopted 2024.

(a) Implementation. The provisions of this section shall be implemented by school districts beginning with the 2025-2026 school year.

(b) General requirements. This course is recommended for students in Grades 11 and 12. The practicum course is a paid or an unpaid capstone experience for students participating in a coherent sequence of career and technical education courses in the Agriculture, Food, and Natural Resources Career Cluster. Prerequisite: a minimum of two credits with at least one course in a Level 2 or higher course from the Agriculture, Food, and Natural Resources Career Cluster. Students shall be awarded two credits for successful completion of this course. A student may repeat this course once for credit provided that the student is experiencing different aspects of the industry and demonstrating proficiency in additional and more advanced knowledge and skills.

(c) Introduction.

(1) 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.

(2) The Agriculture, Food, and Natural Resources Career Cluster focuses on the production, processing, marketing, distribution, financing, and development of agricultural commodities and resources, including food, fiber, wood products, natural resources, horticulture, and other plant and animal products and resources.

(3) Practicum in Agriculture, Food, and Natural Resources is designed to give students supervised practical application of knowledge and skills. Practicum experiences can occur in a variety of locations appropriate to the nature and level of experiences such as employment, independent study, internships, assistantships, mentorships, or laboratories. To prepare for careers in agriculture, food, and natural resources, students must attain academic knowledge and skills, acquire technical knowledge and skills related to the workplace, and develop knowledge and skills regarding career opportunities, entry requirements, and industry expectations. To prepare for success, students need opportunities to learn, reinforce, apply, and transfer their knowledge and skills and technologies in a variety of settings.

(4) Students are encouraged to participate in extended learning experiences such as career and technical student organizations and other leadership or extracurricular organizations.

(5) Statements that contain the word "including" reference content that must be mastered, while those containing the phrase "such as" are intended as possible illustrative examples.

(d) Knowledge and skills.

(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:

(A) adhere to policies and procedures;

(B) demonstrate positive work behaviors, including punctuality, time management, initiative, and cooperation;

(C) apply constructive criticism and critical feedback from supervisor and peers to work performance;

(D) apply ethical reasoning to a variety of situations in order to make ethical decisions;

(E) model professional appearance, including using appropriate dress, grooming, and personal protective equipment;

(F) comply with safety rules and regulations to maintain safe working conditions and environments;

(G) demonstrate a positive and productive work ethic by performing assigned tasks as directed; and

(H) comply with all applicable rules, laws, and regulations in a consistent manner.

(2) The student develops a supervised agricultural experience program. The student is expected to:

(A) plan, propose, conduct, document, and evaluate a supervised agricultural experience program;

(B) use appropriate record-keeping skills in a supervised agricultural experience program;

(C) participate in youth agricultural leadership opportunities;

(D) review and participate in a local program of activities; and

(E) create or update documentation of relevant agricultural experience such as community service, professional, or classroom experiences.

(3) The student applies concepts of critical thinking and problem solving. The student is expected to:

(A) analyze elements of a problem to develop creative and innovative solutions in the agricultural workplace;

(B) compare alternative ways to solve a problem in the agricultural workplace; and

(C) analyze data to inform agriculture operational decisions or activities.

(4) The student demonstrates leadership and teamwork skills to accomplish goals and objectives. The student is expected to:

(A) analyze leadership characteristics such as trustworthiness, positive attitude, integrity, and work ethic;

(B) demonstrate teamwork processes such as team building, consensus, continuous improvement, respect for the opinions of others, cooperation, adaptability, and conflict resolution in the agricultural workplace;

(C) demonstrate responsibility for shared group and individual work tasks in the agricultural workplace;

(D) establish and maintain effective working relationships using interpersonal skills to accomplish objectives; and

(E) demonstrate respect for all individuals.

(5) The student demonstrates oral and written communication skills in creating, expressing, and interpreting information and ideas, including technical terminology and information. The student is expected to:

(A) apply appropriate content knowledge, technical concepts, and vocabulary to analyze information and follow directions;

(B) use professional communication skills when receiving and conveying information in the agricultural workplace;

(C) identify and analyze information contained in informational texts, internet sites, or technical materials in the agricultural workplace;

(D) evaluate verbal and nonverbal cues and behaviors to enhance communication in the agricultural workplace;

(E) apply active listening skills to receive and clarify information in the agricultural workplace; and

(F) produce effective written and oral communication in the agricultural workplace.

(6) The student practices financial literacy as it relates to agriculture. The student is expected to:

(A) develop a budget based on personal financial goals;

(B) interpret the different components of a pay stub;

(C) read and reconcile bank statements;

(D) maintain financial records, including pay stubs, bank statements, and tax records;

(E) define credit and identify factors that impact a credit score;

(F) identify methods to prevent identity theft; and

(G) prepare or model how to complete a personal income tax form.

(7) The student demonstrates technical knowledge and skills required to pursue a career in the Agriculture, Food, and Natural Resources Career Cluster. The student is expected to:

(A) develop advanced technical knowledge and skills related to the individual occupational objective;

(B) develop an individualized training plan;

(C) evaluate personal strengths and weaknesses in technical skill proficiency;

(D) explain safe operation of tools and equipment related to the work experience;

(E) identify the cost of supplies, tools, equipment, or structures related to the work experience;

(F) identify the importance of maintaining supplies, tools, equipment, or structures related to the work experience; and

(G) identify opportunities for licensure or certification related to the chosen career path.

(8) The student documents technical knowledge and skills. The student is expected to:

(A) create a professional portfolio that includes:

(i) attainment of technical skill competencies;

(ii) licensures or certifications;

(iii) recognitions, awards, scholarships, or letters of recommendation;

(iv) extended learning experiences such as community service and active participation in career and technical student organizations and professional organizations;

(v) a summary of individual practicum experience;

(vi) a resume;

(vii) samples of work; and

(viii) an evaluation from the practicum supervisor; and

(B) present the portfolio to interested stakeholders.

§127.87. Extended Practicum in Agriculture, Food, and Natural Resources (One Credit), Adopted 2024.

(a) Implementation. The provisions of this section shall be implemented by school districts beginning with the 2025-2026 school year.

(b) General requirements. This course is recommended for students in Grades 11 and 12. The practicum course is a paid or an unpaid capstone experience for students participating in a coherent sequence of career and technical education courses in the Agriculture, Food, and Natural Resources Career Cluster. Prerequisite: a minimum of two credits with at least one course in a Level 2 or higher course from the Agriculture, Food, and Natural Resources Career Cluster. Corequisite: Practicum in Agriculture, Food, and Natural Resources. This course must be taken concurrently with Practicum in Agriculture, Food, and Natural Resources and may not be taken as a stand-alone course. Students shall be awarded one credit for successful completion of this course. A student may repeat this course once for credit provided that the student is experiencing different aspects of the industry and demonstrating proficiency in additional and more advanced knowledge and skills.

(c) Introduction.

(1) 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.

(2) The Agriculture, Food, and Natural Resources Career Cluster focuses on the production, processing, marketing, distribution, financing, and development of agricultural commodities and resources, including food, fiber, wood products, natural resources, horticulture, and other plant and animal products/resources.

(3) Extended Practicum in Agriculture, Food, and Natural Resources, a corequisite course, is designed to give students supervised practical application of knowledge and skills. Practicum experiences can occur in a variety of locations appropriate to the nature and level of experiences such as employment, independent study, internships, assistantships, mentorships, or laboratories. To prepare for careers in agriculture, food, and natural resources, students must attain academic knowledge and skills, acquire technical knowledge and skills related to the workplace, and develop knowledge and skills regarding career opportunities, entry requirements, and industry expectations. To prepare for success, students need opportunities to learn, reinforce, apply, and transfer their knowledge and skills and technologies in a variety of settings.

(4) Students are encouraged to participate in extended learning experiences such as career and technical student organizations and other leadership or extracurricular organizations.

(5) Statements that contain the word "including" reference content that must be mastered, while those containing the phrase "such as" are intended as possible illustrative examples.

(d) Knowledge and skills.

(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:

(A) participate in a paid or an unpaid, laboratory or work-based application of previously studied knowledge and skills related to agriculture, food, and natural resources;

(B) participate in training, education, or preparation for licensure, certification, or other relevant credentials to prepare for employment;

(C) demonstrate professional standards needed to be employable such as punctuality, time management, initiative, and cooperation with increased fluency;

(D) demonstrate teamwork and conflict-management skills with increased fluency to achieve collective goals; and

(E) demonstrate planning and time-management skills and tools with increased fluency to enhance results and complete work tasks.

(2) The student develops a supervised agricultural experience program. The student is expected to:

(A) plan, propose, conduct, document, and evaluate a supervised agricultural experience program as an experiential learning activity;

(B) use appropriate record-keeping skills in a supervised agricultural experience program;

(C) participate in youth agricultural leadership opportunities;

(D) review and participate in a local program of activities; and

(E) create or update documentation of relevant agricultural experience such as community service, professional, or classroom experiences.

(3) The student implements advanced professional communications strategies. The student is expected to:

(A) apply appropriate content knowledge, technical concepts, and vocabulary with increased fluency to analyze information and follow directions;

(B) demonstrate verbal communication consistently in a clear, concise, and effective manner;

(C) demonstrate non-verbal communication consistently and effectively; and

(D) analyze, interpret, and effectively communicate information, data, and observations.

(4) The student applies concepts of critical thinking and problem solving. The student is expected to:

(A) apply critical-thinking skills with increased fluency both independently and collaboratively to solve problems and make decisions; and

(B) demonstrate the use of content, technical concepts, and vocabulary when analyzing information and following directions.

(5) The student understands and applies proper safety techniques in the workplace. The student is expected to:

(A) demonstrate and consistently follow workplace safety rules and regulations;

(B) demonstrate safe operation of tools and equipment;

(C) troubleshoot equipment when operation fails;

(D) demonstrate safe handling and proper disposal of supplies;

(E) identify unsafe conditions or practices; and

(F) describe procedures for reporting and handling accidents and safety incidents.

(6) The student documents growth in advanced technical knowledge and skills. The student is expected to:

(A) develop advanced technical knowledge and skills related to the student's occupational objective;

(B) demonstrate growth of technical skill competencies;

(C) evaluate personal strengths and weaknesses in technical skill proficiency; and

(D) update a professional portfolio.

ATTACHMENT
Text of Proposed New 19 TAC

Chapter 127. Texas Essential Knowledge and Skills for Career Development and Career and Technical Education

Subchapter O. Science, Technology, Engineering, and Mathematics

§127.795. Applied Physics and Engineering (One Credit), Adopted 2024.

(a) Implementation. The provisions of this section shall be implemented by school districts beginning with the 2025-2026 school year.

(b) General requirements. This course is recommended for students in Grades 10-12. Prerequisites: one credit of Algebra I and one credit of high school science. Corequisite: one credit of high school science. 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.

(c) Introduction.

(1) 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.

(2) The Science, Technology, Engineering, and Mathematics 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.

(3) In Applied Physics and Engineering, students conduct laboratory and field investigations, use scientific and engineering practices during investigations, and make informed decisions using critical thinking and scientific problem solving. Various systems are described in terms of space, time, energy, and matter. Students study topics, including laws of motion, conservation of energy, momentum, electricity, magnetism, thermodynamics, and characteristics and behavior of waves. Students apply physics concepts and perform laboratory experimentations for at least 40% of instructional time using safe practices.

(4) Nature of science. 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 is 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.

(5) Scientific hypotheses and theories. Students are expected to know that:

(A) hypotheses are tentative and testable statements that must be capable of being supported or not supported by observational evidence. Hypotheses of durable explanatory power that have been tested over a wide variety of conditions are incorporated into theories; and

(B) 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.

(6) Scientific inquiry. Scientific inquiry is the planned and deliberate investigation of the natural world using scientific and engineering practices. Scientific methods of investigation are descriptive, comparative, or experimental. The method chosen should be appropriate to the question being asked. Student learning for different types of investigations include descriptive investigations, which involve collecting data and recording observations without making comparisons; comparative investigations, which involve collecting data with variables that are

manipulated to compare results; and experimental investigations, which involve processes similar to comparative investigations but in which a control is identified.

(A) Scientific practices. Students should be able to ask questions, plan and conduct investigations to answer questions, and explain phenomena using appropriate tools and models.

(B) Engineering practices. Students should be able to identify problems and design solutions using appropriate tools and models.

(7) Science and social ethics. Scientific decision making is a way of answering questions about the natural world involving its own set of ethical standards about how the process of science should be carried out. Students should be able to distinguish between scientific decision-making methods (scientific methods) and ethical and social decisions that involve science (the application of scientific information).

(8) Science consists of recurring themes and making connections between overarching concepts. Recurring themes include systems, models, and patterns. All systems have basic properties that can be described in 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, while models allow for boundary specification and provide tools for understanding the ideas presented. 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.

(9) Students are encouraged to participate in extended learning experiences such as career and technical student organizations, other leadership or extracurricular organizations, or practical, hands-on activities or experiences through which a learner interacts with industry professionals in a workplace, which may be an in-person, virtual, or simulated setting. Learners prepare for employment or advancement along a career pathway by completing purposeful tasks that develop academic, technical, and employability skills.

(10) Statements that contain the word "including" reference content that must be mastered, while those containing the phrase "such as" are intended as possible illustrative examples.

(d) Knowledge and skills.

(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.

(2) Scientific and engineering practices. The student, for at least 40% of instructional time, asks questions, identifies problems, and plans and safely conducts classroom, laboratory, and field investigations to answer questions, explain phenomena, or design solutions using appropriate tools and models. The student is expected to:

(A) ask questions and define problems based on observations or information from text, phenomena, models, or investigations;

(B) apply scientific practices to plan and conduct descriptive, comparative, and experimental investigations and use engineering practices to design solutions to problems;

(C) use appropriate safety equipment and practices during laboratory, classroom, and field investigations as outlined in Texas Education Agency-approved safety standards;

(D) use appropriate tools such as ammeters, balances, ballistic carts or equivalent, batteries, calipers, Celsius thermometers, consumable chemicals, collision apparatus, computers and modeling software, constant velocity cars, data acquisition probes and software, discharge tubes with power supply (H, He, Ne, Ar), dynamics and force demonstration equipment, electroscopes, electrostatic generators, electrostatic kits, friction blocks, graphing technology, hand-held visual spectroscopes, hot plates, iron filings, laser pointers, light bulbs, macrometers, magnets, magnetic compasses, mass sets, metric rulers, meter sticks, models and diagrams, motion detectors, multimeters, optics bench, optics kit, optic lenses, pendulums, photogates, plane mirrors, polarized film, prisms, protractors, resistors, ripple tank with wave generators, rope or string, scientific calculators, simple machines, slinky springs, springs, spring scales, standard laboratory glassware, stopwatches, switches, tuning forks, timing devices, trajectory apparatus, voltmeters, wave motion ropes, wires, or other equipment and materials that will produce the same results;

(E) collect quantitative data using the International System of Units (SI) and qualitative data as evidence;

(F) organize quantitative and qualitative data using notebooks or engineering journals, bar charts, line graphs, scatter plots, data tables, equations, conceptual mathematical relationships, labeled drawings and diagrams, or graphic organizers such as Venn diagrams;

(G) develop and use models to represent phenomena, systems, processes, or solutions to engineering problems; and

(H) distinguish between scientific hypotheses, theories, and laws.

(3) Scientific and engineering practices. The student analyzes and interprets data to derive meaning, identify features and patterns, and discover relationships or correlations to develop evidence-based arguments or evaluate designs. The student is expected to:

(A) identify advantages and limitations of models such as their size, scale, properties, and materials;

(B) analyze data by identifying significant statistical features, patterns, sources of error, and limitations;

(C) use mathematical calculations to assess quantitative relationships in data; and

(D) assess and optimize experimental processes and engineering designs.

(4) Scientific and engineering practices. The student develops evidence-based explanations and communicates findings, conclusions, and proposed solutions. The student is expected to:

(A) develop explanations and propose solutions supported by data and models and consistent with scientific ideas, principles, and theories;

(B) communicate explanations and solutions individually and collaboratively in a variety of settings and formats; and

(C) engage respectfully in scientific argumentation using applied scientific explanations and empirical evidence.

(5) Scientific and engineering practices. The student knows the contributions of scientists and recognizes the importance of scientific research and innovation on society. The student is expected to:

(A) analyze, evaluate, and critique scientific explanations and solutions by using empirical evidence, logical reasoning, and experimental and observational testing so as to encourage critical thinking by the student;

(B) relate the impact of past and current research on scientific thought and society, including research methodology, cost-benefit analysis, and contributions of diverse scientists as related to the content; and

(C) research and explore resources such as museums, libraries, professional organizations, private companies, online platforms, and mentors employed in a science, technology, engineering, and mathematics (STEM) field in order to investigate STEM careers.

(6) The student thinks critically and creatively to devise a system or process in applying fundamental engineering solutions needed for a project to meet desired needs and specifications within constraints. The student is expected to:

(A) identify an engineering need through collaborative conversation or research;

(B) develop a proposal to execute an engineering solution that includes performance metrics and constraints such as economics, resources, or safety;

(C) analyze an implemented engineering solution and suggest changes to improve the engineering design or process; and

(D) assess the risks or trade-offs and benefits of a design solution such as accessibility, aesthetics, codes, cost, functionality, ethical considerations, or sustainability.

(7) The student uses the scientific and engineering practices to investigate physical concepts and phenomena. The student is expected to:

(A) develop and test hypotheses that can be supported by observational evidence;

(B) compare scientific concepts such as particle or wave behavior or the law of thermodynamics to describe physical phenomena;

(C) design procedures to conduct an investigation;

(D) perform accurate measurement techniques using precision instruments and proper techniques;

(E) identify and quantify causes and effects of uncertainties in measured data;

(F) analyze and interpret data using equations, tables, charts, and graphs to reveal potential patterns, trends, and sources of error; and

(G) communicate conclusions supported through various methods such as laboratory reports, labeled drawings, graphic organizers, journals, summaries, oral reports, or technology-based reports.

(8) The student demonstrates appropriate safety techniques in field and laboratory environments. The student is expected to:

(A) locate and use safety guidelines as described in various manuals, instructions, or regulations; and

(B) identify hazardous materials and properly dispose of wastes.

(9) The student describes and applies the laws governing motion in a variety of situations. The student is expected to:

(A) generate and interpret relevant equations for one-dimensional motion using graphs and charts;

(B) define scalar and vector quantities;

(C) use one-dimensional equations for displacement, distance, speed, velocity, average velocity, frames of reference, acceleration, and average acceleration;

(D) use graphical vector addition for displacement, velocity, average velocity, acceleration, and average acceleration within a frame of reference;

(E) use graphs and charts to generate and interpret relevant equations for two-dimensional motion;

(F) explain projectile and circular motion using two-dimensional equations or vectors and apply the concepts to an investigation such as testing a catapult or carousel;

(G) explain Newton's first law of motion and apply the concepts of equilibrium and inertia to investigations using relevant real-world examples such as rockets, satellites, and automobile safety devices;

(H) conduct investigations that include calculations and free body diagrams to observe the effect of forces on objects, including tension, friction, normal force, gravity, centripetal force, and applied force, using the relationship between force, mass, and acceleration as represented by Newton's second law of motion;

(I) conduct or design investigations such as those that involve rockets, tug-of-war, or balloon cars to illustrate and analyze the simultaneous forces between two objects as represented in Newton's third law of motion using free body diagrams;

(J) design a model based on Newton's law of universal gravitation between two or more objects to determine the relationships between force, their masses, and the distance between their centers;

(K) design, evaluate, and refine a device that uses the concepts of impulse and conservation of momentum to minimize the net force on objects during collisions such as those that occur during vehicular accidents or sports activities or when a personal electronic device is dropped; and

(L) describe and calculate the mechanical energy of the power generated within, the impulse applied to, and the momentum of a physical system.

(10) The student describes the nature of forces in the physical world. The student is expected to:

(A) use Coulomb's law to predict how the magnitude of the electric force between two objects depends on their charges and the distance between their centers;

(B) build models such as generators, motors, and transformers that show how electric, magnetic, and electromagnetic forces and fields work in everyday life;

(C) test a variety of materials to determine conductive or insulative properties based on their electric properties;

(D) design, evaluate, and refine series and parallel circuits using schematics, digital resources, or materials such as switches, wires, resistors, lightbulbs, batteries, multimeters, voltmeters, and ammeters; and

(E) construct series and parallel circuits and use Ohm's Law to calculate current, potential difference, resistance, and power of various real-world series and parallel circuits such as models of in-home wiring, automobile wiring, and simple electrical devices.

(11) The student describes and applies the laws of the conservation of energy. The student is expected to:

(A) describe the transformations among work, potential energy, and kinetic energy using the work-energy theorem;

(B) calculate work, power, kinetic energy, and potential energy;

(C) identify, describe, and give real-world examples of simple machines such as levers, pulleys, wheel and axles, wedges, screws, and inclined planes;

(D) calculate the mechanical advantage of simple machines; and

(E) apply the laws of conservation of energy to a physical system using simple machines such as a Rube Goldberg machine.

(12) The student analyzes the concept of thermal energy. The student is expected to:

(A) explain the laws of thermodynamics and how they relate to systems such as engines, heat pumps, refrigeration, solar, and heating and air conditioning;

(B) investigate and demonstrate the movement of thermal energy through various states of matter by convection, conduction, and radiation through environmental and man-made systems; and

(C) design, construct, and test a device or system that either minimizes or maximizes thermal energy consumption and perform a cost-benefit analysis such as comparing materials and energy sources that are renewable and nonrenewable.

(13) The student analyzes the properties of wave motion and optics. The student is expected to:

(A) examine and describe oscillatory motion using pendulums and wave propagation in various types of media;

(B) investigate and analyze characteristics of waves, including period, velocity, frequency, amplitude, and wavelength;

(C) investigate and calculate the relationship between wave speed, frequency, and wavelength;

(D) compare the characteristics and behaviors of transverse waves and longitudinal waves, including electromagnetic waves and sound waves;

(E) describe how the differences in wavelength and frequency within the electromagnetic spectrum impact real-world technologies such as radio, x-rays, and microwaves;

(F) investigate and explain behaviors of waves, including reflection, refraction, diffraction, interference, resonance, polarization, and the Doppler effect; and

(G) describe and predict image formation as a consequence of reflection from a plane mirror and refraction through a thin convex lens.

§127.796. Scientific Research and Design (One Credit), Adopted 2024.

(a) Implementation. The provisions of this section shall be implemented by school districts beginning with the 2025-2026 school year.

(b) General requirements. This course is recommended for students in Grades 11 and 12. Prerequisite: Biology, and one credit of the following: Applied Physics and Engineering, Chemistry, Integrated Physics and Chemistry (IPC), or Physics. 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.

(c) Introduction.

(1) 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.

(2) The Science, Technology, Engineering, and Mathematics 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.

(3) Scientific Research and Design allows districts and schools flexibility to develop local curriculum to supplement a program of study or coherent sequence. The course has the components of any rigorous scientific or career and technical education (CTE) program of study, including problem identification, investigation design, data collection, data analysis, formulation, and presentation of conclusions. These components are integrated with the CTE emphasis of helping students gain entry-level employment in high-skill, high-wage jobs and/or continue their education.

(4) Nature of science. 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 is 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.

(5) Scientific hypotheses and theories. Students are expected to know that:

(A) hypotheses are tentative and testable statements that must be capable of being supported or not supported by observational evidence. Hypotheses of durable explanatory power that have been tested over a wide variety of conditions are incorporated into theories; and

(B) 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.

(6) Scientific inquiry. Scientific inquiry is the planned and deliberate investigation of the natural world using scientific and engineering practices. Scientific methods of investigation are descriptive, comparative, or experimental. The method chosen should be appropriate to the question being asked. Student learning for different types of investigations include descriptive investigations, which involve collecting data and recording observations without making comparisons; comparative investigations, which involve collecting data with variables that are manipulated to compare results; and experimental investigations, which involve processes similar to comparative investigations but in which a control is identified.

(A) Scientific practices. Students should be able to ask questions, plan and conduct investigations to answer questions, and explain phenomena using appropriate tools and models.

(B) Engineering practices. Students should be able to identify problems and design solutions using appropriate tools and models.

(7) Science and social ethics. Scientific decision making is a way of answering questions about the natural world involving its own set of ethical standards about how the process of science should be carried out. Students should be able to distinguish between scientific decision-making methods (scientific methods) and ethical and social decisions that involve science (the application of scientific information).

(8) Science consists of recurring themes and making connections between overarching concepts. Recurring themes include systems, models, and patterns. All systems have basic properties that can be described in 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, while models allow for boundary specification and provide tools for understanding the ideas presented. 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.

(9) Students are encouraged to participate in extended learning experiences such as career and technical student organizations, other leadership or extracurricular organizations, or practical, hands-on activities or experiences through which a learner interacts with industry professionals in a workplace, which may be an in-person, virtual, or simulated setting. Learners prepare for employment or advancement along a career pathway by completing purposeful tasks that develop academic, technical, and employability skills.

(10) Statements that contain the word "including" reference content that must be mastered, while those containing the phrase "such as" are intended as possible illustrative examples.

(d) Knowledge and skills.

(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.

(2) Scientific and engineering practices. The student, for at least 40% of instructional time, asks questions, identifies problems, and plans and safely conducts classroom, laboratory, and field investigations to answer questions, explain phenomena, or design solutions using appropriate tools and models. The student is expected to:

(A) ask questions and define problems based on observations or information from text, phenomena, models, or investigations;

(B) apply scientific practices to plan and conduct descriptive, comparative, and experimental investigations and use engineering practices to design solutions to problems;

(C) use appropriate safety equipment and practices during laboratory, classroom, and field investigations as outlined in Texas Education Agency-approved safety standards;

(D) use appropriate tools such as measurement and data collection tools, software, sensors, probes, microscopes, cameras, and glassware;

(E) collect quantitative data using the International System of Units (SI) and qualitative data as evidence;

(F) organize quantitative and qualitative data using notebooks, journals, graphs, charts, tables, spreadsheets, and drawings and models;

(G) develop and use models to represent phenomena, systems, processes, or solutions to engineering problems; and

(H) distinguish between scientific hypotheses, theories, and laws.

(3) Scientific and engineering practices. The student analyzes and interprets data to derive meaning, identify features and patterns, and discover relationships or correlations to develop evidence-based arguments or evaluate designs. The student is expected to:

(A) identify advantages and limitations of models such as their size, scale, properties, and materials;

(B) analyze data by identifying significant statistical features, patterns, sources of error, and limitations;

(C) use mathematical calculations to assess quantitative relationships in data; and

(D) evaluate experimental and engineering designs.

(4) Scientific and engineering practices. The student develops evidence-based explanations and communicates findings, conclusions, and proposed solutions. The student is expected to:

(A) develop explanations and propose solutions supported by data and models and consistent with scientific ideas, principles, and theories;

(B) communicate explanations and solutions individually and collaboratively in a variety of settings and formats; and

(C) engage respectfully in scientific argumentation using applied scientific explanations and empirical evidence.

(5) Scientific and engineering practices. The student knows the contributions of scientists and recognizes the importance of scientific research and innovation on society. The student is expected to:

(A) analyze, evaluate, and critique scientific explanations and solutions by using empirical evidence, logical reasoning, and experimental and observational testing so as to encourage critical thinking by the student;

(B) relate the impact of past and current research on scientific thought and society, including research methodology, cost-benefit analysis, and contributions of diverse scientists as related to the content; and

(C) research and explore resources such as museums, libraries, professional organizations, private companies, online platforms, and mentors to investigate science, technology, engineering, and mathematics careers.

(6) The student develops a proposal that centers around a scientific or engineering topic or problem within a specific program of study or area of interest. The student is expected to:

(A) establish a rationale and preliminary set of ideas for a research question or questions using organizational tools, collaboration, or research;

(B) perform a literature review and evaluate several examples related to the project;

(C) refine a research question by interacting with professionals in the field of study and document the conversations;

(D) distinguish between descriptive, comparative, or experimental research design methodologies;

(E) develop a research question or questions that are testable and measurable;

(F) justify in writing the significance and feasibility of the project;

(G) generate a materials list and propose a cost analysis; and

(H) use the citation style appropriate to the field of study throughout the documentation.

(7) The student formulates hypotheses to guide experimentation and data collection independently or in a team that centers around a scientific or engineering topic or problem within a specific program of study or area of interest. The student is expected to:

(A) perform background research on the selected investigative problem;

(B) examine hypotheses generated to guide a research process by evaluating the merits and feasibility of the hypotheses; and

(C) identify the control, independent variable, and dependent variables within the research and justify the purpose of each.

(8) The student develops, implements, and collects data for their investigative designs that centers around a scientific or engineering topic or problem within a specific program of study or area of interest. The student is expected to:

(A) write the procedure of the experimental design, including a schematic of the lab, materials, set up, ethical considerations, and safety protocols;

(B) conduct the experiment with the independent and dependent variables;

(C) acquire data using appropriate equipment and technology; and

(D) record observations as they occur within an investigation, including qualitative and quantitative observations such as journals, photographic evidence, logs, tables, and charts.

(9) The student organizes and evaluates qualitative and quantitative data obtained through experimentation that centers around a scientific or engineering topic or problem within a specific program of study or area of interest. The student is expected to:

(A) manipulate data by constructing charts, data tables, or graphs using technology to organize information collected in an experiment;

(B) identify sources of random error and systematic error and differentiate between both types of error;

(C) report error of a set of measured data in various formats such as standard deviation and percent error; and

(D) analyze data using statistical methods to recognize patterns, trends, and proportional relationships.

(10) The student knows how to synthesize valid conclusions from qualitative and quantitative data that centers around a scientific or engineering topic or problem within a specific program of study or area of interest. The student is expected to:

(A) justify conclusions that are supported by research data;

(B) consider and summarize alternative explanations for observations and results; and

(C) identify limitations within the research process and provide recommendations for additional research.

(11) The student communicates clearly and concisely to an audience of professionals conclusions that center around a scientific or engineering topic or problem within a specific program of study or area of interest. The student is expected to:

(A) develop a plan of action on how to present to a target audience;

(B) review artifacts used in the communication of the presentation for errors, grammar, professional standards, and citations;

(C) develop a professional collection or portfolio of work that includes artifacts such as a journal, proposal, written procedures, methodology, iterations, interviews and check ins with professionals, changes within the experiment, and photographic evidence;

(D) practice a professional presentation with peers and educators using a rubric to measure content, skill, and performance;

(E) incorporate feedback provided by a review panel to document for future improvements or changes; and

(F) communicate data analysis and experimental results of original findings of a research project clearly to an audience of professionals.

ATTACHMENT
Text of Proposed New 19 TAC

Chapter 127. Texas Essential Knowledge and Skills for Career Development and Career and Technical Education

Subchapter P. Transportation, Distribution, and Logistics

§127.887. Introduction to Aircraft Technology (One Credit), Adopted 2024.

(a) Implementation. The provisions of this section shall be implemented by school districts beginning with the 2025-2026 school year.

(b) General requirements. This course is recommended for students in Grades 9-12. Students shall be awarded one credit for successful completion of this course.

(c) Introduction.

(1) 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.

(2) The Transportation, Distribution, and Logistics Career Cluster focuses on planning, management, and movement of people, materials, and goods by road, pipeline, air, rail, and water and related professional support services such as transportation infrastructure planning and management, logistics services, mobile equipment, and facility maintenance.

(3) Introduction to Aircraft Technology is designed to teach the theory of operation of aircraft airframes, powerplants, and associated maintenance and repair practices. Maintenance and repair practices include knowledge of the general curriculum subjects, powerplant theory and maintenance, and the function, diagnosis, and service of airframe structures, airframe systems and components, and powerplant systems and components of aircraft. Industry-recognized professional licensures, certifications, and registrations are available for students who meet the requirements set forth by the accrediting organization.

(4) Students are encouraged to participate in extended learning experiences such as career and technical student organizations and other leadership or extracurricular organizations.

(5) Statements that contain the word "including" reference content that must be mastered, while those containing the phrase "such as" are intended as possible illustrative examples.

(d) Knowledge and skills.

(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:

(A) identify and compare employment opportunities, including entrepreneurship opportunities, and certification requirements for the field of aircraft maintenance and repair;

(B) exhibit the ability to cooperate, contribute, and collaborate as a member of a team;

(C) identify individual ethical and legal behavior standards according to professional and regulatory agencies;

(D) research Federal Aviation Regulations and discuss the impact of the English language proficiency requirements as prescribed by the Federal Aviation Regulations;

(E) identify and explain human factors that may impact health and safety in a worksite and how they are addressed by industry standards;

(F) explain the role of human factors in maintaining health and safety in the workplace and demonstrate personal responsibility to maintain health and safety in the workplace;

(G) identify and explain how employees' personal responsibility and other human factors, including personal attitudes, can affect the success and profitability of a workplace;

(H) apply reasoning skills to a variety of simulated workplace situations to make ethical decisions;

(I) identify industry standards for employee appearance and health habits;

(J) demonstrate appropriate etiquette and behavior;

(K) identify and demonstrate effective written and oral communication skills; and

(L) identify and demonstrate effective listening skills.

(2) The student relates academic skills to the requirements of aircraft maintenance and repair. The student is expected to:

(A) demonstrate effective oral and written communication skills with individuals from various cultures such as fellow workers, management, and customers;

(B) identify requirements of work orders and technical documents for repairs;

(C) locate and interpret documents, including schematics, charts, graphs, drawings, blueprints, wiring diagrams, service-repair manuals, service bulletins, type certificate data sheets, supplemental type certificates, airworthiness directives, federal aviation regulations, and advisory information;

(D) demonstrate proficiency in metric and U.S. customary standard measurement systems;

(E) perform precision measurements using engineering scales, dial calipers, and Vernier micrometers to determine if a component is within tolerance of specifications; and

(F) use critical-thinking and problem-solving skills to identify aircraft maintenance problems and recommend solutions.

(3) The student demonstrates an awareness of aviation history. The student is expected to:

(A) research and discuss the historical interest in flight;

(B) describe early aircraft designs such as lighter-than-air or heavier-than-air designs;

(C) research and describe the contributions of various pioneers in aviation history, including Charles Taylor;

(D) identify driving forces that provide rapid advancements in aircraft design and performance; and

(E) describe the contributions of aviation and aerospace to society.

(4) The student uses regulatory and industry standards and demonstrates technical knowledge and skills for aircraft maintenance and repair, utilizing aircraft, aircraft training devices, or equivalent simulated situations. The student is expected to:

(A) identify and locate aviation regulations prescribed by 14 Code of Federal Regulations Chapter I that govern mechanic privileges related to the construction, maintenance, and service of aircraft;

(B) apply the principles of simple machines, basic aerodynamics, aircraft structures, and theory of flight to accomplish an assigned task;

(C) identify aircraft categories such as airplane, rotorcraft, glider, and lighter-than-air, in reference to federal aviation regulations;

(D) explain the certification process, ratings, privileges, and limitations of airmen;

(E) identify and compare airframe construction and basic repair methods and techniques, including wood structures, metal tubular structures, fabric coverings, sheet metal, and composite structures;

(F) identify and explain airframe systems and components, including landing gear, hydraulic power, cabin atmosphere control systems, and electrical systems;

(G) describe aircraft reciprocating and turbine engine operating theory, functions, and basic repair methods and techniques;

(H) identify and explain powerplant systems and components, including engine instruments, electrical systems, lubrication systems, ignition and starting systems, cooling systems, exhaust systems, and propellers;

(I) explain common aircraft terminology and standard practices required to complete maintenance, modifications, and repairs;

(J) identify necessary elements of logbook entries and critique sample logbook entries; and

(K) describe inspections required to maintain compliance with airworthiness, safety, health, and environmental regulations.

(5) The student understands the function and application of the tools, equipment, technologies, and preventative maintenance used in aircraft maintenance and repair. The student is expected to:

(A) identify and demonstrate basic skills in safely using hand tools, power tools, and equipment commonly employed in the maintenance and repair of aircraft;

(B) research and explain the proper handling and disposal of environmentally hazardous materials used in servicing aircraft;

(C) research and describe the impact of new and emerging aircraft technologies; and

(D) identify and examine the need for preventative maintenance procedures and practices.

(6) The student uses regulatory and industry standards and demonstrates technical knowledge and skills of the trade, utilizing aircraft, aircraft training devices, or equivalent simulated situations. The student is expected to:

(A) start and ground operate an aircraft or simulated aircraft using a high-fidelity flight simulator with a physical yoke and pedal device;

(B) research and locate appropriate documentation to perform a function in a written work order and complete the required logbook entry;

(C) draw top, side, and front views of various aircraft categories, including airplane, rotorcraft, glider, and lighter-than-air;

(D) perform basic airframe and engine inspections according to a checklist;

(E) use an engine troubleshooting chart to show the results of simple defects on engine performance; and

(F) discuss and describe preventative maintenance plans and systems to keep aircraft systems in operation.

§127.888. Aircraft Airframe Technology (Two Credits), Adopted 2024.

(a) Implementation. The provisions of this section shall be implemented by school districts beginning with the 2025-2026 school year.

(b) General requirements. This course is recommended for students in Grades 10-12. Prerequisite: Aircraft Maintenance Technology. Students shall be awarded two credits for successful completion of this course.

(c) Introduction.

(1) 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.

(2) The Transportation, Distribution, and Logistics Career Cluster focuses on planning, management, and movement of people, materials, and goods by road, pipeline, air, rail, and water and related professional support services such as transportation infrastructure planning and management, logistics services, mobile equipment, and facility maintenance.

(3) Aircraft Airframe Technology is designed to teach the theory of operation of aircraft airframes and associated maintenance and repair practices of Federal Aviation Administration (FAA) airframe curriculum subjects utilizing aircraft, aircraft training devices, or equivalent simulated situations. In this course, the academic and technical skills are separated to reflect the learning outcomes as designed in the FAA Airman Certification Standards. Airframe maintenance and repair practices include knowledge of the theory, function, diagnosis, and service of airframe structures, systems, and components of aircraft. Industry-recognized professional licensures, certifications, and registrations are available for students who meet the requirements set forth by the accrediting organization.

(4) Students are encouraged to participate in extended learning experiences such as career and technical student organizations and other leadership or extracurricular organizations.

(5) Statements that contain the word "including" reference content that must be mastered, while those containing the phrase "such as" are intended as possible illustrative examples.

(6) The FAA uses standard terms with specific expectations for performance. The terms are defined as follows.

(A) Check means to verify proper operation.

(B) Inspect means to examine with or without inspection-enhancing tools or equipment.

(C) Overhaul means to disassemble, clean, inspect, repair as necessary, and reassemble.

(D) Repair means to correct a defective condition.

(E) Service means to perform functions that assure continued operation.

(F) Troubleshoot means to analyze and identify malfunctions.

(7) When a student performs an action, such as checking, inspecting, overhauling, repairing, servicing, troubleshooting, and installing in this course, they are to complete all associated tasks. If an action detects a flaw, defect, or discrepancy in an aircraft or component, that finding could trigger another maintenance action. Actions may include documenting findings through logbook entries, maintenance action forms, installation plans, and work orders.

(d) Knowledge and skills.

(1) The student demonstrates professional standards, interpersonal communication, and employability skills as required by business and industry. The student is expected to:

(A) identify and compare employment opportunities, including entrepreneurship opportunities, and certification requirements for the field of aircraft maintenance and repair;

(B) identify and demonstrate ways to contribute and collaborate as an effective member of a team;

(C) identify individual ethical and legal behavior standards according to professional and regulatory agencies;

(D) research and discuss the impact of the English language proficiency requirements as prescribed by the Federal Aviation Regulations;

(E) identify and explain human factors that may impact health and safety in a worksite and how they are addressed by industry standards;

(F) explain the role of human factors in maintaining health and safety in the workplace and demonstrate personal responsibility to maintain health and safety in the workplace;

(G) identify and explain how employees' personal responsibility and other human factors, including personal attitudes, can affect the success and profitability of a workplace;

(H) apply reasoning skills to a variety of simulated workplace situations in order to make ethical decisions;

(I) identify industry standards related to employee appearance and health habits;

(J) identify and practice effective written and oral communication skills;

(K) identify and practice effective listening skills; and

(L) define and apply FAA standard terms that have specific expectations for performance, including check, inspect, overhaul, repair, service, and troubleshoot.

(2) The student relates academic skills to the requirements of metallic structures. The student is expected to:

(A) describe best practices for maintenance safety, including the use of personal protective equipment (PPE), and precautions for sheet metal repairs and fabrication;

(B) identify characteristics and types of metallic structures;

(C) identify types of sheet metal defects and select sheet metal repair materials;

(D) explain inspection and testing processes of metal structures;

(E) explain the selection of rivets, hardware, and fasteners for a sheet metal repair per FAA-approved data;

(F) explain the layout, forming, and drilling of sheet metal components per FAA-approved data; and

(G) explain rivet layout, installation, and removal per FAA-approved data.

(3) The student uses regulatory and industry standards and demonstrates technical knowledge and skills for metallic structures utilizing aircraft, aircraft training devices, or equivalent simulated situations. The student is expected to:

(A) install and remove solid rivets such as universal head, countersink head, and blind rivets;

(B) create a drawing of a repair, including the number of rivets and size of sheet metal required, utilizing a manufacturer's structural repair manual;

(C) design a rivet pattern for a specific repair;

(D) determine the applicability of sheet metal for a repair in a specific application;

(E) design a repair using a manufacturer's structural repair manual;

(F) sketch and build a piece of sheet metal to fit a prepared area; and

(G) determine the extent of damage to a metallic structure and decide if it is repairable.

(4) The student relates academic skills to the requirements of non-metallic structures. The student is expected to:

(A) identify and discuss maintenance safety practices for composite materials, composite structures, and windows;

(B) identify and discuss tools, inspection techniques, and practices for wood structures, including determining acceptable and unacceptable wood defects;

(C) define and explain covering textile terms;

(D) define and explain covering methods of attachment commonly used, including types of approved aircraft covering material and stitching seams commonly used with aircraft covering;

(E) describe inspection methods for textile aircraft coverings;

(F) identify and discuss composite repair methods, techniques, fasteners, and practices;

(G) differentiate between composite structure fiber, core, and matrix materials;

(H) identify and discuss types of composite structure defects such as delamination, crush core, and surface gouges;

(I) identify inspection and testing of composite structures such as tap testing and ultrasonics;

(J) research and describe the care and maintenance of windows;

(K) research and describe thermoplastic material inspection and types of thermoplastic material defects;

(L) research and describe temporary and permanent window repairs; and

(M) research and describe inspection of restraints and upholstery.

(5) The student uses regulatory and industry standards and demonstrates technical knowledge and skills for non-metallic structures, utilizing aircraft, aircraft training devices, or equivalent simulated situations. The student is expected to:

(A) inspect and repair fiberglass, composite, plastic, or glass-laminated structures;

(B) clean and inspect acrylic-type windshields;

(C) perform a tap test on composite material;

(D) locate and explain repair procedures for elongated bolt holes; and

(E) perform lay up for a repair to a composite panel, including preparation for vacuum bagging, using a manufacturer's repair manual.

(6) The student understands the academic knowledge and skills for flight controls. The student is expected to:

(A) identify and compare types of aircraft control cables and control cable maintenance techniques;

(B) identify and explain the function of cable connectors, cable guides, and control stops;

(C) identify and explain the function of push-pull tubes and torque tubes;

(D) identify bellcranks and explain their function;

(E) explain the purpose of maintaining a calibration schedule for cable tension meters and other rigging equipment;

(F) explain the use and interpretation of cable tensiometer equipment and a cable tension chart;

(G) define and explain flutter and flight control balance;

(H) identify and explain primary aircraft flight controls, stabilizer systems, and flight control rigging; and

(I) identify and explain secondary and auxiliary control surfaces and other aerodynamic wing features.

(7) The student uses regulatory and industry standards and demonstrates technical knowledge and skills for flight controls, utilizing aircraft, aircraft training devices, or equivalent simulated situations. The student is expected to:

(A) identify fixed-wing aircraft rigging adjustment locations;

(B) inspect and report findings on primary and secondary flight control surfaces;

(C) inspect and report findings on primary control cables;

(D) adjust and secure a primary flight control cable;

(E) adjust push-pull flight control systems;

(F) check the balance of a flight control surface and balance a control surface;

(G) determine allowable axial play limits for a flight control bearing; and

(H) identify and locate appropriate data to verify aircraft flight control travel limits.

(8) The student understands the academic knowledge and skills for airframe inspection. The student is expected to:

(A) explain the use of inspection requirements under 14 Code of Federal Regulations (CFR) Part 91;

(B) discuss maintenance recordkeeping requirements under 14 CFR Part 43;

(C) research and describe requirements for complying with airworthiness directives, as found in 14 CFR Part 39;

(D) identify and differentiate between FAA-approved data and other data sources such as manufacturer manuals;

(E) explain the need for compliance with service letters, service bulletins, instructions for continued airworthiness, and airworthiness directives;

(F) explain the purpose and methods of visual inspections;

(G) describe the method to select and use checklists and other maintenance publications, including service letters, service bulletins, instructions for continued airworthiness, and airworthiness directives; and

(H) describe the importance of maintenance record documentation.

(9) The student uses regulatory and industry standards and demonstrates technical knowledge and skills for airframe inspection, utilizing aircraft, aircraft training devices, or equivalent simulated situations. The student is expected to:

(A) perform a portion of a 100-hour inspection in accordance with 14 CFR Part 43 such as a records check using the appropriate checklist;

(B) enter results of a 100-hour inspection, including airworthy and unairworthy conditions, in a maintenance record; and

(C) analyze and inspect applicable equipment and documents to determine compliance with a specific airworthiness directive.

(10) The student understands the academic knowledge and skills for landing gear. The student is expected to:

(A) identify and discuss safety precautions when using aircraft jacks;

(B) identify and discuss safety precautions when working with high pressure fluids and gases;

(C) identify and discuss safety precautions in the storage and handling of hydraulic fluids;

(D) identify and discuss safety precautions in the operation of retractable landing gear systems around personnel;

(E) identify and discuss safety precautions in landing gear, tire, and wheel maintenance operations;

(F) describe fixed and retractable landing gear systems and components;

(G) explain the necessity of landing gear strut servicing and lubrication;

(H) describe and compare the method of inspection of bungee and spring steel landing gear systems;

(I) describe and compare aircraft steering systems;

(J) explain landing gear position and warning system inspection, check, and servicing;

(K) explain brake assembly servicing and inspection; and

(L) describe and compare brake actuating systems.

(11) The student uses regulatory and industry standards and demonstrates technical knowledge and skills for landing gear, utilizing aircraft, aircraft training devices, or equivalent simulated situations. The student is expected to:

(A) inspect and service landing gear such as fixed or retractable systems;

(B) jack an aircraft for a gear retraction check;

(C) inspect wheels, brakes, bearings, and tires;

(D) bleed air from a hydraulic brake system;

(E) inspect a tire for defects;

(F) replace shock strut air valve;

(G) locate and explain the process for checking landing gear alignment;

(H) troubleshoot aircraft steering system issues such as nose-wheel shimmy;

(I) identify landing gear position and warning system components;

(J) troubleshoot landing gear position and warning systems;

(K) inspect a brake for serviceability; and

(L) inspect tube landing gear for damage.

(12) The student understands the academic knowledge and skills for hydraulic and pneumatic systems. The student is expected to:

(A) describe hydraulic system components, including reservoirs, filters, hoses, lines, fittings, valves, actuators, accumulators, and pumps;

(B) explain the function of hydraulic system components, including reservoirs, filters, hoses, lines, fittings, valves, actuators, accumulators, and pumps;

(C) explain hydraulic system operation, inspections, operational checks, servicing, and troubleshooting;

(D) describe pneumatic system components, including reservoirs, filters, hoses, lines, fittings, valves, actuators, accumulators, and pumps;

(E) explain the function of pneumatic system components, including reservoirs, filters, hoses, lines, fittings, valves, actuators, accumulators, and pumps;

(F) explain pneumatic system operation, inspections, operational checks, servicing, and troubleshooting;

(G) identify types of hydraulic seals and hydraulic seal fluid compatibility;

(H) research and identify the risks associated with high pressure gases and fluids;

(I) research and identify the risks of not properly relieving system pressure prior to system servicing;

(J) research and identify the risks associated with storage and handling of hydraulic fluids; and

(K) research and identify the risks of cross-contamination of hydraulic fluids.

(13) The student uses regulatory and industry standards and demonstrates technical knowledge and skills for hydraulic and pneumatic systems, utilizing aircraft, aircraft training devices, or equivalent simulated situations. The student is expected to:

(A) identify different types of hydraulic fluids;

(B) install seals and backup rings in a hydraulic component;

(C) remove, clean, inspect, and install a hydraulic system filter;

(D) service a hydraulic system reservoir;

(E) purge air from a hydraulic system;

(F) inspect a hydraulic system and a pneumatic system for leaks;

(G) troubleshoot a hydraulic system and a pneumatic system for leaks;

(H) locate and explain hydraulic fluid servicing instructions;

(I) identify and select hydraulic fluid for a given aircraft; and

(J) locate installation procedures for a seal, backup ring, or gasket.

(14) The student understands the academic knowledge and skills for environmental systems. The student is expected to:

(A) explain the operation and purpose of pressurization systems and bleed air heating systems;

(B) explain and compare aircraft instrument cooling methods;

(C) differentiate between exhaust heat exchanger system and combustion heater system components, function, and operation;

(D) differentiate between vapor-cycle system and air-cycle system components, function, and operation;

(E) explain cabin pressurization systems, components, and operation;

(F) differentiate between types of aircraft oxygen systems;

(G) differentiate between types of aircraft oxygen system components;

(H) identify and assess risks associated with oxygen system maintenance;

(I) identify and assess risks associated with the recovery of vapor-cycle refrigerant;

(J) identify and assess risks associated with storage, handling, and use of compressed gas cylinders;

(K) identify and assess risks associated with disregarding manufacturer's recommended refrigerant servicing procedures; and

(L) identify and assess risks associated with maintenance of combustion heaters.

(15) The student uses regulatory and industry standards and demonstrates technical knowledge and skills for environment systems, utilizing aircraft, aircraft training devices, or equivalent simulated situations. The student is expected to:

(A) inspect and service an oxygen system;

(B) clean and inspect emergency oxygen masks and supply hoses;

(C) inspect an oxygen system cylinder for serviceability;

(D) locate and describe the procedures to troubleshoot a combustion heater;

(E) locate and describe the procedures for servicing a refrigerant (vapor-cycle) system;

(F) locate and describe the troubleshooting procedures for an air-cycle system;

(G) inspect a cabin heater system equipped with an exhaust heat exchanger for cracks; and

(H) locate troubleshooting procedures for a pressurization system.

(16) The student understands the academic knowledge and skills for aircraft instrument systems. The student is expected to:

(A) describe annunciator indicating systems and define the meaning of warning, caution, and advisory lights;

(B) differentiate between fuel quantity indicating systems;

(C) differentiate between types of gyroscopic instruments; and

(D) explain the function and operation of:

(i) magnetic compasses and compass swinging procedures;

(ii) pressure and temperature indicating instruments;

(iii) position indication sensors and instruments;

(iv) engine indication and crew alerting systems;

(v) instrument vacuum and pneumatic systems;

(vi) pitot-static systems;

(vii) electronic displays and flight instrument systems;

(viii) transponder and encoder systems;

(ix) angle of attack and stall warning systems; and

(x) takeoff and landing gear configuration warning systems.

(17) The student uses regulatory and industry standards and demonstrates technical knowledge and skills for aircraft instrument systems, utilizing aircraft, aircraft training devices, or equivalent simulated situations. The student is expected to:

(A) remove and install an aircraft instrument;

(B) determine barometric pressure using an altimeter;

(C) verify proper range markings on an instrument for a particular aircraft using approved data;

(D) locate the procedures for troubleshooting a vacuum-operated instrument system;

(E) identify exhaust gas temperature system components;

(F) inspect an aircraft's alternate static air source; and

(G) locate and explain the adjustment procedures for a stall warning system.

(18) The student understands the academic knowledge and skills for aircraft communication and navigation systems. The student is expected to:

(A) describe radio operating principles and radio components;

(B) identify and explain mounting requirements of antennas, static discharge wicks, and avionics components;

(C) identify the components of communication systems, including very high frequency (VHF), high frequency (HF), satellite communications (SATCOM), and Aircraft Communication Addressing and Reporting System (ACARS);

(D) explain the basic operation of communications systems, including VHF, HF, SATCOM, and ACARS;

(E) identify the components of emergency locator transmitters (ELT) and explain the basic operation of ELTs;

(F) identify the components of navigation systems, including distance measuring equipment (DME), instrument landing system (ILS), global positioning system (GPS), automatic direction finder (ADF), and VHF omnidirectional range (VOR);

(G) explain the basic operation of navigation systems, including DME, ILS, GPS, ADF, and VOR;

(H) identify the components of collision avoidance systems, including radio altimeter (RA), automatic dependent surveillance-broadcast (ADS-B), traffic collision avoidance systems (TCAS), and ground proximity warning system (GPWS);

(I) explain the basic operation of collision avoidance systems, including RA, ADS-B, TCAS, and GPWS;

(J) identify the components and explain the basic operation of intercom systems;

(K) identify the components and explain the basic operation of weather radar;

(L) identify the components and explain the basic operation of autopilot and auto-throttle systems;

(M) research and identify the risks of improper ELT testing procedures;

(N) research and identify the risks of performing maintenance on high power/high frequency systems such as weather radar and SATCOM systems; and

(O) research and identify the risks of improper mounting of antennas.

(19) The student uses regulatory and industry standards and demonstrates technical knowledge and skills for aircraft communication and navigation systems, utilizing aircraft, aircraft training devices, or equivalent simulated situations. The student is expected to:

(A) locate and explain autopilot inspection procedures;

(B) identify navigation and communication antennas;

(C) perform an operational check of a VHF communications system;

(D) locate proper testing procedures for an ELT, inspect ELT batteries for expiration date, and perform an operational check of an ELT; and

(E) locate and explain the installation procedures for antennas, including mounting and coaxial connections.

(20) The student understands the academic knowledge and skills for aircraft fuel systems. The student is expected to:

(A) identify fuel system types and fuel system components, including filters and selector valves;

(B) differentiate between types of aircraft fuel tanks and types of fuel cells;

(C) explain fuel flow during fuel transfer, fueling, defueling, and fuel jettisoning;

(D) describe characteristics of fuel types;

(E) describe fuel system maintenance industry best practices;

(F) differentiate between fuel quantity indication methods such as float type, electrical resistance, or visual indicators;

(G) research and identify the risks of improper fuel system maintenance;

(H) research and identify the risks of fuel system contamination and spills;

(I) research and identify the risks of fuel system maintenance requiring fuel tank entry; and

(J) research and identify the risks when defueling aircraft.

(21) The student uses regulatory and industry standards and demonstrates technical knowledge and skills for aircraft fuel systems, utilizing aircraft, aircraft training devices, or equivalent simulated situations. The student is expected to:

(A) inspect a metal, bladder, or integral fuel tank;

(B) inspect a fuel selector valve;

(C) drain a fuel system sump;

(D) service a fuel system strainer; and

(E) identify and locate fuel system operating instructions, inspection procedures, crossfeed procedures, required placards, and defueling procedures.

(22) The student understands the academic knowledge and skills for aircraft electrical systems. The student is expected to:

(A) identify the components of generators, direct current (DC) generation systems, and DC power distribution systems;

(B) explain the basic operation of generators, DC generation systems, and DC power distribution systems;

(C) identify the components of alternators, alternating current (AC) generation systems, and AC power distribution systems;

(D) explain the basic operation of alternators, AC generation systems, and AC power distribution systems;

(E) identify the components and explain the basic operation of voltage regulators, over-volt protection, and overcurrent protection;

(F) identify the components and explain the basic operation of inverter systems;

(G) explain aircraft wiring size and type selection criteria;

(H) explain the purpose of aircraft wiring shielding;

(I) explain the purpose of aircraft bonding and lightning protection;

(J) describe basic electrical system troubleshooting practices;

(K) identify soldering preparation techniques, types of solder, and flux usage;

(L) identify types of aircraft electrical connectors, splices, terminals, and switches;

(M) describe methods of aircraft battery troubleshooting and maintenance;

(N) research and identify the risks of testing electrical systems, including energized and non-energized systems;

(O) research and identify the risks of connecting and disconnecting external power;

(P) research and identify the risks of maintenance in areas containing aircraft wiring;

(Q) research and identify the risks of improperly routing and securing wires and wire bundles;

(R) research and identify the risks of improper selection or installation of wire terminals; and

(S) research and identify the risks of improper soldering practices.

(23) The student uses regulatory and industry standards and demonstrates technical knowledge and skills for aircraft electrical systems, utilizing aircraft, aircraft training devices, or equivalent simulated situations. The student is expected to:

(A) inspect aircraft wiring installation and routing;

(B) perform wire terminating and splicing;

(C) identify components using a wiring circuit diagram;

(D) connect aircraft wires using a solder joint;

(E) troubleshoot a simple airframe electrical circuit;

(F) install bonding jumpers to electrically connect two isolated components;

(G) measure the resistance of an electrical system component;

(H) inspect and test anti-collision, position, and landing lights for proper operation;

(I) identify components in an electrical schematic where AC is rectified to a DC voltage;

(J) perform a continuity test to verify the condition of a conductor; and

(K) perform a test on a conductor for a short to ground.

(24) The student understands the academic knowledge and skills for ice and rain control systems. The student is expected to:

(A) explain causes and effects of aircraft icing;

(B) identify the components of ice detection systems, aircraft anti-ice systems, and de-ice systems;

(C) explain the basic operation of ice detection systems, aircraft anti-ice systems, and de-ice systems;

(D) explain wind screen rain control systems, including wiper blade, chemical, and pneumatic bleed air systems;

(E) research and identify the risks of improper ice and rain control system testing or maintenance;

(F) research and identify the risks of improper storage and handling of deicing fluids; and

(G) research and identify the risks of improper selection and use of cleaning materials for heated windshields.

(25) The student uses regulatory and industry standards and demonstrates technical knowledge and skills for aircraft electrical systems, utilizing aircraft, aircraft training devices, or equivalent simulated situations. The student is expected to:

(A) clean a pneumatic deicer boot;

(B) locate and explain the procedures for inspecting an electrically operated windshield wiper system;

(C) locate and explain the procedures for replacing blades on a windshield wiper system; and

(D) locate and explain the procedures for inspecting a pneumatic rain removal system.

(26) The student understands the academic knowledge and skills for airframe fire protection systems. The student is expected to:

(A) explain types of fires and aircraft fire zones;

(B) identify the components and explain the basic operation of overheat detection and warning systems;

(C) identify the components and explain the basic operation of fire detection and warning systems;

(D) identify the components and explain the basic operation of smoke and carbon monoxide detection systems;

(E) describe types of fire extinguishing systems and extinguishing agents;

(F) research and identify the risks of maintenance on circuits associated with fire bottle squibs;

(G) research and explain the use of PPE when working on or testing fire extinguishing systems; and

(H) explain the risks of exposure to fire extinguishing agents.

(27) The student uses regulatory and industry standards and demonstrates technical knowledge and skills for airframe fire protection systems, utilizing aircraft, aircraft training devices, or equivalent simulated situations. The student is expected to:

(A) evaluate an installed fire extinguisher system for proper container pressure;

(B) locate and explain the procedures for checking a smoke detection system;

(C) locate and explain the procedures for inspecting an overheat detection system; and

(D) inspect fire protection system cylinders and check for hydrostatic test date.

(28) The student understands the academic knowledge and skills for rotorcraft fundamentals. The student is expected to:

(A) explain the characteristics of rotorcraft aerodynamics and flight controls;

(B) identify the components and explain the function of rotorcraft transmissions;

(C) explain the need for rigging requirements for rotary wing aircraft;

(D) identify rotor systems, rotor blade functions, and rotor blade construction;

(E) explain the need for helicopter skid shoe and tube inspections;

(F) explain causes of rotor system and drive system vibrations;

(G) explain the purpose of rotor blade track and balance;

(H) research and identify the risks of working around helicopter blades during ground operations;

(I) research and identify the risks of improper ground-handling procedures;

(J) research and identify the risks of ground operations and functional tests; and

(K) research and identify the risks of improper maintenance of rotorcraft systems and components.

(29) The student uses regulatory and industry standards and demonstrates technical knowledge and skills for rotorcraft fundamentals, utilizing aircraft, aircraft training devices, or equivalent simulated situations. The student is expected to:

(A) identify components of a helicopter rotor system;

(B) identify and locate helicopter rotor blade track and balance procedures;

(C) identify and locate procedures needed to rig helicopter controls; and

(D) identify and locate procedures to track and balance a rotor system.

(30) The student understands the academic knowledge and skills for water and waste systems. The student is expected to:

(A) identify the components and explain the basic operation of potable water systems;

(B) identify the components and explain the basic operation of lavatory waste systems;

(C) describe servicing requirements for water and waste systems; and

(D) research and identify the need for PPE to reduce the risks associated with servicing lavatory waste systems.

(31) The student uses regulatory and industry standards and demonstrates technical knowledge and skills for water and waste systems, utilizing aircraft, aircraft training devices, or equivalent simulated situations. The student is expected to:

(A) locate and explain the procedures for servicing a lavatory waste system; and

(B) locate and explain the procedures for servicing a potable water system.

§127.889. Aircraft Powerplant Technology (Two Credits), Adopted 2024.

(a) Implementation. The provisions of this section shall be implemented by school districts beginning with the 2025-2026 school year.

(b) General requirements. This course is recommended for students in Grades 11 and 12. Prerequisite: Aircraft Maintenance Technology. Students shall be awarded two credits for successful completion of this course.

(c) Introduction.

(1) 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.

(2) The Transportation, Distribution, and Logistics Career Cluster focuses on planning, management, and movement of people, materials, and goods by road, pipeline, air, rail, and water and related professional support services such as transportation infrastructure planning and management, logistics services, mobile equipment, and facility maintenance.

(3) Aircraft Powerplant Technology is designed to teach the theory of operation of aircraft powerplants and associated maintenance and repair practices of the Federal Aviation Administration (FAA) powerplant curriculum subjects utilizing aircraft, aircraft training devices, or equivalent simulated situations. In this course, the academic and technical skills are separated to reflect the learning outcomes as designed in the FAA Airman Certification Standards. Powerplant maintenance and repair practices include knowledge of the theory, function, diagnosis, and service of powerplants, systems, and components of aircraft. Industry-recognized professional licensures, certifications, and registrations are available for students who meet the requirements set forth by the accrediting organization.

(4) Students are encouraged to participate in extended learning experiences such as career and technical student organizations and other leadership or extracurricular organizations.

(5) Statements that contain the word "including" reference content that must be mastered, while those containing the phrase "such as" are intended as possible illustrative examples.

(6) The FAA uses standard terms with specific expectations for performance. The terms are defined as follows.

(A) Check means to verify proper operation.

(B) Inspect means to examine with or without inspection enhancing tools or equipment.

(C) Overhaul means to disassemble, clean, inspect, repair as necessary, and reassemble.

(D) Repair means to correct a defective condition.

(E) Service means to perform functions that assure continued operation.

(F) Troubleshoot means to analyze and identify malfunctions.

(7) When a student performs an action, such as checking, inspecting, overhauling, repairing, servicing, troubleshooting, and installing in this course, they are to complete all associated tasks. If an action detects a flaw, defect, or discrepancy in an aircraft or component, that finding could trigger another maintenance action. Actions may include documenting findings through logbook entries, maintenance action forms, installation plans, and work orders.

(d) Knowledge and skills.

(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:

(A) identify and compare employment opportunities, including entrepreneurship opportunities, and certification requirements for the field of aircraft maintenance;

(B) identify and demonstrate ways to contribute and collaborate as an effective member of a team;

(C) identify individual ethical and legal behavior standards according to professional and regulatory agencies;

(D) research and discuss the impact of the English language proficiency requirements as prescribed by the Federal Aviation Regulations;

(E) identify and explain human factors that may impact health and safety in a worksite as addressed by industry standards;

(F) explain the role of human factors in maintaining health and safety in the workplace and demonstrate personal responsibility to maintain health and safety in the workplace;

(G) identify and explain how employees' personal responsibility attitudes can affect the success and profitability of a workplace;

(H) apply reasoning skills to a variety of simulated workplace situations in order to make ethical decisions;

(I) identify standards of industry related to employee appearance and health habits;

(J) identify and practice effective written and oral communication skills;

(K) identify and practice effective listening skills; and

(L) define and apply FAA standard terms that have specific expectations for performance, including check, inspect, overhaul, repair, service, and troubleshoot.

(2) The student relates academic skills to the requirements of reciprocating engines. The student is expected to:

(A) identify the components and types of reciprocating internal combustion aircraft engines, including inline, opposed, V-type, and radial engines;

(B) explain the operational theory of reciprocating internal combustion aircraft engines, including inline, opposed, V-type, and radial engines;

(C) explain the purpose and methods of reciprocating engine preservation;

(D) explain the purpose and methods of reciprocating engine maintenance and inspection;

(E) locate and explain the procedures for reciprocating engine ground operations;

(F) identify the components and explain the basic operation of diesel engines;

(G) explain the basic operational theory of diesel engines;

(H) research and identify the risks of maintenance that requires moving the propeller;

(I) research and identify the risks of ground operating a reciprocating engine;

(J) research and identify the actions necessary in the event of a reciprocating engine fire; and

(K) research and identify the risks in not using the manufacturer's procedures during maintenance.

(3) The student uses regulatory and industry standards and demonstrates technical knowledge and skills for reciprocating engines, utilizing aircraft, aircraft training devices, or equivalent simulated situations. The student is expected to:

(A) perform and document findings from a cylinder assembly inspection;

(B) operate and troubleshoot a reciprocating engine;

(C) install a wrist pin in a piston;

(D) identify the parts of a cylinder and a crankshaft;

(E) identify and inspect bearings found in reciprocating engines; and

(F) inspect and rig cable and push-pull engine controls.

(4) The student relates academic skills to the requirements of turbine engines. The student is expected to:

(A) identify the components and types of turbine engines;

(B) explain the basic operational theory of turbine engines;

(C) explain the purpose and methods of monitoring turbine engine performance;

(D) explain the purpose and methods of turbine engine troubleshooting, maintenance, and inspection;

(E) research and explain the causes of turbine engine performance loss;

(F) explain the basic operational theory of bleed air systems;

(G) explain the purpose and methods of turbine engine preservation;

(H) explain the theory and application of auxiliary power units;

(I) research and identify the risks of turbine engine operation;

(J) research and identify the risks of performing maintenance on a turbine engine;

(K) research and identify the actions necessary in the event of a turbine engine fire; and

(L) research and identify the risks of foreign object damage (FOD) to turbine engines.

(5) The student uses regulatory and industry standards and demonstrates technical knowledge and skills for turbine engines, utilizing aircraft, aircraft training devices, or equivalent simulated situations. The student is expected to:

(A) identify different turbine compressors;

(B) identify different types of turbine engine blades;

(C) identify components of turbine engines;

(D) map airflow direction and pressure changes in turbine engines;

(E) identify and locate the procedures for the adjustment of a fuel control unit;

(F) identify and locate the installation or removal procedures for a turbine engine;

(G) identify damaged turbine engine blades; and

(H) analyze causes for turbine engine performance loss.

(6) The student relates academic skills to the requirements of engine inspection. The student is expected to:

(A) explain the purpose of inspection requirements under 14 Code of Federal Regulations (CFR) Part 43 and 14 CFR Part 91;

(B) explain the purpose and methods of identification of life-limited parts and life-limited parts replacement intervals;

(C) explain the purpose and types of special inspections such as sudden engine stoppage, hard landings, and FOD ingestion;

(D) explain the purpose of using FAA-approved data;

(E) explain the importance of compliance with service letters, service bulletins, instructions for continued airworthiness, airworthiness directives (AD), and Type Certificate Data Sheets (TCDS);

(F) explain the purpose of maintenance recordkeeping requirements under 14 CFR Part 43;

(G) explain the purpose of engine component inspection, checking, and servicing;

(H) explain the importance of inspecting engine mounts and mounting hardware;

(I) research and identify the risks of performing a compression test on a reciprocating engine; and

(J) research and identify the risks of performing maintenance on an operating reciprocating engine and a turbine engine.

(7) The student uses regulatory and industry standards and demonstrates technical knowledge and skills for engine inspection, utilizing aircraft, aircraft training devices, or equivalent simulated situations. The student is expected to:

(A) evaluate a powerplant for compliance with FAA-approved or manufacturer data;

(B) perform a powerplant records inspection;

(C) inspect a powerplant for compliance with applicable ADs;

(D) determine powerplant installation eligibility in accordance with the TCDS;

(E) inspect engine controls for proper operation and adjustment;

(F) inspect an aircraft engine accessory for serviceability;

(G) inspect engine records for time or cycles on life-limited parts;

(H) perform an engine start and inspect engine operational parameters; and

(I) inspect an engine mount to determine serviceability.

(8) The student relates academic skills to the requirements of engine instrument systems. The student is expected to:

(A) identify the components of engine instrument systems, including fuel flow, temperature, engine speed, pressure, torque meter, engine pressure ratio (EPR), engine indicating and crew alerting system (EICAS), and electronic centralized aircraft monitor (ECAM);

(B) explain the operational theory of engine instrument systems, including fuel flow, temperature, engine speed, pressure, torque meter, EPR, EICAS, and ECAM;

(C) describe the types of annunciator indicators and the functions of annunciator indicating systems;

(D) define the meaning of annunciator indicating system warning, caution, and advisory lights;

(E) identify the components and explain the operational theory of full authority digital engine controls (FADEC);

(F) explain the purpose and methods of marking engine instrument ranges;

(G) research and identify the risks of damaging instrument systems or indicating systems during maintenance; and

(H) research and identify the risks of inaccurate engine instrument calibration or inaccurate instrument readings.

(9) The student uses regulatory and industry standards and demonstrates technical knowledge and skills for engine inspection, utilizing aircraft, aircraft training devices, or equivalent simulated situations. The student is expected to:

(A) remove, inspect, and install a fuel-flow transmitter;

(B) remove, inspect, and install a fuel-flow gauge;

(C) identify components of an electric tachometer system;

(D) inspect tachometer markings for accuracy;

(E) locate procedures for troubleshooting a turbine EPR system;

(F) inspect exhaust gas temperature (EGT) probes;

(G) locate and inspect engine low fuel pressure warning system components; and

(H) troubleshoot an EGT indicating system.

(10) The student relates academic skills to the requirements of engine fire protection systems. The student is expected to:

(A) identify types of fires such as electrical, structural, and petroleum-based fires and explain the purpose of engine fire zones;

(B) identify the components and explain the basic operation of fire detection warning systems;

(C) explain the purpose of fire detection system maintenance and inspection requirements;

(D) identify fire extinguishing agents and types of fire extinguishing systems;

(E) explain the purpose and methods of fire extinguishing system maintenance and inspection;

(F) research and identify the risks of container discharge cartridges;

(G) research and identify the risks of extinguishing agents; and

(H) research and identify the risks of maintenance on circuits associated with electrically activated container discharge cartridges.

(11) The student uses regulatory and industry standards and demonstrates technical knowledge and skills for engine fire protection systems, utilizing aircraft, aircraft training devices, or equivalent simulated situations. The student is expected to:

(A) identify fire detection sensing units;

(B) locate troubleshooting procedures for a fire detection system;

(C) inspect fire extinguisher discharge circuit;

(D) check operation of fire warning press-to-test and troubleshoot faults; and

(E) identify continuous-loop fire detection system components.

(12) The student relates academic skills to the requirements of engine electrical systems. The student is expected to:

(A) identify the components of engine electrical systems, including alternating current generators, direct current generators, alternators, starter generators, voltage regulators, overvoltage protection, and overcurrent protection;

(B) explain the operational theory of engine electrical systems, including alternating current generators, direct current generators, alternators, starter generators, voltage regulators, overvoltage protection, and overcurrent protection;

(C) explain the procedure for locating the correct electrical wire size needed to fabricate a wire;

(D) explain the purpose of engine electrical wiring, switches, and protective devices;

(E) research and identify the risks of reversing polarity when performing electrical system maintenance;

(F) research and identify the actions necessary in response to a warning or caution annunciator light;

(G) research and identify the risks of performing maintenance on energized aircraft systems; and

(H) research and identify the risks of improper routing and securing wiring near flammable fluid lines.

(13) The student uses regulatory and industry standards and demonstrates technical knowledge and skills for engine electrical systems, utilizing aircraft, aircraft training devices, or equivalent simulated situations. The student is expected to:

(A) inspect engine electrical wiring, switches, cable, and protective devices;

(B) analyze the suitability of a replacement component by part number;

(C) troubleshoot a direct-drive electric starter system;

(D) select the appropriate wire size for engine electrical system;

(E) repair a broken engine electrical system wire;

(F) troubleshoot an electrical system using a schematic or wiring diagram;

(G) fabricate a bonding jumper; and

(H) inspect engine electrical connectors.

(14) The student relates academic skills to the requirements of engine lubrication systems. The student is expected to:

(A) describe types, grades, and uses of engine oil;

(B) identify the components and explain the basic operation of lubrication systems, including wet-sumps and dry-sumps;

(C) explain the purpose of chip detectors;

(D) explain the purpose and methods of lubrication system maintenance, inspection, servicing, and analysis;

(E) explain the causes of excessive aircraft engine oil consumption;

(F) research and identify the risks of mixing engine oils;

(G) research and identify the risks in not using the manufacturer's recommendations regarding the use of engine lubricants; and

(H) research and identify the risks of improper handling, storage, and disposal of used lubricating oil.

(15) The student uses regulatory and industry standards and demonstrates technical knowledge and skills for engine lubrication systems, utilizing aircraft, aircraft training devices, or equivalent simulated situations. The student is expected to:

(A) inspect an oil cooler or oil lines;

(B) identify the correct type of oil for a specific engine;

(C) identify approved oils for different climatic temperatures;

(D) identify and locate procedures for obtaining oil samples;

(E) inspect an oil filter or screen based on industry standards;

(F) identify oil system components;

(G) replace an oil system component;

(H) identify oil system flow through the engine;

(I) troubleshoot an engine oil pressure malfunction;

(J) troubleshoot an engine oil temperature system; and

(K) identify types of metal found in an oil filter.

(16) The student relates academic skills to the requirements of ignition and starting systems. The student is expected to:

(A) identify the components of ignition systems, including spark plugs, shower of sparks, magnetos, impulse couplings, solid-state ignitions, and FADECs;

(B) explain the operational theory of ignition systems and components, including spark plugs, shower of sparks, magnetos, impulse couplings, solid-state ignitions, and FADECs;

(C) identify the components and explain the basic operation of engine starters;

(D) identify the components and explain the basic operation of turbine engine ignition systems;

(E) research and identify the risks of advanced and retarded ignition timing on piston engines;

(F) research and identify the risks of maintenance on engines with capacitor discharge ignition systems; and

(G) research and identify the risks of working around reciprocating engines with an ungrounded magneto.

(17) The student uses regulatory and industry standards and demonstrates technical knowledge and skills for ignition and starting systems, utilizing aircraft, aircraft training devices, or equivalent simulated situations. The student is expected to:

(A) remove, clean, inspect, and install a spark plug;

(B) inspect an electrical starting system;

(C) troubleshoot an electrical starting system;

(D) troubleshoot an ignition switch circuit;

(E) identify the correct spark plugs used for replacement installation; and

(F) identify the correct igniter plug on a turbine engine.

(18) The student relates academic skills to the requirements of engine fuel and fuel metering systems. The student is expected to:

(A) explain the purpose of proper fuel to air ratios and fuel metering;

(B) identify the components of fuel metering systems, including float carburetor, pressure carburetor, continuous-flow fuel injection, FADEC, and hydromechanical fuel control;

(C) explain the basic operation of fuel metering systems, including float carburetor, pressure carburetor, continuous-flow fuel injection, FADEC, and hydromechanical fuel control;

(D) explain the adjustment of fuel metering systems, including float carburetor, pressure carburetor, continuous-flow fuel injection, FADEC, and hydromechanical fuel control;

(E) explain the purpose and basic operation of fuel heaters, lines, pumps, valves, filters, and drains;

(F) explain the basic operation of fuel nozzles and manifolds;

(G) identify the components and explain the basic operation of turbine engine fuel metering systems;

(H) locate and explain inspection requirements for an engine fuel system;

(I) explain fuel system operation;

(J) research and identify the risks of adjusting turbine engine fuel controls;

(K) research and identify the risks of adjusting reciprocating engine fuel controls;

(L) research and identify the risks of handling fuel metering system components or fuel control units that may contain fuel; and

(M) research and identify the risks of fuel system maintenance.

(19) The student uses regulatory and industry standards and demonstrates technical knowledge and skills for engine fuel and fuel metering systems, utilizing aircraft, aircraft training devices, or equivalent simulated situations. The student is expected to:

(A) identify carburetor components;

(B) identify fuel and air flow through a float-type carburetor;

(C) remove and install a carburetor main metering jet;

(D) inspect the needle, seat, and float level on a float-type carburetor;

(E) adjust carburetor idle speed and mixture;

(F) research and locate procedures for a turbine engine revolutions per minute overspeed inspection;

(G) research and locate procedures for adjusting a hydromechanical fuel control unit;

(H) explain procedures for removing and installing a turbine engine fuel control unit;

(I) identify components of an engine fuel system;

(J) identify fuel selector placards;

(K) inspect engine fuel system fluid lines and components;

(L) locate the procedures for troubleshooting a turbine engine fuel heater system; and

(M) inspect fuel selector valve.

(20) The student relates academic skills to the requirements of reciprocating engine induction and cooling systems. The student is expected to:

(A) identify the components and explain the theory of operation of reciprocating engine induction and cooling systems;

(B) explain the causes and effects of induction system icing;

(C) identify the components and explain the theory of superchargers, supercharger controls, turbochargers, turbocharger controls, and intercoolers;

(D) identify the components and explain the theory of augmenter cooling systems;

(E) identify the components and explain the theory of induction system filtering and carburetor heaters;

(F) research and identify the risks of maintenance on turbochargers;

(G) research and identify the risks of ground operation of aircraft engines;

(H) research and identify the risks of maintenance-related FOD; and

(I) research and identify the risks of chemicals used in liquid cooling systems.

(21) The student uses regulatory and industry standards and demonstrates technical knowledge and skills for reciprocating engine induction and cooling systems, utilizing aircraft, aircraft training devices, or equivalent simulated situations. The student is expected to:

(A) inspect a carburetor heat system;

(B) inspect an alternate air valve for proper operation;

(C) inspect an induction system drain for proper operation;

(D) service an induction air filter;

(E) inspect an induction system for obstruction;

(F) inspect an air intake manifold for leaks;

(G) locate the proper specifications for coolant used in a liquid-cooled engine;

(H) inspect reciprocating engine cooling ducting and baffle seals for damage;

(I) identify components of a turbocharger induction system;

(J) identify exhaust augmenter-cooled engine components;

(K) inspect and repair a cylinder baffle;

(L) inspect a cowl flap system for normal operation; and

(M) inspect cylinder cooling fins for damage.

(22) The student relates academic skills to the requirements of turbine engine air systems. The student is expected to:

(A) identify the components and explain the operational theory of air cooling systems, turbine engine induction systems, turbine engine bleed air systems and turbine engine anti-ice systems;

(B) explain the purpose and theory of turbine engine cowling air flow and turbine engine internal cooling;

(C) identify the components and purpose of turbine engine baffle and methods of seal installation;

(D) identify and explain the purpose of turbine engine insulation blankets and shrouds;

(E) research and identify the risks of maintenance on compressor bleed air systems; and

(F) research and identify the risks of ground operation of aircraft engines following other than manufacturer's instructions.

(23) The student uses regulatory and industry standards and demonstrates technical knowledge and skills for turbine engine air systems, utilizing aircraft, aircraft training devices, or equivalent simulated situations. The student is expected to:

(A) identify location of turbine engine insulation blankets;

(B) identify turbine engine cooling air flow;

(C) inspect rigid or flexible turbine engine cooling ducting or baffle seals; and

(D) identify turbine engine ice and rain protection system components.

(24) The student relates academic skills to the requirements of engine exhaust and reverser systems. The student is expected to:

(A) identify the components of reciprocating engine exhaust systems, turbine engine exhaust systems, noise suppression systems, and thrust reversers;

(B) explain the operational theory of reciprocating engine exhaust systems, turbine engine exhaust systems, noise suppression systems, and thrust reversers;

(C) research and identify the risks of maintenance and inspection of exhaust system components;

(D) research and identify the risks of operating reciprocating engines with exhaust systems leaks and exhaust system failures; and

(E) research and identify the risks of ground operation of aircraft engines.

(25) The student uses regulatory and industry standards and demonstrates technical knowledge and skills for engine exhaust and reverser systems, utilizing aircraft, aircraft training devices, or equivalent simulated situations. The student is expected to:

(A) identify the type of exhaust system on a particular aircraft;

(B) inspect exhaust system;

(C) locate and explain procedures for testing and troubleshooting a turbine thrust reverser system; and

(D) perform a pressure leak check of a reciprocating engine exhaust system.

(26) The student relates academic skills to the requirements of propellers. The student is expected to:

(A) explain the theory and operation of propellers;

(B) identify types of propellers and blade design;

(C) explain the theory and operation of constant speed propellers, pitch control systems, and propeller governors;

(D) explain the theory and operation of turbine engine propeller beta range operation;

(E) explain the purpose and methods of propeller servicing, maintenance, and inspections;

(F) identify and locate procedures for removal and installation of a propeller;

(G) explain the purpose of propeller TCDS;

(H) explain the theory and operation of propeller synchronization systems and propeller ice control systems; and

(I) research and identify the risks of propeller ground operation, maintenance, and inspections.

(27) The student uses regulatory and industry standards and demonstrates technical knowledge and skills for propellers, utilizing aircraft, aircraft training devices, or equivalent simulated situations. The student is expected to:

(A) check blade static tracking;

(B) inspect a propeller for condition and airworthiness;

(C) measure propeller blade angle;

(D) locate and explain the procedures for balancing a fixed-pitch propeller;

(E) identify propeller range of operation; and

(F) determine what minor propeller alterations are acceptable using the propeller specifications, TCDS, and listings.

§127.890. Aircraft Maintenance Technology (One Credit), Adopted 2024.

(a) Implementation. The provisions of this section shall be implemented by school districts beginning with the 2025-2026 school year.

(b) General requirements. This course is recommended for students in Grades 9-12. Recommended prerequisites: Introduction to Aircraft Technology. Students shall be awarded one credit for successful completion of this course.

(c) Introduction.

(1) 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.

(2) The Transportation, Distribution, and Logistics Career Cluster focuses on planning, management, and movement of people, materials, and goods by road, pipeline, air, rail, and water and related professional support services such as transportation infrastructure planning and management, logistics services, mobile equipment, and facility maintenance.

(3) Aircraft Maintenance Technology is designed to teach the theory of operation, general maintenance, and repair practices of Federal Aviation Administration (FAA) general curriculum subjects utilizing aircraft, aircraft training devices, or equivalent simulated situations. In this course, the academic and technical skills are separated to reflect the learning outcomes as designed in the FAA airman certification standards. Maintenance and repair practices include knowledge of the function, diagnosis, and service of aircraft and their associated equipment. Industry-recognized professional licensures, certifications, and registrations are available for students who meet the requirements set forth by the accrediting organization.

(4) Students are encouraged to participate in extended learning experiences such as career and technical student organizations and other leadership or extracurricular organizations.

(5) Statements that contain the word "including" reference content that must be mastered, while those containing the phrase "such as" are intended as possible illustrative examples.

(6) The FAA uses standard terms with specific expectations for performance. The terms are defined as follows.

(A) Check means to verify proper operation.

(B) Inspect means to examine with or without inspection enhancing tools or equipment.

(C) Overhaul means to disassemble, clean, inspect, repair as necessary, and reassemble.

(D) Repair means to correct a defective condition.

(E) Service means to perform functions that assure continued operation.

(F) Troubleshoot means to analyze and identify malfunctions.

(7) When a student performs an action, such as checking, inspecting, overhauling, repairing, servicing, troubleshooting, and installing in this course, they are to complete all associated tasks. If an action detects a flaw, defect, or discrepancy in an aircraft or component, that finding could trigger another maintenance action. Actions may include documenting findings through logbook entries, maintenance action forms, installation plans, and work orders.

(d) Knowledge and skills.

(1) The student demonstrates professional standards, interpersonal communication, and employability skills as required by business and industry. The student is expected to:

(A) identify employment opportunities, including entrepreneurship opportunities, and certification requirements for the field of aircraft maintenance and repair;

(B) identify and demonstrate ways to contribute and collaborate as an effective member of a team;

(C) identify individual ethical and legal behavior standards according to professional and regulatory agencies;

(D) research and discuss the impact of the English language proficiency requirements as prescribed by the Federal Aviation Regulations;

(E) identify and explain the technical knowledge and skills related to human factors in health and safety in the worksite as addressed by industry standards;

(F) explain the role of human factors in maintaining health and safety in the workplace and demonstrate personal responsibility to maintain health and safety in the worksite;

(G) identify and explain how employees' personal responsibility attitudes can affect the success and profitability of a worksite;

(H) apply reasoning skills to a variety of workplace situations to make ethical decisions;

(I) identify industry standards related to employee appearance and health habits;

(J) practice effective written and oral communication skills;

(K) identify and practice effective listening skills; and

(L) define and apply FAA standard terms that have specific expectations for performance, including check, inspect, overhaul, repair, service, and troubleshoot.

(2) The student relates academic skills to the requirements of human factors. The student is expected to:

(A) describe safety culture and organizational factors in the work environment;

(B) identify and explain types of human error and human error principles;

(C) identify and discuss the chain-of-events theory, including pre-conditions and conditions for unsafe acts;

(D) identify and discuss the 12 common causes of mistakes in the aviation workplace; and

(E) research and discuss the purpose of safety management systems in the aviation workplace.

(3) The student uses regulatory and industry standards and demonstrates technical knowledge and skills for human factors, utilizing aircraft, aircraft training devices, or equivalent simulated situations. The student is expected to:

(A) complete and submit a malfunction and defect report; and

(B) research and report on information regarding human factor errors.

(4) The student relates academic skills to the requirements of aviation mathematics. The student is expected to:

(A) perform algebraic operations involving addition, subtraction, multiplication, and division, using positive and negative numbers;

(B) determine areas and volumes of various geometric shapes;

(C) solve ratio, proportion, and percentage problems; and

(D) extract roots and raise numbers to a given power.

(5) The student uses regulatory and industry standards and demonstrates technical knowledge and skills for aviation mathematics, utilizing aircraft, aircraft training devices, or equivalent simulated situations. The student is expected to:

(A) compute the volume of a shape such as a baggage compartment, a fuel tank, or an engine cylinder;

(B) compute the area of an aircraft wing;

(C) convert between fractions and decimals;

(D) compute torque value conversions between inch-pounds and foot-pounds; and

(E) compute the compression ratio of a reciprocating engine cylinder.

(6) The student relates academic skills to the requirements of fundamentals of electricity and electronics. The student is expected to:

(A) explain electron theory, including magnetism, capacitance, induction, direct current electrical circuits, and alternating current electrical circuits;

(B) explain electrical laws and theory, including Ohm's Law, Kirchhoff's Law, Watt's Law, Faraday's Law, Lenz's Law, and Right-hand motor rule;

(C) identify and explain electrical measurement tools that measure voltage, current, resistance, and power;

(D) identify and discuss electrical measurement principles for measuring voltage, current, resistance, and power;

(E) identify and explain electrical measurement procedures for measuring voltage, current, resistance, and power;

(F) compare types of batteries; and

(G) compare series circuits and parallel circuits.

(7) The student uses regulatory and industry standards and demonstrates technical knowledge and skills for fundamentals of electricity and electronics, utilizing aircraft, aircraft training devices, or equivalent simulated situations. The student is expected to:

(A) use multimeters to perform circuit continuity tests, test a switch and fuse, and measure voltage, current, and resistance;

(B) interpret aircraft electrical circuit diagrams and symbols;

(C) inspect and service an aircraft battery; and

(D) identify faults in circuits by using appropriate troubleshooting techniques.

(8) The student relates academic skills to the requirements of physics for aviation. The student is expected to:

(A) explain the theory of flight, including lift, weight, thrust, and drag, as related to Bernoulli's Principle, Newton's Laws of Motion, and fluid mechanics;

(B) describe the function and operation of aircraft flight controls and additional aerodynamic devices, including vortex generators, wing fences, and stall strips; and

(C) analyze and compare standard atmospheric factors affecting atmospheric conditions, including the relationship between temperature, density, weight, and volume.

(9) The student uses regulatory and industry standards and demonstrates technical knowledge and skills for physics for aviation, utilizing aircraft, aircraft training devices, or equivalent simulated situations. The student is expected to:

(A) determine density and pressure altitude;

(B) identify changes to pressure and velocity of a fluid as it passes through a venturi;

(C) calculate force, area, and pressure for a given scenario; and

(D) calculate the lift of an aircraft and determine if the aircraft will climb, descend, or maintain altitude given its weight.

(10) The student relates academic skills to the requirements of weight and balance. The student is expected to:

(A) describe the purpose of weighing an aircraft and determining the aircraft's center of gravity;

(B) explain the procedures for weighing an aircraft, including the general preparation for weighing, with emphasis on aircraft weighing area considerations;

(C) explain the procedures for calculating center of gravity, including arm, positive and negative moment, center of gravity, and moment index; and

(D) explain adverse loading considerations, proper empty weight configuration, and ballast placement.

(11) The student uses regulatory and industry standards and demonstrates technical knowledge and skills for weight and balance, utilizing aircraft, aircraft training devices, or equivalent simulated situations. The student is expected to:

(A) calculate aircraft weight and balance, including equipment changes, empty weight, and empty weight center of gravity; and

(B) locate datum, weight and balance information, placarding, and limitation requirements for an aircraft in an appropriate reference such as the type certificate data sheet.

(12) The student relates academic skills to the requirements of aircraft drawings. The student is expected to:

(A) identify and use aircraft drawing terminology; and

(B) interpret aircraft drawings, blueprints, sketches, charts, graphs, and system schematics related to repairs, alterations, and inspections.

(13) The student uses regulatory and industry standards and demonstrates technical knowledge and skills for aircraft drawings, utilizing aircraft, aircraft training devices, or equivalent simulated situations. The student is expected to:

(A) identify and describe the meaning of lines and symbols used in an aircraft drawing;

(B) interpret dimensions used in an aircraft drawing;

(C) identify changes to aircraft drawings; and

(D) identify material requirements indicated by an aircraft drawing.

(14) The student relates academic skills to the requirements of regulations, forms, and publications. The student is expected to:

(A) identify recency of experience requirements, the privileges and limitations of mechanic certificates, and how to reestablish privileges once they are lost;

(B) define maintenance terminology as defined in 14 Code of Federal Regulations (CFR) Part 1, including time in service, maintenance, preventive maintenance, major alteration, major repair, minor alteration, and minor repair;

(C) describe requirements for maintenance record entries for approval for return to service after maintenance, alterations, and inspections;

(D) identify compliance requirements for manufacturer-specified maintenance methods, techniques, practices, and inspection intervals;

(E) explain FAA-approved maintenance data, including maintenance manuals and other methods acceptable by the administrator; and

(F) describe mechanic change of address notification procedures.

(15) The student uses regulatory and industry standards and demonstrates technical knowledge and skills for regulations, forms, and publications, utilizing aircraft, aircraft training devices, or equivalent simulated situations. The student is expected to:

(A) evaluate a 100-hour inspection aircraft maintenance record entry for accuracy;

(B) locate applicable FAA aircraft specifications and FAA Type Certificate Data Sheets (TCDS) for an aircraft or component;

(C) determine the conformity of aircraft instrument range markings and placarding;

(D) use a manufacturer's illustrated parts catalog to locate specific part numbers for aircraft parts such as door handles, rudder pedals, or seat latches;

(E) determine whether a given repair or alteration is major or minor; and

(F) explain the difference between approved data such as data required for major repairs or alterations and acceptable data such as data required for minor repairs or alterations.

(16) The student relates academic skills to the requirements of fluid lines and fittings. The student is expected to:

(A) identify rigid tubing and flexible hose materials, applications, sizes, and fittings;

(B) describe rigid tubing and flexible hose fabrication, installation, and inspection techniques;

(C) explain the importance of properly using a torque wrench and torque seal when securing fluid hose and line fittings; and

(D) analyze and describe the risks associated with high-pressure hydraulic system configuration prior to and during maintenance.

(17) The student uses regulatory and industry standards and demonstrates technical knowledge and skills for fluid lines and fittings, utilizing aircraft, aircraft training devices, or equivalent simulated situations. The student is expected to:

(A) fabricate and install a rigid line with a flare and a bend;

(B) fabricate and install a flexible hose; and

(C) perform a rigid line and flexible hose inspection.

(18) The student relates academic skills to the requirements of aircraft materials, hardware, and processes. The student is expected to:

(A) identify and describe material markings and hardware markings commonly used in aircraft;

(B) compare suitability and compatibility of materials and hardware used for maintenance;

(C) explain forces placed on aircraft materials, including tension, compression, torsion, bending, strain, and shear;

(D) identify safety wire and safety clip requirements and techniques;

(E) describe precision measurement tools, principles, and procedures;

(F) explain soldering preparation, types of solder, and flux usage;

(G) analyze torquing tools, principles, and procedures and the relationship between torque and fastener preload; and

(H) differentiate between the characteristics of acceptable and unacceptable welds.

(19) The student uses regulatory and industry standards and demonstrates technical knowledge and skills for aircraft materials, hardware, and processes, utilizing aircraft, aircraft training devices, or equivalent simulated situations. The student is expected to:

(A) select aircraft materials and hardware such as bolts, turnbuckles, washers, and rivets based on manufacturer's markings appropriate for a specific scenario;

(B) install safety wire on hardware such as nuts, bolts, and turnbuckles;

(C) check for proper calibration of a precision-measurement tool and record precision measurements with an instrument that has a Vernier scale;

(D) determine required torque values and properly torque aircraft hardware; and

(E) inspect welds and differentiate between acceptable and unacceptable welds.

(20) The student relates academic skills to the requirements of ground operations and servicing. The student is expected to:

(A) describe proper towing and securing procedures for aircraft using approved data;

(B) describe proper aircraft ground servicing, including oil, oxygen, hydraulic, pneumatic, and deicing systems and fueling and defueling procedures;

(C) differentiate between characteristics of aviation gasoline, turbine fuels, and fuel additives;

(D) explain engine starting, ground operation, and aircraft taxiing procedures;

(E) explain airport operation area procedures and air traffic control communications, including runway incursion prevention;

(F) identify the types and classes of fire extinguishers;

(G) analyze the importance of proper tool and hardware use and accountability;

(H) describe the need for proper material handling and parts protection;

(I) identify hazardous materials, locate the appropriate safety data sheet (SDS), and select the indicated personal protection equipment (PPE); and

(J) analyze and describe the potential effects of foreign object damage on aircraft.

(21) The student uses regulatory and industry standards and demonstrates technical knowledge and skills for ground operations and servicing, utilizing aircraft, aircraft training devices, or equivalent simulated situations. The student is expected to:

(A) perform a foreign object damage control procedure;

(B) connect external power to an aircraft;

(C) prepare an aircraft for towing;

(D) use appropriate hand signals for the movement of aircraft;

(E) identify different grades of aviation fuel and select an approved fuel for an aircraft;

(F) prepare an aircraft for fueling and inspect an aircraft fuel system for water and foreign object debris (FOD) contamination;

(G) follow a checklist to start up or shut down an aircraft reciprocating or turbine engine;

(H) identify procedures for extinguishing fires in an engine induction system;

(I) secure an aircraft by locating and following the correct procedures for a turbine-powered aircraft after engine shutdown; and

(J) locate and explain procedures for securing a turbine-powered aircraft after engine shutdown.

(22) The student relates academic skills to the requirements of cleaning and corrosion control. The student is expected to:

(A) explain the need for aircraft cleaning procedures;

(B) explain corrosion theory, including types and effects of corrosion, corrosion-prone areas in aircraft, and corrosion preventive maintenance procedures;

(C) describe corrosion identification and inspection techniques, corrosion removal and treatment procedures, the selection of optimal corrosion preventive compounds (CPC), and the frequency of corrosion treatment;

(D) describe the use of high-pressure application equipment;

(E) identify and discuss the effects of improper use of cleaners on aluminum or composite materials;

(F) explain accelerated corrosion caused by dissimilar metals and the role of protective barriers, including conversion coatings, materials used for protection of airframe structures, and primer materials, to mitigate this risk;

(G) identify topcoat materials and discuss concerns regarding surface preparation for a desired finishing material, effects of ambient conditions on finishing materials, and effects of improper surface preparation on finishing materials; and

(H) identify health concerns when using paints, solvents, and finishing materials and processes, including the use of PPE.

(23) The student uses regulatory and industry standards and demonstrates technical knowledge and skills for cleaning and corrosion control, utilizing aircraft, aircraft training devices, or equivalent simulated situations. The student is expected to:

(A) identify types of protective finishes;

(B) inspect finishes for corrosion and identify, select, and use aircraft corrosion prevention and cleaning materials; and

(C) apply aircraft corrosion prevention and coating materials.

§127.920. Advanced Transportation Systems Laboratory (One Credit), Adopted 2024.

(a) Implementation. The provisions of this section shall be implemented by school districts beginning with the 2025-2026 school year.

(b) General requirements. This course is recommended for students in Grades 11 and 12 as a corequisite course for students participating in a coherent sequence of career and technical education courses in the Transportation, Distribution, and Logistics Career Cluster. This course provides an enhancement opportunity for students to develop the additional skills necessary to pursue industry certification. Recommended prerequisite: a minimum of one credit from the courses in the Transportation, Distribution, and Logistics Career Cluster. Corequisites: Automotive Technology II: Automotive Services, Diesel Equipment Technology II, Collision Repair, Paint and Refinishing, Aircraft Airframe Technology, Aircraft Maintenance Technology, or Aircraft Powerplant Technology. This course must be taken concurrently with

a corequisite course and may not be taken as a stand-alone course. Districts are encouraged to offer this lab in a consecutive block with the corequisite course to allow students sufficient time to master the content of both courses. Students shall be awarded one credit for successful completion of this course.

(c) Introduction.

(1) 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.

(2) The Transportation, Distribution, and Logistics Career Cluster focuses on planning, management, and movement of people, materials, and goods by road, pipeline, air, rail, and water and related professional support services such as transportation infrastructure planning and management, logistics services, mobile equipment, and facility maintenance.

(3) Advanced Transportation Systems Laboratory provides the opportunity to extend knowledge of the major transportation systems and the principles of diagnosing and servicing these systems. Topics in this course may include alternative fuels such as hybrid, bio diesel, hydrogen, compressed natural gas (CNG), liquidized natural gas (LNG), propane, and solar; total electric vehicles and power trains; advanced transportation systems such as collision avoidance, telematics, vehicle stability control, navigation, vehicle-to-vehicle communications; and other technologies. This study will allow students to have an increased understanding of science, technology, engineering, and mathematics in all aspects of these systems. This will reinforce, apply, and transfer academic knowledge and skills to a variety of relevant activities, problems, and settings.

(4) Students are encouraged to participate in extended learning experiences such as career and technical student organizations and other leadership or extracurricular organizations.

(5) Statements that contain the word "including" reference content that must be mastered, while those containing the phrase "such as" are intended as possible illustrative examples.

(d) Knowledge and skills.

(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:

(A) demonstrate knowledge of the technical knowledge and skills related to health and safety in the workplace such as safety glasses and other personal protective equipment (PPE) and safety data sheets (SDS);

(B) identify employment opportunities, including entrepreneurship opportunities and internships, and industry-recognized certification requirements in the transportation field of study;

(C) demonstrate the principles of group participation, team concept, and leadership related to citizenship and career preparation;

(D) apply competencies related to resources, information, interpersonal skills, problem solving, critical thinking, and systems of operation in the transportation industry;

(E) discuss certification opportunities;

(F) discuss response plans to emergency situations;

(G) identify employers' expectations and appropriate work habits, ethical conduct, legal responsibilities, and good citizenship skills; and

(H) develop personal goals, objectives, and strategies as part of a plan for future career and educational opportunities.

(2) The student demonstrates an understanding of the technical knowledge and skills that form the core of knowledge of transportation services. The student is expected to:

(A) extend knowledge of new and emerging transportation technologies related to the corequisite course and its industry such as hybrid, avionics, unmanned aerial systems, collision avoidance, and light duty diesel systems;

(B) demonstrate advanced technical skills related to the corequisite course and its industry;

(C) demonstrate an understanding of the use of advanced tools and equipment; and

(D) demonstrate an understanding of research and development in the transportation industry of the corequisite course.

(3) The student develops an elevated aptitude for the essential knowledge and skills listed for the corequisite course. The student is expected to:

(A) demonstrate deeper understanding of the corequisite course;

(B) develop hands-on skills at an industry-accepted standard; and

(C) exhibit progress toward achieving industry-recognized documentation of specific expertise in a transportation field or skill.