TN Department of Education | College, Career and Technical Education

May 2025

Agriscience

Primary Career Cluster:	Agriculture, Food, & Natural Resources
Course Contact:	CTE.Standards@tn.gov
Course Code(s):	C18H19
Prerequisite:	*None*
Credit:	1
Grade Level:	9
Elective Focus - Graduation Requirements:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other Agriculture, Food, & Natural Resources courses. This course satisfies the third lab science credit requirement for graduation.
POS Concentrator:	This course satisfies one out of two required courses to meet the Perkins V concentrator definition when taken in sequence in the approved program of study.
Programs of Study and Sequence:	This is the first course in *Agribusiness, Agricultural Engineering, Industrial, and Mechanical Systems, Environmental and Natural Resources Management, Food Science, Horticulture Science, Veterinary and Animal Science, and Meat Science* programs of study.
Aligned Student Organization(s):	FFA: http://www.tnffa.org
Coordinating Work-Based Learning:	All Agriculture students are encouraged to participate in a Supervised Agricultural Experience (SAE) program. In addition, teachers who hold an active WBL certificate may offer placement for credit when the requirements of the state board's WBL Framework and the Department's WBL Policy Guide are met. For information, visit https://www.tn.gov/education/educators/career-and-technical-education/work-based-learning.html.
Promoted Tennessee Student Industry Credentials:	Credentials are aligned with postsecondary and employment opportunities and with the competencies and skills that students acquire through their selected program of study. For a listing of promoted student industry credentials, visit https://www.tn.gov/education/educators/career-and-technical-education/student-industry-certification.html.
Teacher Endorsement(s):	(048 and 015), (048 and 016), (048 and 017), (048 and 081), (048 and 126), (048 and 127), (048 and 128), (048 and 129), (048 and 151), (048 and 211), (048 and 212), (048 and 213), (048 and 214), (048 and 414), (048 and 415), (048 and 416), (048 and 417), (048 and 418), (048 and 449), (048 and 951) (150 and 015), (150 and 016), (150 and 017), (150 and 081), (150 and 126), (150 and 127), (150 and 128), (150 and 129), (150 and 151), (150 and 211), (150 and 212), (150 and 213), (150 and 214), (150 and 414), (150 and 415), (150 and 416), (150 and 417), (150 and 418), (150 and 449), (150 and 951), (448 and 015), (448 and 016), (448 and 017), (448 and 081), (448 and 126),

	(448 and 127), (448 and 128), (448 and 129), (448 and 151), (448 and 211), (448 and 212), (448 and 213), (448 and 214), (448 and 414), (448 and 415), (448 and 416), (448 and 417), (448 and 418), (448 and 449), (448 and 951), (950 and 015), (950 and 016), (950 and 017), (950 and 081), (950 and 126), (950 and 127), (950 and 128), (950 and 129), (950 and 151), (950 and 211), (950 and 212), (950 and 213), (950 and 214), (950 and 414), (950 and 415), (950 and 416), (950 and 417), (950 and 418), (950 and 449), (950 and 951)
Required Teacher Certification:	None
Required Teacher Training:	None
Teacher Resources:	https://www.tn.gov/education/educators/career-and-technical-education/career-clusters/cte-cluster-agriculture-food-natural-resources.html Best for All Central: https://bestforall.tnedu.gov/

Course at a Glance

CTE courses provide students with an opportunity to develop specific academic, technical, and 21st-century skills necessary to be successful in their careers and lives. In pursuit of ensuring every student in Tennessee achieves this level of success, we begin with rigorous course standards that feed into intentionally designed programs of study.

Students engage in industry-relevant content through general education integration and experiences such as career and technical student organizations (CTSO) and work-based learning (WBL). Through these experiences, students are immersed with industry-standard content and technology, solve industry-based problems, meaningfully interact with industry professionals, and use/produce industry-specific, informational texts.

Using a Career and Technical Student Organization (CTSO) in Your Classroom

CTSOs are a great resource to put classroom learning into real-life experiences for students through classroom, regional, state, and national competitions, and leadership opportunities. Below are CTSO connections for this course. This is not an exhaustive list.

- Participate in the CTSO Fall Leadership Conference to engage with peers by demonstrating logical thought processes and developing industry-specific skills that involve teamwork and project management.
- Participate in FFA career and leadership events (CDE/LDE) that align with this course, including Agriscience Fair, Agricultural Issues, Agricultural Technology & Mechanicals Systems, Agronomy, Conduct of Meetings, Creed Speaking, Employment Skills, Environmental & Natural Resources, and TN FFA Quiz Bowl.

For more ideas and information, visit Tennessee FFA at https://tnffa.org/.

Using Work-Based Learning (WBL) in Your Classroom

Sustained and coordinated activities related to the course content are the key to successful work-based learning. Possible activities for this course include the following. This is not an exhaustive list.

- **Standards 1.1-1.2** | During a visit to an agriculture production facility or agribusiness facility, have the manager talk about safety in the workplace.
- **Standards 2.1-2.3** | Invite a guest speaker to talk about the impact agriculture has on society at the local, regional, state, national, and global levels.
- **Standards 3.1-3.3** | Have the students complete a project supervised or evaluated by an environmental scientist or wildlife biologist.
- **Standards 4.1-6.2** | Contact an animal geneticist to talk with the class about the positive uses of genetics and genomics.
- **Standards 7.1-7.2 and 9.1-9.3**| Have a local veterinarian speak to the class about the importance of knowing the function of an animal's body systems to properly care for animals.
- **Standards 8.1-8.2** | Contact an agricultural extension agent to work with students to interpret basic soil analysis.
- **Standards 11.1-11.3** | Have the students complete a project supervised or evaluated by a local electrician.
- **Standards 12.1-12.2** | Invite a small engine technician to the classroom to explain the chemical reactions that convert fuel energy into kinetic and heat energy in gas and diesel engines.

Course Description

Agriscience is an introductory laboratory science course that prepares students for biology, subsequent science and agriculture courses, and postsecondary study. This course helps students understand the important role that agricultural science and technology play in the 21st century. In addition, it serves as the first course for all programs of study in the Agriculture, Food, & Natural Resources cluster. Upon completion of this course, proficient students will be prepared for success in more advanced agriculture and science coursework. This course counts as a lab science credit toward graduation requirements.

Course Standards

1. Agriscience Safety and Careers

1.1 Safety: Identify and explain **general laboratory safety procedures, equipment, and tools**, including, but not limited to, prevention and control procedures in agriscience laboratories. Demonstrate safety procedures and complete the safety test with 100 percent accuracy.

1.2 Careers: Explore and compare **local, regional, state, national, and global career opportunities** in the agriscience industry. Use multiple prints, online, and/or personal interview sources, to capture at a minimum the following:

a. job description;
b. essential knowledge and skills;
c. program or path of study to reach occupational goals, starting with high school through postsecondary and/or military options;
d. credentialing and/or licensure requirements;
e. non-educational job requirements such as minimum age, experience in the field, physical fitness tests, background checks, or other notable evaluations; and
f. resume writing.

2. Agriscience Investigation and Overview

2.1 Overview: Articulate important **historical and current events**, impacting the **agricultural industry and agricultural youth development**. Include landmark laws, theories, and practices such as, but not limited to, the Morrill Act, the Smith-Lever Act, the Smith-Hughes Act, and influential figures such as John Deere, Henry Groseclose, Booker T. Washington, and important government agencies in the promotion of knowledge and technology of agricultural science, biotechnology, and key technological developments.

2.2 Economic Impact: Analyze information summarizing the **agricultural industry's economic impact**. Explain the **major agriculture commodity** trends and the importance it has to Tennessee, the United States, and the global economy. Develop a **foundational Supervised Agricultural Experience program** that provides growth into an immersion SAE with an opportunity to implement multiple science and engineering practices:

a. AQDP – asking questions and developing problems;
b. MOD – developing and using models;
c. PCI – planning and carrying out investigations;
d. AID – analyzing and interpreting data;
e. UMCT – using mathematics and computational thinking;
f. CEDS – constructing explanations for science and designing solutions for engineering;
g. EAE – engaging in argument from evidence; and
h. OECI – obtaining, evaluating, and communicating information.

2.3 Solutions: Define the criteria for successful **solutions** to common agricultural problems and identify **relevant constraints**, including social and political constraints. Include problems at the local, state, national, and global level. Evaluate solutions to these problems and how the solutions meet the defined **criteria** and **constraints**. For example, how to grow larger quantities of safe high-quality food on less land to feed the growing population.

3. Fundamentals of Environmental Systems

3.1 Systems: Research a variety of **controlled environment systems** including, but not limited to, aquaponic systems, from recycled bottles, hydroponic setups, wildlife habitats, greenhouses, etc. Design a controlled environment that accounts **for the inputs, outputs, and stability of flows of matter** from the major biogeochemical cycles, such as carbon, nitrogen, phosphorus, and water.

3.2 Models: Develop **models for the flow of energy and matte**r (inorganic forms and overall biomass) in various ecosystems impacting agricultural and environmental systems. Using these models, calculate rates of productivity by analyzing the major components of a food chain. Employ **mathematical models** to explain growth patterns and rates, both density-dependent and density-independent **factors, observed in ecosystems' energy and nutrient flow.**

3.3 Biodiversity: Evaluate the impact of **habitat fragmentation, destruction, and other environmental pressures,** such as invasive species, overharvesting, pollution, and climate change on local and global biodiversity (genetic, species, and ecosystems.) Distinguish between **types of pollution (point and nonpoint sources)** and their sources to predict the

effects on environmental conditions (e.g., water, soil, and air), animal populations, and plant populations from various kinds of human activity.

4. Fundamentals of Cell Structures and Processes

4.1 Cell Structures: Explain the major events of the **eukaryotic cell cycle** which accounts for a single cell growing into a multicellular plant or animal that may have its reproductive capacity. Compare and contrast **cell division in various eukaryotic cell types** in plants and animals.

4.2 Processes: Gather evidence to support that the arrangement of cells into **tissues, organs, and systems** meets the needs of an entire organism. For example, the distribution of water and nutrients to all cells in plants and animals.

5. Fundamentals of Genetics, Genomics, and Heredity

5.1 Role of Genetics and Genomics: Evaluate the **roles of genetics and genomics** in understanding health and disease. Describe the **impact genomics has made in the plant and animal science industry**. Compare and contrast the important connections between these advancements, including but not limited, to the clustered regularly interspaced short palindromic repeater (CRISPR) technology and agricultural consumers' views about the way these technologies impact food products.

5.2 Genetic Data: Analyze and interpret data (e.g., pedigrees, genetic markers, birth weights) that supports how **sexual and asexual reproduction** in plants and animals contributes or limits to genetic variation in populations.

6. Fundamentals of Anatomy and Physiology

6.1 Animal Systems: Identify and describe the major **animal body systems (skeletal, muscular, respiratory, digestive, nervous, circulatory, and reproductive)**. Develop explanations for the **relationships between the structure of individual parts and their function in the larger system** for common livestock, companion animals, and wildlife species. (e.g., tendons transfer muscle movements to the skeletal system by attaching bones and muscles)

6.2 Form and Function: Apply the **selection of specific traits** to common animal breeds with different **intended or domesticated uses**, such as but not limited, to draft horse versus light horse, meat cattle versus dairy cattle. Explain the **form of domestic and wild animals** to their intended uses or their adaptive environmental niche.

7. Fundamentals of the BioChemistry of Animal Digestion

7.1 Digestion: Explain the sequential organization of the different **types of digestive systems** in domestic animals, and compare and contrast **anatomical and physiological differences** between monogastric versus ruminants, and herbivores versus carnivores. Analyze the **stages of digestion and associated processes**, including enzymes and hormones, for a simple and multi-chambered stomach.

7.2 Nutritional Deficiencies: Develop a solution to eliminate dietary **deficiencies** identified through the **analysis of feedstuffs**. Solutions should adhere to specified criteria for proper nutrition based on animal purpose, age, lifespan, and relevant constraints, such as environmental factors and expense.

8. Fundamentals of Plant and Soil Science

8.1 Fundamentals of Plant Growth: Apply concepts related to the basic **cellular and biochemical process** in plants to demonstrate the following:

a. Create a graphic illustration of the parts and functions of plant cells.
b. Use quantitative reasoning to balance chemical equations related to plant processes.
c. Interpret the role of physics within the cohesion/tension theory and its significance to plant life.
d. Examine the roles of photopigments and the effects of different colors of light on plant growth.

8.2 Fundamentals of Soil Science: Analyze models to explain the correlation between **plant nutrient deficiencies and soil composition**. Conduct basic soil analysis to determine the **chemical elements and nutritional levels available in various soils** that are essential for plant growth. Predict the ability of soils to meet the nutritional requirements of plants based on chemical composition, physical structure, and biological activity.

9. Fundamentals of Plant and Animal Reproductive Systems

9.1 Fundamentals of Plant Reproductive Systems: Compare and contrast the basic **reproductive structures of plants**, drawing out key differences between **sexual and asexual reproduction** processes used in plant reproduction.

9.2 Seed Anatomy: Using various seed models, analyze the **structure and function** of each to predict their roles in **plant reproduction and propagation**.

9.3 Fundamentals of Animal Reproduction Systems: Identify and describe the organs of the **male and female animal reproductive systems** that provide **physiological functions**. Compare and contrast the **differences** in the reproductive systems **between small and large animal species**.

10. Fundamentals of Machines

10.1 Tools: Use various models to analyze the structure and function of **simple machines** and how those tools make work easier. Identify the correct **name and function of tools** commonly used in agricultural applications.

10.2 Fabrication: Design and create **simple projects** that incorporate the use of various tools and fabrication concepts.

11. Fundamentals of Power and Energy Systems

11.1 Energy: Use models to evaluate the **changes in energy** in agricultural applications.

a. Define types of energies and objects present in a system.

b. Analyze the relations between changes in energy and work done on/by the system.
c. Analyze how simple machines use a tradeoff in force for distance to accomplish the same amount of work while obeying the law of conservation of energy.
d. Explain energy transfers through radiation and how energy transferred from the sun can be stored and transferred for later use.

11.2 Safety: Identify different models of producing **electrical energy**. Discuss the **safety hazards** as well as prevention and control methods relevant to electrical power models. Predict **strategies to prevent or manage electrical hazards** and evaluate the efficacy of the prevention measures.

11.3 Energy Consumption: Summarize methods and compare units used to benchmark **energy use**. Utilize the **appropriate instruments needed** to calculate and measure voltage, amperage, resistance, and wattage.

12. Fundamentals of Engines

12.1 Engine cycles: Develop models that explain how **changes in chemical energy, thermal energy, and states of matter** allow the operation of small gasoline and diesel engine cycles.

12.2 Horsepower: Using mathematical models, calculate **horsepower and thermal efficiency** for a variety of internal combustion engines.

13. Research Project

13.1 Agriscience Fair: Using FFA Resources for the Agriscience Fair focus on an agricultural issue, question or principle, research, and use the scientific method to collect and analyze. **Document the scientific process as a digital portfolio artifact. Complete an agriscience project in one of six categories:**

- Animal Systems;
- Environmental Services/Natural Resource Systems;
- Food Products and Processing Systems;
- Plant Systems;
- Power, Structural and Technical Systems; and
- Social Science.

14. Ethical Use of Artificial Intelligence

14.1 Ethical Artificial Intelligence (AI): **Explore the ethical implications of AI usage** through interactive discussions and case studies, learning to identify bias, ensure fairness, and protect privacy in AI systems. **Develop** critical thinking **skills to evaluate the societal impact of AI technologies**, while fostering a sense of responsibility and ethical decision-making in the use of AI tools.

Standards Alignment Notes

References to other standards include:

- SAE for All: Evolving the Essentials: All Agriculture students are encouraged to participate in a Supervised Agricultural Experience (SAE) program to practice and demonstrate the knowledge and skills learned in their agriculture courses.
- AFNR: National Agriculture, Food, & Natural Resources (AFNR) Career Cluster Content Standards: Students who are engaging in the activities outlined above should be able to demonstrate fluency in Standards AS, CS, and PS at the conclusion of the course.
- P21: Partnership for 21st Century Skills Framework for 21st Century Learning
    - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

Principles of Farm and Agribusiness Management

Primary Career Cluster:	Agriculture, Food, & Natural Resources
Course Contact:	CTE.Standards@tn.gov
Course Code(s):	C18H41
Prerequisite(s):	*Agriscience* (C18H19)
Credit:	1
Grade Level:	10
Elective Focus-Graduation Requirement:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other Agriculture, Food, & Natural Resources courses. In addition, this course satisfies the fourth math credit requirement for graduation.
POS Concentrator:	This course satisfies one out of two required courses to meet the Perkins V concentrator definition when taken in sequence in the approved program of study.
Programs of Study and Sequence:	This is the second course in the *Agribusiness* program of study.
Aligned Student Organization(s):	FFA: http://www.tnffa.org
Coordinating Work-Based Learning:	All Agriculture students are encouraged to participate in a Supervised Agricultural Experience (SAE) program. In addition, teachers who hold an active WBL certificate may offer placement for credit when the requirements of the state board's WBL Framework and the Department's WBL Policy Guide are met. For information, visit https://www.tn.gov/education/educators/career-and-technical-education/work-based-learning.html.
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Teacher Endorsement(s):	048, 150, 448, and 950
Required Teacher Certifications:	None
Required Teacher Training:	None
Teacher Resources:	https://www.tn.gov/education/educators/career-and-technical-education/career-clusters/cte-cluster-agriculture-food-natural-resources.html Best for All Central: https://bestforall.tnedu.gov/

Course at a Glance

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Using a Career and Technical Student Organization (CTSO) in Your Classroom

CTSOs are a great resource to put classroom learning into real-life experiences for your students through classroom, regional, state, and national competitions, and leadership opportunities. Below are CTSO connections for this course. This is not an exhaustive list.

- Participate in the CTSO Leadership Conference to engage with peers by demonstrating logical thought processes and developing industry-specific skills that involve teamwork and project management.
- Participate in FFA career and leadership events (CDE/LDE) that align with this course including Agriscience Fair, Agricultural Communications, Agricultural Issues, Agricultural Sales, Cooperative Development Challenge, Employment Skills, Extemporaneous Public Speaking, Farm Business Management, Marketing Plan, and Prepared Public Speaking.

Using Work-Based Learning (WBL) in Your Classroom

Sustained and coordinated activities that relate to the course content are the key to successful work-based learning. Possible activities for this course include the following. This is not an exhaustive list.

- **Standards 1.1-1.4** | Have an industry representative as a guest speaker with one of the topics dealing with safety in the workplace.
- **Standards 2.1-2.4** | Have the students develop an agricultural business plan that is evaluated by local agribusiness managers.
- **Standards 3.1-3.2** | Have students work with an accountant to analyze accounting records or the student's SAE records.
- **Standards 4.1-4.4** | Invite a commodities dealer as a guest speaker to discuss price points and patterns and set up a simulated trade program.
- **Standards 5.1-5.5**| Have students set up a sales and marketing project that will be evaluated by agricultural sales and marketing representatives.

Course Description

Principles of Farm and Agribusiness Management teaches students to apply the economic and business principles involved in selling and supplying agriculture products to a wide range of careers across the industry and builds the foundational knowledge of finance and marketing principles. Upon completion of this course, proficient students will be prepared for more advanced coursework in the Agribusiness program of study.

Course Standards

1. Introduction to U.S. and Global Agribusiness

1.1 Careers: Explore and compare local, regional, state, national, and global **career opportunities in the agribusiness industry**. Use multiple sources to capture, at a minimum, the following:

a. job description;
b. essential knowledge and skills;
c. program or path of study to reach occupational goals, starting with high school through postsecondary and/or military options;
d. credentialing and/or licensure requirements; and
e. non-educational job requirements such as minimum age, experience in the field, physical fitness tests, background checks, or other notable evaluations.

1.2 Economic and Social Implication: Discuss the specific **business practices, laws, regulations, and technologies** that have evolved resulting in economic and societal implications for the agriculture industry.

1.3 Import Regulations: Compare and contrast **regulations** in the United States with those in countries from which the **United States imports agricultural products**.

1.4 Supply and Blockchain: Describe how the different segments of **supply and blockchain management** impact the different areas of the agriculture industry:

a. animal systems;
b. agribusiness systems;
c. environmental systems;
d. food products and processing systems;
e. natural and environmental systems;
f. plant systems; and
g. power, structures, and technical systems.

2. Business Concepts and Structures

2.1 Types of Ownership: Compare and contrast **types of business ownership models,** including at minimum the following: sole proprietorship, partnerships, small businesses, cooperatives, limited liability corporations, and corporations. Explain the organizational structure of each model and describe its advantages and disadvantages to both owner and customer**.**

2.2 Strategic Planning: Compare and contrast the impact of implementing a **strategic management plan** for a farm and/or agribusiness. Demonstrate the implementation of a new business strategy (internal or external) using a SWOT analysis as a team and present the results.

2.3 Business Planning: Develop and present a **business plan for an agricultural entrepreneurial enterprise** that includes basic business and entrepreneurship principles such as budget, target customer, product information, and risk assessment. Use the principles and concepts outlined in the FFA Farm Business career development event and

the principles and concepts of a Supervised Agricultural Experience (SAE) program.

2.4 Business Concepts: Define and analyze the relationships among **basic business concepts,** including the **business cycle, profit, loss, competition, equilibrium price, consumer debt, ethics, social responsibility, supply and demand, and risk management** of an agricultural product on both the national and global levels.

3. Accounting Practices

3.1 Spreadsheet Operations: Create new **spreadsheet formulas and formats** to analyze data by calculating with, extracting from, presenting, and/or summarizing the following:

a. basic arithmetic calculations;
b. basic mathematic (e.g., SUM, AVG, MIN, MAX) and text (e.g., LEN, LEFT, RIGHT, MID) functions;
c. copying formulas that include both relative and absolute cell references;
d. sorting in ascending/descending order;
e. filtering data to retrieve specific values; and
f. basic conditional formatting (e.g., red for negative values).

3.2 Analyzing Financial Records: Examine how **analyzing all financial records and spreadsheets** can affect **operations and management decisions** for an agricultural enterprise. Present findings to improve efficiency or productivity.

4. Markets and Futures

4.1 Production Cost: Compare the cost affecting the production of agricultural products with the **costs of producing and marketing** non-agricultural products. Include the time value of money and conduct an investment analysis consisting of the following:

a. present value,
b. future value,
c. annuity,
d. payback period,
e. net present value,
f. internal rate of return,
g. interest rates and inflation, and
h. loan payment with calculated payments.

4.2 Agricultural Futures: Research and explain the economic impact of the top ten **agriculture futures and commodities** at the local, state, national, and global levels. Describe the factors that impact their values and trading patterns to predict the value of each commodity at a specified point in time.

4.3 Trends: Analyze the top **new trends impacting the agriculture industry,** including the affected products, commodities, and/or services. Predict how these advancements will change the price points and cost projections for different agricultural products and services.

4.4 Market Strategies: Compare and contrast the **sale of agricultural products through local marketing venues** (e.g., farmers' markets, buyers, and marketing cooperatives) to the sale of products in the future market.

5. Sales and Marketing

5.1 Marketing Strategies: Prioritize **basic marketing principles and fundamentals** to help increase the sale of agriculture products using traditional, online mediums, value-added, and niche marketing venues.

5.2 Social Media: Explain the value of **social media marketing** for increasing agriculture market reach and customer interaction. Compare and contrast features and benefits of major social media applications (e.g., social networks, video sharing, and interaction tools as well as mobile marketing, blogs, and other forms of "push" media). Synthesize characteristics and components of each application by creating a decision tree for selecting tools and strategies that will result in effective brand promotion and customer engagement.

5.3 Targeted Sales: Research an **agricultural product or service** to determine its features and consumer benefits. Identify appropriate **marketing strategies and target audiences,** develop, and present materials designed to market the product or service.

5.4 Sales Principles: Demonstrate an understanding of **basic sales principles** by writing scripts for a role-play between an agricultural product salesperson and a customer. Assemble customer needs, features, and benefits, possible objections, suggestive selling item(s), closing strategies, and follow-up with techniques used for post-sale communications.

5.5 Marketing and Sales Planning: Develop and present an **agricultural marketing or sales plan** for a specific product or service. The plan should include at least the following: a mission statement, long- and short-term smart goals, target markets, profit and loss projections, industry trends, and product samples.

6. Team Project and Data Analysis:

6.1 Team Project with Data Analysis: As a team, **identify a problem** related to the program of study as a whole. **Research and utilize the Engineering Design Process to design a solution**. Document the following steps in an engineering design notebook for inclusion in the program portfolio. When possible, connect the problem to an FFA Career Development Event.

a. **Problem Identification**: Brainstorm specific problems and challenges within the program of study. Conduct basic research to understand the scope and implications of the identified problem. Identify one problem as a focus area.
b. **Research and Analysis**: Conduct in-depth research on chosen topics related to the problem. Locate and analyze a dataset related to the problem.
c. **Review the Stages of the Engineering Design Process**: Define the problem, research, brainstorm solutions, develop prototypes, test and evaluate, and iterate. Consider constraints such as cost, efficiency, and environmental impact during the design process.
d. **Project Implementation**: Assign specific roles within the design teams (e.g., project manager, researcher, designer, tester). Design a solution tailored to address the

identified problem or scenario. Document progress through design journals, sketches, diagrams, and digital presentations. (Note: Prototype is optional in the Year 2 course.

e. **Presentation and Reflection**: Showcase the problem and solution to the class. Share the data that was analyzed and how it affected the solution. Discuss the design process and challenges. As a class, critically evaluate the effectiveness and feasibility of the solutions and propose potential improvements.

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Organizational Leadership and Communications

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Course Contact:	CTE.Standards@tn.gov
Course Code:	C18H18
Prerequisite:	*Principles of Farm and Agribusiness Management* (C18H41)
Credit:	1
Grade Level:	11
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- Participate in the CTSO Fall Leadership Conference to engage with peers by demonstrating logical thought processes and developing industry-specific skills that involve teamwork and project management.
- Participate in FFA career and leadership events (CDE/LDE) that align with this course including Agriscience Fair, Agricultural Communications, Agricultural Issues, Agricultural Sales, Cooperative Development Challenge, Employment Skills, Extemporaneous Public Speaking, Farm Business Management, Marketing Plan, Parliamentary Procedure, and Prepared Public Speaking.

Using Work-Based Learning (WBL) in Your Classroom

Sustained and coordinated activities that relate to the course content are the key to successful work-based learning. Possible activities for this course include the following. This is not an exhaustive list.

- **Standards 1.1-1.3** | Have an industry representative as a guest speaker with one of the topics dealing with communications and leadership opportunities for gainful employment.
- **Standards 2.1-2.4** | Invite a local agribusiness manager to simulate an organizational restructuring of a production facility to improve performance and profitability.
- **Standards 3.1-3.7** | Have the students develop a newsworthy social media post that is supervised by or evaluated by area communications and social media specialists.
- **Standards 4.1-4.6** | Invite a commodities dealer as a guest speaker to discuss price points and patterns, and set up a simulated trade program.
- **Standards 5.1-5.4** | Have students develop management and leadership strategies projects that are supervised and/or evaluated by area managers and influencers.

Course Description

Organizational Leadership and Communications is an applied knowledge course for students interested in learning more about the attributes and skills of successful leaders in the agriculture industry. This course covers organizational behavior, communication, management, and leadership topics. Students participate in activities that will assist them in the development of communication and interpersonal skills transferrable to any agribusiness application. Upon completion of this course, proficient students will be prepared for the level-four *Agricultural Business and Finance* course

and advanced study at a postsecondary institution. Standards in this course are aligned with National Agriculture, Food, & Natural Resources Career Cluster Content Standards.

Course Standards

1. Postsecondary and Career Awareness

1.1 Portfolio documents: Evaluate, update, and improve a **set of personal tools**, including but not limited to resume, supervised agricultural experience records, and electronic portfolio, to reflect **current skills, experiences, education, goals, etc**., and complete the processes needed to pursue and obtain a career in the agriculture industry.

1.2 Careers: Compare both in-state and out-of-state **postsecondary programs in a variety of agricultural communication and leadership programs**. Compile a list of activities that will increase employment opportunities for a person pursuing a **career in communications or leadership positions; include educational opportunities and entry-level job experiences**.

1.3 Business Records: Establish and maintain appropriate **personal and business records** to complete taxes, employment, and supervised agricultural experience (SAE) related applications, including but not limited to **resumes, budgets, income statements, balance sheets, cash flow statements, profit and loss statements, and equity statements**.

2. Organizational Structure and Performance

2.1 Key Structures: Compare and contrast the **relationships between organizational performance, human capital, social capital, organizational learning, total quality management, and customer satisfaction**. Analyze case studies to identify the key elements supporting a high-performing organization and describe how each element impacted the success of the agribusiness.

2.2 Organizational Behavior: Define **organizational behavior**, analyzing the major developments and features of the agriculture industry that have influenced changes in organizational behavior over the past century. These features include but are not limited to scientific advancements, transportation of goods, labor market shifts, labor organization, the rise of large corporations, subsidies, automation, information technology, and globalization.

2.3 Motivation Factors: Differentiate between **extrinsic and intrinsic motivation** and summarize how each influences employee productivity.

2.4 Group Dynamics: Define the **stages of team development**. Draw conclusions about the advantages and disadvantages of group decision-making and evaluate the potential effectiveness of group decision-making at each stage.

3. Communication

3.1 Communication Methods: Contrast **verbal and non-verbal communication skills** when interacting with peers, subordinates, supervisors, and customers. What are appropriate

communication methods for an agribusiness representative using both **traditional and digital methods, including social media.**

3.2 Formal and Informal: Evaluate other's **verbal and non-verbal communications in formal and informal settings** (e.g., speeches, presentations, oral reports, etc.) and propose recommendations for improvement in clarity, logic, purpose, and professionalism.

3.3 Newsworthy: Analyze social media trends to determine **"What is Newsworthy."** Discuss the impact of social media trends. Predict the impact of the finding to describe the importance of effective communication among team members and with the audience.

3.4 Constructive Feedback: Define **constructive criticism**, **analyze potential conflicts involved in giving and receiving feedback**, and create a plan for engaging in productive dialogue. Role-play work-related feedback as an employer and as an employee. Demonstrate active listening and appropriate response skills.

3.5 Conflict Resolution Management: Compare and contrast the different **methods of conflict resolution management**. Explain the impact that assertive and aggressive communications have on the workplace. Apply concepts about different methods for handling conflicts by participating in role-play exercises and constructively critiquing the practices of others.

3.6 Promotions: Create a series of posts to **promote a selected product or organization** via social media using writing strategies and styles appropriate for the selected tool and immediacy of customer responses.

3.7 Digital Media: Identify and describe characteristics of **essential features of a product website or social media**, including visual components, navigation features, and optimization for search engines. Create a rubric to evaluate the effectiveness of the design and interactive features.

4. Management and Leadership

4.1 Traits and Skills: Appraise **character traits and interpersonal skills** needed by effective agribusiness managers. Determine which individual traits and skills can be developed and create a plan for personal growth.

4.2 Management Strategies: Compare and contrast **management and operational strategies** to improve the operation of the business or organization, which leads to either a better financial outcome or improved employee motivation.

4.3 Organizational Culture: Define **organizational culture** and evaluate the role of business leaders in establishing and maintaining a workplace in which employees work cooperatively with others from diverse backgrounds.

4.4 Project Management: Research a variety of **project management models** to show important connections and distinctions between the essential phases of each model. Select one model and modify it to meet the needs of a sample organization; justify its application in an agribusiness setting.

4.5 Ethics: Research **professional ethical standards** from recognized national organizations. Synthesize principles from the standards to create a code of agribusiness ethics designed to address professional, ethical, and legal issues such as:

a. conducting business with friends, relatives, or competitors;
b. sales incentives;
c. pricing policies;
d. illegal practices; and
e. behavior toward customers, employees, and shareholders.

4.6 Parliamentary Procedure: Demonstrate **knowledge of parliamentary procedures** by planning and conducting a simulated annual or monthly stockholders meeting for a small agricultural corporation or cooperative. Develop an agenda and take official minutes. Identify meeting materials to be used, including data and reports, and outline the responsibilities of organizational leadership in facilitating the meeting.

5. Innovation and Influence

5.1 Innovation Adoption: Explain the relationship between the **stages of innovation adoption** (i.e., knowledge, persuasion, decision, implementation, and confirmation) and the **rate of innovation adoption** (i.e., innovator, early adopter, early majority, late majority, and laggard). Analyze the role that opinion leaders play in the adoption process. Write coherent arguments based on evidence from real-world examples to support the hypothesis.

5.2 Resistance to Change: Analyze case studies of stakeholder **resistance to change**, identify the causes, and propose measures for overcoming the resistance.

5.3 Persuasion and Influence: Compare and contrast **theories of persuasion and influence** (i.e., reciprocity, commitment, social proof, liking, authority, and scarcity) and apply these theories to agricultural sales and marketing communications mediums.

5.4 Presentation Planning: Explain the understanding of **stakeholder resistance, adoption models, and persuasion theories**. Develop a sales plan for a new agricultural product or service (e.g., commodity trading to farmers) and deliver a focused, coherent presentation on the plan.

Standards Alignment Notes

References to other standards include:

- SAE for All: Evolving the Essentials: All Agriculture students are encouraged to participate in a Supervised Agricultural Experience (SAE) program to practice and demonstrate the knowledge and skills learned in their agriculture courses
- AFNR: National Agriculture, Food, & Natural Resources (AFNR) Career Cluster Content Standards: Students engaged in the activities outlined above should be able to demonstrate fluency in Standard CS at the conclusion of the course.
- P21: Partnership for 21st Century Skills Framework for 21st Century Learning
    - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

Foundational Supervised Agricultural Experience (SAE) - I

Primary Career Cluster:	Agriculture, Food, & Natural Resources
Course Contact:	CTE.Standards@tn.gov
Course Code:	C18H58
Prerequisite:	*None*
Credit:	½ credit each year
Grade Level:	9
Elective Focus - Graduation Requirements:	This course satisfies ½ credit of three credits required for an elective focus when taken in conjunction with other Agriculture, Food, & Natural Resources courses.
Program of Study (POS) Concentrator:	This course satisfies one-half out of two required courses to meet the Perkins V concentrator definition, when taken in sequence in the approved program of study.
Programs of Study Sequence:	This course can be used to supplement all Agriculture, Food, & Natural Resources programs of study and is designed to evolve with a student through high school.
Aligned Student Organization(s):	FFA: http://www.tnffa.org
Coordinating Work-Based Learning:	All Agriculture students are encouraged to participate in a Supervised Agricultural Experience (SAE) program. In addition, teachers who hold an active WBL certificate may offer placement for credit when the requirements of the state board's WBL Framework and the Department's WBL Policy Guide are met. For information, visit https://www.tn.gov/education/educators/career-and-technical-education/work-based-learning.html.
Promoted Tennessee Student Industry Credentials:	Credentials are aligned with postsecondary and employment opportunities and with the competencies and skills that students acquire through their selected program of study. For a listing of promoted student industry credentials, visit https://www.tn.gov/education/educators/career-and-technical-education/student-industry-certification.html.
Teacher Endorsement(s):	048, 150, 448, and 950
Required Teacher Certification:	None
Required Teacher Training:	None
Teacher Resources:	https://www.tn.gov/education/educators/career-and-technical-education/work-based-learning.html Best for All Central https://bestforall.tnedu.gov/

Course at a Glance

CTE courses provide students with an opportunity to develop specific academic, technical, and 21st-century skills necessary to be successful in careers and life. In pursuit of ensuring every student in Tennessee achieves this level of success, we begin with rigorous course standards that feed into intentionally designed programs of study.

Students engage in industry-relevant content through general education integration and experiences such as career and technical student organizations (CTSO) and work-based learning (WBL). Through these experiences, students are immersed with industry-standard content and technology, solve industry-based problems, meaningfully interact with industry professionals, and use/produce industry-specific, informational texts.

Using a Career and Technical Student Organization (CTSO) in Your Classroom

CTSOs are a great resource to put classroom learning into real-life experiences for your students through classroom, regional, state, and national competitions, and leadership opportunities. Below are CTSO connections for this course, note this is not an exhaustive list.

- Participate in the CTSO Fall Leadership Conference to engage with peers by demonstrating logical thought processes and developing industry-specific skills that involve teamwork and project management.
- Participate in FFA career and leadership events (CDE/LDE) that align with this course including Agriscience Fair, Agricultural Communications, Agricultural Issues, Agronomy, Extemporaneous Speaking, Prepared Public Speaking, and events related to the specific student's specific SAE program.

Using Work-Based Learning (WBL) in Your Classroom

Sustained and coordinated activities that relate to the course content are the key to successful work-based learning. Possible activities for this course include the following. This is not an exhaustive list.

- **Standards 1.1-2.4** | Have an industry representative as a guest speaker with one of the topics dealing with SAE and WBL opportunities for gainful employment.
- **Standards 3.1-3.4** | Invite a college recruiter as a guest speaker to focus on employability and college readiness skills.
- **Standard 4.1-4.3** | Have the students work with an accountant or bookkeeper to evaluate data sets required to make financial recommendations.
- **Standard 5.1-5.3** | Invite an industry representative with safety compliance responsibilities as a guest speaker.
- **Standards 6.1-6.2** | Visit a local industry to discuss the impact of the different sectors of the agriculture industry.
- **Standards 7.1-7.2** | Have students work with a mentor to solve workplace problems.

Course Description

Supervised Agricultural Experience (SAE) is the delivery model for work-based learning (WBL) used in approved Agriculture, Food, and Natural Resources (AFNR) programs. It consists of two levels, foundational and immersion. Foundational SAEs are career-generic and focused on career exploration and planning, personal finance, workplace safety, college and career skills, and general agricultural literacy. Foundational SAE meets CTE career exploration and planning expectations. SAEs require a documented formal project plan, accurate recordkeeping, and student supervision.

Course Requirements

This course aligns with the requirements of the WBL Framework (established in Tennessee State Board High School Policy), with the Tennessee Department of Education's WBL Policy Guide, and with state and federal Child Labor Law. As such, the following components are course requirements:

Course Standards

1. Personalized Learning Plan

1.1 Personalized Learning Plan: A student will have a personalized learning plan that identifies their **long-term goals**, and demonstrates how the **supervised agricultural experience** (SAE) or **work-based learning (WBL) experience** aligns with their elective focus and/or high school plan of study, addresses how the student plans to meet and demonstrate the course standards, and addresses employability skill attainment in the following areas:

a. application of academic and technical knowledge and skills (embedded in course standards),
b. career knowledge and navigation skills,
c. 21st-century learning and innovation skills, and
d. personal and social skills.

1.2 Documentation: A student will develop **portfolios**, or a similar **compilation of work** and **evaluation samples**, that demonstrate employability skills development in the categories above.

1.3 SAE Project: Choose a specific **SAE project** to build knowledge and skills in a particular agriculture area. Articulate how the **knowledge and skills learned in a specific SAE program** will benefit preparation for agriculture- and natural resources-related careers. Conduct at least 90 hours of research, work, or activities related to the chosen SAE project.

2. Career Exploration and Planning of Foundational Supervised Agricultural Experience (SAE) Programs

2.1 Career Opportunities: Describe opportunities and means to achieve related **career opportunities** in each of the **agriculture, food, and natural resources** programs of study that align with career goals.

2.2 Pursuing Career: Identify and summarize the **steps to pursue a career** in agriculture, food, and natural resources. Create a personal plan outlining goals and steps to obtain a career.

2.3 Requirements: Examine the **educational, training, and certification requirements** to secure a career in agriculture careers. Analyze personal skill sets and add to career plan options for attaining the required education, training, and experiences to obtain the career.

2.4 Labor Market: Research and describe careers aligned to each agriculture, food, and natural resources program of study and connect personal interests and skills to a career. Assemble and analyze **labor market data of occupational opportunities** at the local, state, national, and global levels.

3. Employability Skills for College and Readiness

3.1 Personal Responsibility: Define **personal responsibility** and distinguish how it applies **in the workplace and community**. Assess the personal level of responsibility and examine opportunities for improvement.

3.2 Verbal and Non-Verbal Communication: Identify and categorize strategies to ensure clarity, logic, and professionalism in **verbal and non-verbal communication skills**. Apply techniques to enhance written and visual communications.

3.3 Decision Making: Identify and summarize steps in the **decision-making process** to solve workplace problems. Differentiate the strengths and talents of all team members to formulate an action plan to complete a team-oriented project.

4. Personal Financial Planning and Management

4.1 Personal Financial Management Plan: Research the components of an effective **personal financial management plan**. Explain how these practices can contribute to future financial independence.

4.2 SAE Financial Management Plan: Design and implement an **SAE personal financial management plan** aligned to a Fundamental SAE project. Evaluate and identify recordkeeping systems designed to meet the needs of the financial plan.

5. Workplace Safety

5.1 Protective Equipment: Identify and differentiate the appropriate **protective equipment** including personal protective equipment for the safe use and operation of specific tools and equipment associated with agricultural occupations.

5.2 Operation, Storage, and Maintenance: Interpret operating instructions related to the **operation, storage, and maintenance of tools and equipment** related to agricultural occupations. Assess and demonstrate appropriate operation, storage, and maintenance techniques for tools and equipment.

6. Agriculture Literacy

6.1 Current Trends: Research and analyze **current trends** in agriculture, food, and natural resources programs of study and predict their impact on local, state, national, and global levels.

6.2 Economic Impact: Summarize the components of the agricultural economy. Explain the **economic impact** of the agriculture industry as related to employment and commodities produced.

7. Leadership Skills

7.1 Leadership Skills: Examine the **leadership skills needed for careers in agriculture industries** and engage youth leadership opportunities to practice and develop effective leadership skills, such as teamwork, decision-making, problem-solving, critical thinking, and time management.

7.2 Parliamentary Procedure: Demonstrate a working knowledge of **parliamentary procedure**. When appropriate, conduct meetings and facilitate discussions per Robert's Rules of Order.

Standards Alignment Notes

References to other standards include:

- AFNR: National Agriculture, Food, & Natural Resources (AFNR) Career Cluster Content Standards: Students engaged in activities outlined above should be able to demonstrate fluency in Standards CRP.01-11, CS.01, CS.02, CS.03, CS.07, CS.09, CS.10, and CS.11 at the grade appropriate level.
- P21: Partnership for 21st Century Skills Framework for 21st Century Learning: Students engaged in the activities outlined above should be able to demonstrate fluency in 21st Century Themes, Learning and Innovation Skills, Information and Media Technology Skills, and Life and Career Skills.
- Fundamental SAE: Supervised Agricultural Experience (SAE) Philosophy and Guiding Principles: SAE is an essential component of student learning that should be used by every AFNR student.

Foundational Supervised Agricultural Experience (SAE) – II

Primary Career Cluster:	Agriculture, Food, & Natural Resources
Course Contact:	CTE.Standards@tn.gov
Course Code(s):	C18HB7
Prerequisite(s):	*None*
Credit:	½ credit
Grade Level:	10
Elective Focus - Graduation Requirements:	This course satisfies ½ credit of three credits required for an elective focus when taken in conjunction with other Agriculture, Food, & Natural Resources courses.
Program of Study (POS) Concentrator	This course satisfies one-half out of two required courses to meet the Perkins V concentrator definition, when taken in sequence in the approved program of study.
Programs of Study and Sequence:	This course can be used to supplement all Agriculture, Food, & Natural Resources programs of study and is designed to evolve with a student through high school.
Aligned Student Organization(s):	FFA: http://www.tnffa.org
Coordinating Work-Based Learning:	All Agriculture students are encouraged to participate in a Supervised Agricultural Experience (SAE) program. In addition, teachers who hold an active WBL certificate may offer placement for credit when the requirements of the state board's WBL Framework and the Department's WBL Policy Guide are met. For information, visit https://www.tn.gov/education/educators/career-and-technical-education/work-based-learning.html.
Promoted Tennessee Student Industry Credentials:	Credentials are aligned with postsecondary and employment opportunities and with the competencies and skills that students acquire through their selected program of study. For a listing of promoted student industry credentials, visit https://www.tn.gov/education/educators/career-and-technical-education/student-industry-certification.html.
Teacher Endorsement(s):	048, 150, 448, and 950
Required Teacher Certification:	None
Required Teacher Training:	None
Teacher Resources:	https://www.tn.gov/content/tn/education/educators/career-and-technical-education/career-clusters/cte-cluster-agriculture-food-natural-resources.html/ Best for All Central https://bestforall.tnedu.gov/

Course at a Glance

CTE courses provide students with an opportunity to continue to develop specific academic, technical, and 21st-century skills necessary to be successful in their careers and lives. In pursuit of ensuring every student in Tennessee achieves higher levels of success, we begin with rigorous course standards that feed into intentionally designed programs of study.

Students engage in industry-relevant content through general education integration and experiences such as career and technical student organizations (CTSO) and work-based learning (WBL). Through these experiences, students are immersed with industry-standard content and technology, solve industry-based problems, meaningfully interact with industry professionals, and use/produce industry-specific, informational texts.

Using a Career and Technical Student Organization (CTSO) in Your Classroom

CTSOs are a great resource to put classroom learning into real-life experiences for your students through classroom, regional, state, and national competitions, and leadership opportunities. Below are CTSO connections for this course, note this is not an exhaustive list.

- Participate in the CTSO Fall Leadership Conference to engage with peers by demonstrating logical thought processes and developing industry-specific skills that involve teamwork and project management.
- Participate in FFA career and leadership events (CDE/LDE) that align with this course including Agriscience Fair, Agricultural Communications, Agricultural Issues, Agronomy, Extemporaneous Speaking, Prepared Public Speaking, and events related to the specific student's specific SAE program.

Using Work-Based Learning (WBL) in Your Classroom

Sustained and coordinated activities that relate to the course content are the key to successful work-based learning. Possible activities for this course include the following. This is not an exhaustive list.

- **Standards 1.1-2.4** |Have an industry representative as a guest speaker with one of the topics dealing with SAE and WBL opportunities for gainful employment.
- **Standards 3.1-3.4** | Invite a college recruiter as a guest speaker to focus on employability and college readiness skills.
- **Standard 4.1-4.3 |** Have the students work with an accountant or bookkeeper to evaluate data sets needed to make financial recommendations.
- **Standard 5.1-5.3** | Invite an industry representative with safety compliance responsibilities as a guest speaker.
- **Standards 6.1-6.2** | Visit a local industry to discuss the impact of the different sectors of the agriculture industry.
- **Standards 7.1-7.2** | Have students work with a mentor to solve workplace problems.

Course Description

Foundational Supervised Agricultural Experience (SAE) II is the second-level work-based learning (WBL) delivery model used in approved Agriculture, Food, and Natural Resources (AFNR) programs. It consists of two levels, foundational and immersion SAEs. Foundational SAE II builds on the expansion of focused career exploration and planning, personal finance, workplace safety, college and career skills, and general agricultural literacy. Foundational SAE - II meets CTE career exploration and planning expectations. All SAEs require a documented formal project plan, accurate recordkeeping, and student supervision.

Course Requirements

This course aligns with the requirements of the WBL Framework (established in Tennessee State Board High School Policy), with the Tennessee Department of Education's WBL Policy Guide, and with state and federal Child Labor Law. As such, the following components are course requirements:

Course Standards

8. Personalized SAE Learning Plan

8.1 Personalized Learning Plan: Students will revise their personalized SAE learning plan which identifies their **long-term goals** and demonstrates how the **supervised agricultural experience** (SAE) or **work-based learning (WBL) experience** aligns with their elective focus and/or high school plan of study, addresses how the student plans to meet and demonstrate the course standards, and addresses employability skill attainment in the following areas:

e. application of academic and technical knowledge and skills (embedded in course standards),
f. career knowledge and navigation skills,
g. 21st-century learning and innovation skills, and
h. personal and social skills.

8.2 Portfolio: A student will revise and assemble an additional **compilation of work, skills developed,** and **evaluation samples**, to their existing **portfolios** that demonstrate employability skills development in the categories above.

8.3 SAE Expansion: Expand an existing or select a new **SAE project** to enhance knowledge and skills in a selected agriculture or agricultural-related area. Present how the **knowledge and skills learned in a specific SAE program** will benefit a person's preparation for employment within that career area. Conduct at least 180 hours of research, work, or activities related to the chosen SAE project.

9. Career Opportunities of Foundational Supervised Agricultural Experience (SAE) Programs

9.1 Career Opportunities: Research the educational path and training requirements of **career opportunities related to** specific SAEs. Outline a personalized education and training plan that aligns with the SAE career goals.

9.2 Occupational Requirements: Research the **educational, training, and certification requirements** for a career related to an existing or new SAE program area. Analyze personal

skill sets to identify needed skills and options for attaining the required education, training, and experiences.

9.3 Labor Market: Analyze **labor market data** for a new or expanded SAE based and explain the opportunities available at the local, state, national, and global levels.

10. Employability Skills for College and Readiness

10.1 Personal Responsibility: Explain **personal responsibility** and describe how it impacts **the workplace and community**. Assess how past SAE projects have enhanced your personal level of responsibility.

10.2 Verbal and Non-Verbal Communication: Identify and categorize strategies to ensure clarity, logic, and professionalism in **verbal and non-verbal communication skills**. Apply techniques to enhance written and visual communications.

10.3 Decision Making: Explain the steps in the **decision-making process** to solve workplace problems. Summarize the strengths and talents of team members to design an action plan to complete a team-oriented project.

11. Personal Financial Planning and Management

11.1 Personal Financial Management Plan: Research the components of an effective **personal financial management plan**. Explain how these practices can contribute to future financial independence and a profitable SAE program.

11.2 SAE Financial Management Plan: Redesign and revise an **SAE personal financial management plan** aligned to a Fundamental SAE project. Evaluate the current recordkeeping systems and make recommendations to meet the needs of the updated financial plan.

12. Workplace Safety

12.1 Personal Protective Equipment: Identify and differentiate the appropriate **personal protective equipment** for the safe use and operation of specific tools and equipment associated with agricultural occupations.

12.2 Operation, Storage, and Maintenance: Explain the safe **operation, storage, and maintenance of tools and equipment** related to agricultural occupations. Assess and demonstrate appropriate operation, storage, and maintenance techniques for tools and equipment.

13. Agriculture Literacy

13.1 Current Trends: Evaluate **current trends** in agriculture, food, and natural resources programs of study and predict their impact on local, state, national, and global levels.

13.2 Economic Impact: Describe the components of the agricultural economy. Discuss the **economic impact** of the agriculture industry as related to employment and commodities produced.

14. Leadership Skills

14.1 Leadership Skills: Examine the **leadership skills needed for careers in agriculture industries** and engage youth leadership opportunities to practice and develop effective leadership skills, such as teamwork, decision-making, problem-solving, critical thinking, and time management.

14.2 Parliamentary Procedure: Demonstrate a working knowledge of **parliamentary procedure law**. When appropriate, conduct meetings and facilitate discussions per Robert's Rules of Order.

15. Foundational Practicum Project

15.1 Practicum Applications: Apply **skills and knowledge from previous courses to an agricultural science fair project or an agricultural proficiency award**. Where appropriate, develop, practice, and demonstrate skills outlined in previous courses. Document all related work, skill development, efficiency factors, and financial records in a recordkeeping system or record book.

15.2 SAE Reports: Complete **an annual summary report of the results or submit a proficiency award application** aligned to the SAE project to the regional FFA for evaluation.

15.3 Immersion SAE: Develop a **plan to transition at least one Foundational SAE project into one of the following Immersion SAE** areas:

a. placement/internship;
b. ownership/entrepreneurship;
c. research: experimental, analysis, or invention;
d. school-based enterprise; and
e. service-learning.

Standards Alignment Notes

References to other standards include:

- AFNR: National Agriculture, Food, & Natural Resources (AFNR) Career Cluster Content Standards: Students engaged in activities outlined above should be able to demonstrate fluency in Standards CRP.01-11, CS.01, CS.02, CS.03, CS.07, CS.09, CS.10, and CS.11 at the grade appropriate level.
- P21: Partnership for 21st Century Skills Framework for 21st Century Learning: Students engaged in activities outlined above should be able to demonstrate fluency in 21st Century Themes, Learning and Innovation Skills, Information and Media Technology Skills, and Life and Career Skills.
- Fundamental SAE: Supervised Agricultural Experience (SAE) Philosophy and Guiding Principles: SAE is an essential component of student learning that should be used by every AFNR student.

Capstone Supervised Agricultural Experience (SAE)

Primary Career Cluster:	Agriculture, Food, and Natural Resources
Course Contact:	CTE.Standards@tn.gov
Course Code:	C18H57
Prerequisite:	*None*
Credit(s):	1 credit each year, up to a maximum of 2 credits per student
Grade Level(s):	11-12
Elective Focus - Graduation Requirements:	This course satisfies 1 credit of three credits required for an elective focus when taken in conjunction with other Agriculture, Food, & Natural Resources courses.
Program of Study (POS) Concentrator	This course satisfies one out of two required courses to meet the Perkins V concentrator definition when taken in sequence in the approved program of study.
Programs of Study Sequence:	This course can be used to supplement all Agriculture, Food, and Natural Resources programs of study and is designed to evolve with a student through high school.
Aligned Student Organization(s):	FFA: http://www.tnffa.org
Coordinating Work-Based Learning:	All Agriculture students are encouraged to participate in a Supervised Agricultural Experience (SAE) program. In addition, teachers who hold an active WBL certificate may offer placement for credit when the requirements of the state board's WBL Framework and the Department's WBL Policy Guide are met. For information, visit https://www.tn.gov/education/educators/career-and-technical-education/work-based-learning.html
Promoted Tennessee Student Industry Credentials:	Credentials are aligned with postsecondary and employment opportunities and with the competencies and skills that students acquire through their selected program of study. For a listing of promoted student industry credentials, visit https://www.tn.gov/education/educators/career-and-technical-education/student-industry-certification.html
Teacher Endorsement(s):	048, 150, 448, and 950
Required Teacher Certification:	None
Required Teacher Training:	Teachers must complete either the WBL training provided by the Tennessee Department of Education
Teacher Resources:	https://www.tn.gov/education/educators/career-and-technical-education/career-clusters/cte-cluster-agriculture-food-natural-resources.html Best for All Central https://bestforall.tnedu.gov/

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Students engage in industry-relevant content through general education integration and experiences such as career & technical student organizations (CTSO) and work-based learning (WBL). Through these experiences, students are immersed with industry-standard content and technology, solve industry-based problems, meaningfully interact with industry professionals, and use/produce industry-specific, informational texts.

Using a Career and Technical Student Organization (CTSO) in Your Classroom

CTSOs are a great resource to put classroom learning into real-life experiences for your students through classroom, regional, state, and national competitions, and leadership opportunities. Below are CTSO connections for this course; note this is not an exhaustive list.

- Participate in the CTSO Fall Leadership Conference to engage with peers by demonstrating logical thought processes and developing industry-specific skills that involve teamwork and project management.
- Participate in FFA career and leadership events (CDE/LDE) that align with this course including Agriscience Fair, Agricultural Communications, Agricultural Issues, Agronomy, Extemporaneous Speaking, Prepared Public Speaking, and events related to the specific student's specific SAE program.

Using Work-Based Learning (WBL) in Your Classroom

Sustained and coordinated activities that relate to the course content are the key to successful work-based learning. Possible activities for this course include the following. This is not an exhaustive list.

- **Standards 1.1-2.2** |Have an industry representative as a guest speaker with one of the topics dealing with SAE and WBL opportunities for gainful employment.
- **Standard 3.1-3.2 |** Have the students work with an accountant or bookkeeper to evaluate data sets needed to make financial recommendations.
- **Standard 4.1-5.2** | Have the students work with a human services representative to develop a personal, leadership, and growth plan.
- **Standard 6.1-6.2** | Have the students develop newsworthy social media posts that are supervised by or evaluated by area communications and social media specialists.
- **Standard 7.1-8.1** | Have an industry representative as a guest speaker with one of the topics dealing with workplace safety or ethics.
- **Standards 9.1-9.2** | Visit a local industry to discuss the impact of the different sectors of the agriculture industry.

Course Description

Supervised Agricultural Experience (SAE) is the delivery model for Work-Based Learning (WBL) used in approved AFNR programs. It consists of two levels, Foundational and Immersion. Foundational SAE is career-generic and focused on career exploration & planning, personal finance, workplace safety, college and career skills, and general agricultural literacy. Foundational SAE meets CTE Career

Exploration and Planning expectations. Immersion SAE will meet WBL capstone experience requirements for CTE credit and consists of entrepreneurship, internships, research, school-based enterprise, and service-learning activities.

Course Requirements

This capstone course aligns with the requirements of the Work-Based Learning Framework (established in Tennessee State Board High School Policy), with the Tennessee Department of Education's Work-Based Learning Policy Guide, and with state and federal Child Labor Law.

Course Standards

1. Personalized Learning Plan

1.1 Personalized Learning Plan: A student will have a **Personalized Learning Plan** that identifies their long-term goals, demonstrates how the Work-Based Learning (WBL) experience aligns with their elective focus and/or high school plan of study, addresses how the student plans to meet and demonstrate the course standards, and addresses employability skill attainment in the following areas:

a. Application of academic and technical knowledge and skills (embedded in course standards)
b. Career knowledge and navigation skills
c. 21st Century learning and innovation skills
d. Personal and social skills

1.2 Documentation: A student will **develop portfolios, or a similar compilation of work** and evaluation samples, that demonstrate employability skills development in the categories above.

1.3 Benefits: Articulate how the **knowledge and skills learned will benefit preparation** for agriculture-related careers. Conduct at least 180 hours of research, work, or activities related to the chosen Immersion SAE.

2. Principles of Immersion Supervised Agricultural Experience (SAE) Programs

2.1 Immersion Opportunities: Investigate the different **immersion supervised agricultural experience program opportunities** listed below and analyze the relationship each has to achieve aligned career goals.

a. Internship: Develop a personalized training plan outlining the internship experiences and responsibilities of the student, instructor, and employer to create the maximum development of knowledge and skills.
b. Entrepreneurship: Incorporate all aspects of ownership with the ability to identify and account for all resources used in the business. Develop a business plan outlining the continued growth and expansion of the operation.
c. Research: Investigate materials, processes, and information to establish new knowledge or to validate previous research in the agriculture industry. Conduct

agricultural research to discover new knowledge and meet the needs of a growing world within three major areas:

d. School-based Enterprise: Conduct a student-led business enterprise that provides goods or services based on the use of a school campus, facilities, equipment, and/or other resources. Develop a business plan that includes the organizational structure, responsibilities, and distribution of profits.
e. Service Learning: Plan, conduct, and evaluate a project designed to provide a service to a public entity or the community. Develop a project plan with sufficient scope to enable the development of student skills and abilities aligned to AFNR and career-ready skills.

2.2 Selection of Immersion SAE: Choose a specific **Immersion SAE project** to evaluate and select solutions with the greatest potential for success toward long-term career goals. Articulate how the knowledge and skills learned in the specific Immersion SAE program will benefit preparation for agriculture- and natural resources-related careers. Conduct at least 180 hours of research, work, or activities related to the chosen project.

3. Project Management and Recordkeeping Skills

3.1 Project Planning: Formulate annual SMART goals for the Immersion SAE program and apply the concepts of **project planning** to monitor and evaluate Immersion SAE progress.

3.2 Financial Management: Appraise and select **management tools available for managing projects and finances**. Accurately maintain a prescribed recordkeeping system and apply proper financial recordkeeping skills as required by the specific project.

4. Personal and Career Growth

4.1 Personal Growth: Develop **personal SMART goals** and conduct activities to work toward individual and career development. Evaluate the effectiveness of these SMART goals for personal and career goals and make recommendations for improvement.

4.2 Career Growth: Explore and compare **local, regional, state, and/or global career opportunities** to identify the knowledge and technical skills necessary for selected careers or job shadowing by linking specific attributes to development activities outlined in SMART goals and make recommendations for future improvements.

5. Leadership Skills

5.1 Basic Leadership: Examine the **leadership skills** needed for careers in agriculture, food, and natural resources industries and engage youth leadership opportunities to practice and develop effective leadership skills, such as teamwork, decision-making, problem-solving, critical thinking, and time management.

5.2 Parliamentary Skills: Demonstrate a working knowledge of **parliamentary procedure**. Conduct meetings and facilitate discussions applying Robert's Rules of Order.

6. Interpersonal and Communication Skills

6.1 Communication Strategies: Analyze the use of **verbal and non-communication strategies** in workplace situations. Demonstrate positive interpersonal skills to work effectively with others and maintain successful professional relationships.

6.2 Elements of Communications: Compare and contrast the **elements of formal and informal communication** skills. Demonstrate the ability to communicate effectively with diverse groups and individuals using appropriate written, verbal, and nonverbal communication techniques.

7. Occupational Safety

7.1 Occupational Safety Standards: Research local, state, and national laws governing workplace **occupational safety standards**. Execute appropriate health and safety and environmental procedures for agriculture and natural resources occupations aligned with the Immersion SAE task. Explain the responsibility of managers, supervisors, and the injured parties in the event of an incident.

7.2 Tools and Equipment: Evaluate and select **appropriate tools and equipment** to complete specific Immersion SAE tasks. Design and implement plans to ensure the proper use of appropriate protective equipment when using various tools and equipment.

8. Occupational Ethics

8.1 Occupational Ethics: Identify and discuss **occupational ethics**, legal responsibilities, and regulatory compliance issues about specific activities aligned with an Immersion SAE task. Explain protocols to address non-compliance issues.

9. Information and Agricultural Literacy

9.1 Data Collection Methods: Use a variety of **methods to assemble and evaluate information** for technical research, scientific inquiry, and investigation.

9.2 Agricultural Literacy: Research and analysis of how **agriculture, food, and natural resources issues, trends, technologies, and/or public policy impact the different sectors** of the agriculture industry. Devise and implement a strategy for explaining new trends to audiences with limited knowledge of agriculture.

Standards Alignment Notes

References to other standards include:

- SAE for All: Evolving the Essentials: All Agriculture students are encouraged to participate in a Supervised Agricultural Experience (SAE) program to practice and demonstrate the knowledge and skills learned in their agriculture courses.
- P21: Partnership for 21st Century Skills Framework for 21st Century Learning
    - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.
- Immersion SAE: Supervised Agricultural Experience (SAE) Philosophy and Guiding Principles: SAE is an essential component of student learning that should be used by every AFNR student.

Agricultural Business and Finance

Primary Career Cluster:	Agriculture, Food and Natural Resources
Course Contact:	CTE.Standards@tn.gov
Course Code:	C18H11
Prerequisite:	*Organizational Leadership and Communications* (C18H18)
Credit:	1
Grade Level:	12
Elective Focus – Graduation Requirements:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other Agriculture, Food, & Natural Resources courses. In addition, this course satisfies the *Personal Finance* and *Economics* requirement for graduation.
POS Concentrator:	This course satisfies one out of two required courses to meet the Perkins V concentrator definition when taken in sequence in the approved program of study.
Programs of Study and Sequence:	This is the fourth and final course in the *Agribusiness* program of study.
Aligned Student Organization(s):	FFA: http://www.tnffa.org
Coordinating Work-Based Learning:	All Agriculture students are encouraged to participate in a Supervised Agricultural Experience (SAE) program. In addition, teachers who hold an active WBL certificate may offer placement for credit when the requirements of the state board's WBL Framework and the Department's WBL Policy Guide are met. For information, visit https://www.tn.gov/education/educators/career-and-technical-education/work-based-learning.html.
Promoted Tennessee Student Industry Credentials:	Credentials are aligned with postsecondary and employment opportunities and with the competencies and skills that students acquire through their selected program of study. For a listing of promoted student industry credentials, visit https://www.tn.gov/education/educators/career-and-technical-education/student-industry-certification.html**.**
Teacher Endorsement(s):	048, 150, 448, and 950
Required Teacher Certification:	None
Required Teacher Training:	Teachers must attend the state-approved training to teach personal finance for this course to satisfy the personal finance requirement.
Teacher Resources:	https://www.tn.gov/education/educators/career-and-technical-education/career-clusters/cte-cluster-agriculture-food-natural-resources.html Best for All Central: https://bestforall.tnedu.gov/

Course at a Glance

CTE courses provide students with an opportunity to develop specific academic, technical, and 21st-century skills necessary to be successful in their careers and lives. In pursuit of ensuring every

student in Tennessee achieves this level of success, we begin with rigorous course standards that feed into intentionally designed programs of study.

Students engage in industry-relevant content through general education integration and experiences such as career and technical student organizations (CTSO) and work-based learning (WBL). Through these experiences, students are immersed with industry-standard content and technology, solve industry-based problems, meaningfully interact with industry professionals, and use/produce industry-specific, informational texts.

Using a Career and Technical Student Organization (CTSO) in Your Classroom

CTSOs are a great resource to put classroom learning into real-life experiences for your students through classroom, regional, state, and national competitions, and leadership opportunities. Below are CTSO connections for this course, note this is not an exhaustive list.

- Participate in the CTSO Fall Leadership Conference to engage with peers by demonstrating logical thought processes and developing industry-specific skills that involve teamwork and project management.
- Participate in career and leadership development events (CDE/LDE) that highlight job skill demonstration. These include but are not limited to Farm Business Management, Agricultural Communications, Agricultural Issues, Cooperative Development Challenge, Employment Skills, Parliamentary Procedure, Extemporaneous Speaking, and Prepared Public Speaking.

Using a Work-Based Learning (WBL) in Your Classroom

Sustained and coordinated activities that relate to the course content are the key to successful work-based learning. Possible activities for this course include the following. This is not an exhaustive list.

- **Standards 1.2-2.3** | Have an industry representative as a guest speaker with one of the topics dealing with the aspects determining needed occupational skills.
- **Standards 3.1-3.7** | Have the students work with an agricultural accountant or bookkeeper to evaluate data sets to make personal and business financial recommendations.
- **Standards 3.5-3.6, 4.2-5.2** | Do a project to be used by local industry or evaluated by local industry managers.
- **Standards 5.3-6.4** | Complete an integrated project with a professional.

Course Description

Agricultural Business and Finance is an applied course that addresses the economic and business principles necessary to operate a successful agribusiness. The course covers a wide range of topics in business, finance, economics, and management. Upon completion of this course, proficient students will have learned to apply the principles drawn from these topics toward activities that support their business aspirations in the agriculture industry. *Agricultural Business and Finance* is a dual credit course with statewide articulation.

Course Standards

1. History of Agribusiness

1.1 Historical Development: Describe the **evolution of the agribusiness system** in the United States by identifying historical milestones resulting from the boom-and-bust cycle which created the development of the modern-day agribusiness sectors.

1.2 Occupational Trends: Evaluate local job postings, labor, and workforce data to analyze the **knowledge, skills, and abilities necessary for employment** in agribusiness, management, and entrepreneurship occupations related to the following:

a. education and training, including admission requirement and tuition requirements;
b. available positions;
c. salaries;
d. cost vs. benefits of education/training;
e. potential lifetime earnings;
f. employment benefits; and
g. possible need for relocation to advance.

1.3 Types of Ownership: Compare and contrast different **business and ownership models** of agribusinesses (e.g., proprietorships, partnerships, corporations, limited liability companies, franchises, and cooperatives.) Include the scope, economic impact, and future trends of a specific type of agribusiness locally, regionally, nationally, and globally.

2. Saving, Investing, and Financing

2.1 Building Wealth: Analyze and explain how the different **forms of saving, financing, and investing** can contribute to financial well-being, building wealth, personal financial goals, and a sound agribusiness. Compare and contrast these financial services to recommend the appropriate service for specific personal and/or agribusiness financial goals.

2.2 Financial Management: Demonstrate the accurate analysis of **financial data management** by maintaining balanced records for all accounts within a variety of diversified agricultural enterprises or supervised agricultural experience programs (SAE) by performing the following processes:

a. recording and posting entries to affected supplies, inventory, notes receivable, insurance, accounts payable, and taxes;
b. preparing profit and loss statement for a specific enterprise (plant, animal, or service);
c. record closing entries of temporary accounts including revenue, operation expense, non-cash expenses, closing inventory, non-current inventory, etc.; and
d. prepare end-of-the-year closing reports to project profit and documentation to secure loans or investors.

2.3 Financing: Compare and contrast the differences between **personal, business, and farm financing**, including but not limited to sources, terms, and available risk management strategies.

3. Recordkeeping and Accounting

3.1 Recordkeeping Processes: Distinguish between **bookkeeping and accounting**. Justify the need for organized **recordkeeping processes** as an integral part of a comprehensive management system.

3.2 Spreadsheet Functions: Analyze **spreadsheet functions** (e.g., pivot tables, charts, and graphs) to convey a particular meaning or draw conclusions from a spreadsheet dataset to make sound data analysis recommendations.

3.3 Accounting Reports: Create summary **charts and graphs** that summarize appropriate data series, including differentiating between rows and columns in source data.

3.4 Formatting Accounting Reports: Format and modify **accounting report charts and graphs** to improve data presentation impact by using spreadsheet components such as legends, sizes, parameters, layouts, styles, positioning objects (e.g., textbox, SmartArt, or image), borders, positioning, properties, styles, effects, and colors.

3.5 Taxes and Financial Applications: Analyze and explain the basic **personal and business financial records** to complete **taxes, measure profit and loss, liquidity, equity, income tax, employment, and SAE related applications** including resume, budgets, income statements, balance sheets, cash flow statements, profit and loss statements, liquidity, and equity statements.

3.6 Accounting Practices: Apply **fundamental principles of financial recordkeeping** to agribusiness planning, logistics, and operations, including at a minimum the following:

a. differentiating between fixed and variable costs;
b. determining pricing methods;
c. using general ledger and basic accounting principles (accrual vs. cash basis);
d. calculating depreciation, current and not current inventory values, and change in total net worth; and
e. estimating simple and compound interest.

3.7 Accounting Strategies: Explain the relationships between depreciation, taxation, and insurance records as being part of a **sound personal and business strategy**.

4. Consumer Finance

4.1 Personal Finance Practices: Examine personal and business records using specific **responsible personal finance practices** to recommend basic financial management and financial security tips.

4.2 Banking Procedures and Practices: Examine essential principles of consumer finance by summarizing **common banking procedures and services**, including the establishment of personal and operating accounts. Compare and contrast the costs and benefits of financial services based on personal characteristics, wealth, debt, and risk management.

5. Economics of Agribusiness

5.1 Economic Principles: Explain how **economic principles apply to agribusiness**, including macro versus microsystems, factors and effects of competition, inflation, pricing, and supply and demand relationships.

5.2 Government Policies: Analyze the **role of government in setting monetary, fiscal, and taxation policies** that affect the operations of agriculture businesses.

5.3 Global Commodities Impact: Assess the **global impact of American commodities** on world food markets. Compare and contrast the impact of foreign trade laws that affect supply and demand in Tennessee, the United States, and the world economies.

6. Business Planning and Management

6.1 Entrepreneurship: Assess the **importance of entrepreneurship** in society. Differentiate between characteristics of successful and unsuccessful entrepreneurial endeavors. Evaluate methods for identifying opportunities in entrepreneurship and outline the major steps in starting an agribusiness.

6.2 Business Planning: Develop, revise, and present a **comprehensive business plan** for an agriculture-related business. Address at minimum the following components: type of agricultural ventures, projected profits, expenses, margins, returns on investment, and facilities and equipment needs.

a. description of the type of agricultural venture
b. executive summary
c. vision and mission statements
d. industry overview
e. market analysis
f. marketing plan
g. financial plan
h. needed facilities and equipment

6.3 Effective Management: Evaluate and recommend the **appropriate managerial skills** needed to effectively manage various sizes of agriculture-related businesses from a family operation to a cooperative business.

6.4 Regulatory Agencies: Compare and contrast the various **state and national regulatory agencies** developing policies governing modern agribusinesses. Provide a full explanation of the impact of each agency.

Standards Alignment Notes

References to other standards include:

- SAE for All: Evolving the Essentials: All Agriculture students are encouraged to participate in a Supervised Agricultural Experience (SAE) program to practice and demonstrate the knowledge and skills learned in their agriculture courses

- AFNR: National Agriculture, Food, & Natural Resources (AFNR) Career Cluster Content Standards: Students engaged in the activities outlined above should be able to demonstrate fluency in Standards ABS and CS at the conclusion of the course.
- P21: Partnership for 21st Century Skills Framework for 21st Century Learning
    - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

Principles of Agricultural Mechanics

Primary Career Cluster:	Agriculture, Food, & Natural Resources
Course Contact:	CTE.Standards@tn.gov
Course Code(s):	C18H12
Prerequisite(s):	*Agriscience* (C18H19)
Credit:	1
Grade Level:	10
Elective Focus-Graduation Requirements:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other Agriculture, Food, & Natural Resources courses.
POS Concentrator:	This course satisfies one out of two required courses to meet the Perkins V concentrator definition when taken in sequence in the approved program of study.
Programs of Study and Sequence:	This is the second course in the *Agricultural Engineering, Industrial, and Mechanical Systems* program of study.
Aligned Student Organization(s):	FFA: http://www.tnffa.org
Coordinating Work-Based Learning:	All Agriculture students are encouraged to participate in a Supervised Agricultural Experience (SAE) program. In addition, teachers who hold an active WBL certificate may offer placement for credit when the requirements of the state board's WBL Framework and the Department's WBL Policy Guide are met. For information, visit https://www.tn.gov/education/educators/career-and-technical-education/work-based-learning.html.
Promoted Tennessee Student Industry Credentials:	Credentials are aligned with postsecondary and employment opportunities and with the competencies and skills that students acquire through their selected program of study. For a listing of promoted student industry credentials, visit https://www.tn.gov/education/educators/career-and-technical-education/student-industry-certification.html.
Teacher Endorsement(s):	048, 150, 448, and 950
Required Teacher Certifications:	None
Required Teacher Training:	None
Teacher Resources:	https://www.tn.gov/education/educators/career-and-technical-education/career-clusters/cte-cluster-agriculture-food-natural-resources.html Best for All Central: https://bestforall.tnedu.gov/

Course at a Glance

CTE courses provide students with an opportunity to develop specific academic, technical, and 21st-century skills necessary to be successful in careers and life. In pursuit of ensuring every student in Tennessee achieves this level of success, we begin with rigorous course standards that feed into intentionally designed programs of study.

Students engage in industry-relevant content through general education integration and experiences such as career and technical student organizations (CTSO) and work-based learning (WBL). Through these experiences, students are immersed with industry-standard content and technology, solve industry-based problems, meaningfully interact with industry professionals, and use/produce industry-specific, informational texts.

Using a Career and Technical Student Organization (CTSO) in Your Classroom

CTSOs are a great resource to put classroom learning into real-life experiences for your students through classroom, regional, state, and national competitions, and leadership opportunities. Below are CTSO connections for this course. This is not an exhaustive list.

- Participate in the CTSO Fall Leadership Conference to engage with peers by demonstrating logical thought processes and developing industry-specific skills that involve teamwork and project management.
- Participate in FFA career and leadership events (CDE/LDE) that align with this course including Agriscience Fair, Agricultural Issues, Agricultural Technology & Mechanical Systems, Agronomy, Employment Skills, Environmental and Natural Resources, Extemporaneous Speaking, Marketing Plan, Parliamentary Procedure, and Prepared Public Speaking.

Using Work-Based Learning (WBL) in Your Classroom

Sustained and coordinated activities that relate to the course content are the key to successful work-based learning. Possible activities for this course include the following. This is not an exhaustive list.

- **Standards 1.1-1.2** | Have the manager talk about safety in the workplace during a visit to an industry site.
- **Standards 2.1-2.4** | Have a guest speaker explain the importance of project management or have students complete a project plan under the supervision and/or evaluated by a project manager.
- **Standards 3.1-3.2** | Have the students work with an engine or motor technician on a real project.
- **Standards 4.1-4.2** | Invite a local surveyor to work with students to survey a plot of land and provide a review of their field notes.
- **Standards 5.1-5.3** | Have students work on a project evaluated by an irrigation/drainage specialist.
- **Standards 6.1-6.2** | Contact a building inspector to talk with the class about building codes and the importance of following blueprints.
- **Standards 7.1-7.3** | Have the students work with an engineer on a real project.

Course Description

Principles of Agricultural Mechanics is an intermediate course introducing students to basic skills and knowledge in construction and land management for both rural and urban environments. This course covers topics including project management, basic engine and motor mechanics, land surveying, irrigation and drainage, agricultural structures, and basic metalworking techniques. Upon completion of this course, proficient students will be prepared for more advanced coursework in agricultural mechanics.

Course Standards

1. Occupational Safety

1.1 Basic Safety: Identify the benefits of knowing and applying **basic safety procedures** in both an agricultural laboratory and the workplace. Interpret current Occupational Safety and Health Administration (OSHA) guidelines to conduct a compliance review of the agricultural laboratory.

1.2 Shop Safety: Review common laboratory **safety procedures for tool and equipment operation** in the agricultural mechanics laboratories, including but not limited to hand tools, power tools, accident prevention, and control procedures. Demonstrate the ability to follow safety and operational procedures in a lab setting and complete a safety test with 100 percent accuracy.

2. Project Management

2.1 Planning: Outline the basic **principles and procedures** of effective project planning. Create and present a project plan for an agricultural mechanics project or a supervised agricultural experience program, related to agriculture mechanics.

2.2 Designing: Demonstrate the ability to use a variety of **computer-aided design (CAD) software and programs** to create and design models and parts on a CNC machine or 3D printer.

2.3 Tools: Identify the appropriate tools needed to design and complete a project. Compare and contrast the **functions of hand and power tools** that may be selected for a project. Demonstrate the safe use and storage of **hand and/or power tools** associated with a project.

3. Budgets and Estimates: Using industry-specific terminology, identify **components for preparing a budget and cost estimate**. Develop an itemized budget using a spreadsheet accompanied by a scaled drawing or blueprint to construct or repair an agriculture mechanics project. **Engine and Motor Mechanics**

3.1 Engine and Motor Characteristics: Compare and contrast the chief **features, functions, and applications of two-cycle engines, four-cycle engines, and electric motors**. Recommend a maintenance schedule specific to the working environment (e.g., indoor/outdoor conditions, exposure to heat or cold) of the engine and/or motor. Conduct the appropriate maintenance with adherence to specifications outlined in the schedule.

3.2 Types of Power: Identify and differentiate between the different **types of fuel and power sources** used in conjunction with **engines and motors**. Recommend the types and sizes of engines/motors best suited for a range of applications.

4. Surveying

4.1 Calculating Land Area: Using topographical maps and appropriate mathematical equations, determine the **acreage of a specific plot of land**. Document and defend the methods used to arrive at the result, annotating calculations and field notes in a manner easily retrieved by other readers.

4.2 Precision Digital Surveying: Apply precision **surveying processes and geographic information system (GIS) technology** to calculate the acreage of a specific property plot. Using field notes and digital data (e.g., GIS overlays), develop a written survey report of the designated plot to include, at minimum, measurements, degrees, markers, and other notable geographic parameters.

5. Irrigation and Drainage

5.1 Soil Characteristics on Plant Growth: Analyze the **interrelationships among plants, water, air, and soil to maximize the health and productivity of agricultural crops**. Calculate the permeability rate, available water holding capacity, pH levels, and nutrient levels for a specific soil type.

5.2 Irrigation and Drainage Requirements: Apply physics concepts governing various pumping systems and delivery **options to achieve the optimum irrigation and drainage requirements** for row crop, greenhouse, and nursery operations. Develop irrigation schedules to satisfy the design of daily irrigation requirements (DDIR) for specific crops.

6. Irrigation Methods: Compare and contrast **irrigation methods for row crops**, attending to such factors as water conservation, efficiency, and cost. Investigate and document findings on the effectiveness and efficiency of surface irrigation versus a drip irrigation method, developing claim(s) and counterclaim(s) for scenarios in which each method would be most applicable.

Agricultural Structures

6.1 Building Materials: Read and interpret blueprints or building plans to **select appropriate building materials for a given agricultural structure**. Using correct units and measurements, draft a written bill of materials enumerating the quantities of each selection, including but not limited to concrete, masonry, wood, metal, and composite materials.

6.2 Construction: Apply **construction principles** about wood, concrete, metal, masonry, plumbing, and electricity. Construct or repair agricultural structures according to prescribed working plans.

7. Agricultural Metalworking

7.1 Welding Methods: Compare and contrast the physical and chemical properties of **shielded metal arc welding (SMAW), metal inert gas (MIG) welding, gas welding, soldering, and brazing**. Safely set up equipment, identify the components, and explain the electrical or gas

welding process for each welding method. Demonstrate the ability to precisely follow operational and safety procedures for each fusion process across various applications.

7.2 Cutting Methods: Classify the physical and chemical **properties associated with various metal-cutting methods**. Safely set up equipment, identify the components, and explain the cutting process for each cutting method. Demonstrate adherence to operational and safety procedures for using oxy-fuel or plasma.

7.3 Metallic and Non-Metallic Materials: Select and demonstrate the best method to **construct, connect, or repair metallic and non-metallic materials** for a variety of agricultural applications, including but not limited to plumbing, sheeting, and equipment.

8. Team Project and Data Analysis:

8.1 Team Project with Data Analysis: As a team**, identify a problem** related to the program of study as a whole**. Research and utilize the Engineering Design Process to design a solution**. Document the following steps in an engineering design notebook for inclusion in the program portfolio. When possible, connect the problem to an FFA Career Development Event.

a. **Problem Identification**: Brainstorm specific problems and challenges within the program of study. Conduct basic research to understand the scope and implications of the identified problem. Identify one problem as a focus area.
b. **Research and Analysis**: Conduct in-depth research on chosen topics related to the problem. Locate and analyze a dataset related to the problem.
c. **Review the Stages of the Engineering Design Process**: Define the problem, research, brainstorm solutions, develop prototypes, test and evaluate, and iterate. Consider constraints such as cost, efficiency, and environmental impact during the design process.
d. **Project Implementation**: Assign specific roles within the design teams (e.g., project manager, researcher, designer, tester). Design a solution tailored to address the identified problem or scenario. Document progress through design journals, sketches, diagrams, and digital presentations. (Note: Prototype is optional in the Year 2 course.)
e. **Presentation and Reflection**: Showcase the problem and solution to the class. Share the data that was analyzed and how it affected the solution. Discuss the design process and challenges. As a class, critically evaluate the effectiveness and feasibility of the solutions and propose potential improvements.

Standards Alignment Notes

References to other standards include:

- SAE for All: Evolving the Essentials: All Agriculture students are encouraged to participate in a Supervised Agricultural Experience (SAE) program to practice and demonstrate the knowledge and skills learned in their agriculture courses.
- AFNR: National Agriculture, Food, & Natural Resources (AFNR) Career Cluster Content Standards. Students engaged in the activities outlined above should be able to demonstrate fluency in Standards in CS, PST, ABS, NRS, ESS, and PS systems at the conclusion of the course.
- P21: Partnership for 21st Century Skills Framework for 21st Century Learning
    - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

Agricultural Power and Equipment

Primary Career Cluster:	Agriculture, Food, & Natural Resources
Course Contact:	CTE.Standards@tn.gov
Course Code:	C18H13
Prerequisite:	*Principles of Agricultural Mechanics* (C18H12)
Credit:	1
Grade Level:	11
Elective Focus - Graduation Requirements:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other Agriculture, Food, & Natural Resources courses
POS Concentrator:	This course satisfies one out of two required courses to meet the Perkins V concentrator definition when taken in sequence in the approved program of study.
Programs of Study and Sequence:	This is the third course in the *Agricultural Engineering, Industrial, and Mechanical Systems* program of study.
Aligned Student Organization(s):	FFA: http://www.tnffa.org
Coordinating Work-Based Learning:	All Agriculture students are encouraged to participate in a Supervised Agricultural Experience (SAE) program. In addition, teachers who hold an active WBL certificate may offer placement for credit when the requirements of the state board's WBL Framework and the Department's WBL Policy Guide are met. For information, visit https://www.tn.gov/education/educators/career-and-technical-education/work-based-learning.html.
Promoted Tennessee Student Industry Credentials:	Credentials are aligned with postsecondary and employment opportunities and with the competencies and skills that students acquire through their selected program of study. For a listing of promoted student industry credentials, visit https://www.tn.gov/education/educators/career-and-technical-education/student-industry-certification.html.
Teacher Endorsement(s):	048, 150, 448, and 950
Required Teacher Certification:	None
Required Teacher Training:	None
Teacher Resources:	https://www.tn.gov/education/educators/career-and-technical-education/career-clusters/cte-cluster-agriculture-food-natural-resources.html Best for All Central: https://bestforall.tnedu.gov/

Course at a Glance

CTE courses provide students with an opportunity to develop specific academic, technical, and 21st-century skills necessary to be successful in careers and life. In pursuit of ensuring every student in Tennessee achieves this level of success, we begin with rigorous course standards that feed into intentionally designed programs of study.

Students engage in industry-relevant content through general education integration and experiences such as career and technical student organizations (CTSO) and work-based learning (WBL). Through these experiences, students are immersed with industry-standard content and technology, solve industry-based problems, meaningfully interact with industry professionals, and use/produce industry-specific, informational texts.

Using a Career and Technical Student Organization (CTSO) in Your Classroom

CTSOs are a great resource to put classroom learning into real-life experiences for your students through classroom, regional, state, and national competitions, and leadership opportunities. Below are CTSO connections for this course, note this is not an exhaustive list.

- Participate in the CTSO Fall Leadership Conference to engage with peers by demonstrating logical thought processes and developing industry-specific skills that involve teamwork and project management.
- Participate in FFA career and leadership events (CDE/LDE) that align with this course including Agriscience Fair, Agricultural Issues, Agricultural Technology and Mechanical Systems, Employment Skills, Environmental & Natural Resources, and Land Evaluation.

Using Work-Based Learning (WBL) in Your Classroom

Sustained and coordinated activities that relate to the course content are the key to successful work-based learning. Possible activities for this course include the following. This is not an exhaustive list.

- **Standards 1.1-1.3** | During a visit to an industry site have the manager talk about safety in the workplace.
- **Standards 2.1-3.6** | Have the students work with an equipment and/or mechanical technician on a real project.
- **Standards 4.1-4.3** | Have the students work with a hydraulic technician in the field.
- **Standards 5.1-5.2** | Contact a Geographic Information Systems (GIS) technician to work with students on projects requiring precision GIS technology.

Course Description

Agricultural Power and Equipment is an applied course in agricultural engineering with special emphasis on laboratory activities involving small engines, tractors, and agricultural equipment. The standards in this course address navigation, maintenance, repair, and overhaul of electrical motors, hydraulic systems, and fuel-powered engines, as well as exploration of a wide range of careers in agricultural mechanics. Upon completion of this course, proficient students will be able to pursue advanced training in agricultural engineering and related fields at a postsecondary institution.

Course Standards

1. Safety and Occupational Trends

1.1 Safety: Review common **laboratory safety procedures for tool and equipment operation** in the agricultural power and equipment laboratories, including but not limited to personal protective equipment, accident prevention, and control procedures. Demonstrate the ability to follow safety and operational procedures in a lab setting and complete a safety test with 100 percent accuracy.

1.2 Occupational Trends: Investigate occupation **trends in agricultural power and equipment, and related occupations**. Compare and contrast the knowledge, skills, and abilities necessary for employment, as well as the typical level of education required.

1.3 Supervised Agricultural Experience: Investigate opportunities to **expand and diversify an immersion Supervised Agricultural Experience (SAE)** program as related to agriculture power and equipment. Accurately maintain an active recordkeeping system and apply proper financial recordkeeping skills to summarize records by completing SAE-related applications and reports.

2. Engine and Motor Mechanics

2.1 Performance: Compare and contrast the **first and second laws of thermodynamics** as applied to the study of combustion engines. Analyze the theory of operation and efficiency of internal combustion engines in regard to fuels, engine displacement, ignition, lubrication, and cooling.

2.2 Fuel Delivery Systems: Classify **fuel delivery systems**. Compare and contrast the applications of carburetors and fuel injection systems in agricultural equipment.

2.3 Engine Performance: Evaluate and optimize **engine performance** under load and no-load operation, considering the effects of air temperature, humidity, fuel quality, and engine tuning.

2.4 Electric Motors: Identify **major components of electric motors**. Classify electric motors based on the **power source**. Differentiate the appropriate use of **battery-electric and gasoline-powered small equipment**.

2.5 Motor Performance: Evaluate and optimize **electric motor performance** under load and no-load operation, considering the effects of the input power measurements, amperage, and slip load.

2.6 Power Unit Selection: Recommend the correct **engine or motor horsepower (hp)** for specific tasks or procedures (e.g., using a three-phase 5 hp electric motor to drive a 125-foot conveyor belt for lifting grain to a 60-foot silo).

2.7 Troubleshooting: Demonstrate the ability to **troubleshoot single-cylinder engines and electric motors**. Create a written estimate of repairs, including parts, labor, time, and total cost.

3. Agricultural Machinery

3.1 Machinery Selection: Recommend the appropriate machinery for a given agricultural application by matching the **mechanical need to the scale and magnitude of the specific task**. Justify the recommendation based on the availability of parts, operational costs, maintenance, safety, and total cost. For example, recommend the appropriate tractor for a specified task based on power ratings, engine and transmission systems, hydraulic capabilities, hitching, and ballasting.

3.2 Power Sources: Research the types of **power sources for modern machinery** as related to agricultural equipment. Differentiate their characteristics and applications, base price, availability, and accessories needed for each power source. (e.g., lubricants, fuel, batteries, cooling system, etc.)

3.3 Low Voltage: Analyze the use of **low-voltage sensors in agricultural equipment**. Research how the use of sensors can increase the **efficiency of agricultural equipment**. Demonstrate the ability to troubleshoot and repair low-voltage wiring to control sensors or other accessories.

3.4 Maintenance and Repair: Demonstrate the ability to **maintain, troubleshoot, and repair agricultural equipment,** and create a written estimate of repairs including itemization of parts, labor, time, and total cost.

3.5 Precision Machinery: Compare and contrast the **types and functions of precision and advanced technologies** (e.g., geographic information systems [GIS], global positioning systems [GPS], and unmanned aerial vehicles [UAV]) available to the agriculture industry.

3.6 Safe Operation: Demonstrate in a live setting or in a presentation the ability to **safely operate agriculture equipment**, including precision-operated equipment if available.

4. Hydraulics and Pneumatics

4.1 System Components: Identify and explain the **components and operational theory of a basic hydraulic and pneumatics system** used in an agricultural setting.

4.2 Designing Systems: Design a hydraulic or pneumatic system to perform a specific task, applying the **principles of fluid kinematics and hydrostatics** to outline how the system functions. The design should include specifications for pumps, pipes/lines, and flow rates/air pressure.

4.3 Maintenance and Repair: Troubleshoot and repair **hydraulic and/or pneumatic power and control systems** used in agricultural equipment such as piston-driven lifts and compression

devices (e.g., shears, and crushers). Document the parts and labor involved and draft an itemized repair bill using a spreadsheet or invoicing software.

5. Navigation and Surveying

5.1 Precision Technology: Explain how agricultural enterprises **employ geographic information systems (GIS) and global positioning systems (GPS) in their work,** including GIS software, GPS receivers, data acquisition, and spatial analysis of data. Debate the legal, ethical, and economic implications of the use of these emerging technologies in regards to maximizing the efficiency and efficacy of agricultural processes, citing specific textual evidence from case studies and news media.

5.2 Precision Surveying: Correctly and safely use **precision surveying instruments** (e.g., laser, GPS, GIS, etc.) to make measurements of large acreages. Compile a written survey report for use by a lay reader, supplementing the narrative with charts, graphs, and other visual representations to aid comprehension.

Standards Alignment Notes

References to other standards include:

- SAE for All: Evolving the Essentials: All Agriculture students are encouraged to participate in a Supervised Agricultural Experience (SAE) program to practice and demonstrate the knowledge and skills learned in their agriculture courses.
- AFNR: National Agriculture, Food, & Natural Resources (AFNR) Career Cluster Content Standards. Students engaged in the activities outlined above should be able to demonstrate fluency in Standards in CS, PST, ABS, NRS, PS, and ESS at the conclusion of the course.
- P21: Partnership for 21st Century Skills Framework for 21st Century Learning
    - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

Agricultural Fabrication and Biosystems Engineering

Primary Career Cluster:	Agriculture, Food, & Natural Resources
Course Contact:	CTE.Standards@tn.gov
Course Code:	C18H42
Prerequisite:	*Agricultural Power and Equipment* (C18H13)
Credit:	1
Grade Level:	12
Elective Focus - Graduation Requirements:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other Agriculture, Food, & Natural Resources courses. In addition, this course satisfies a fourth-year math credit requirement for graduation.
POS Concentrator:	This course satisfies one out of two required courses to meet the Perkins V concentrator definition when taken in sequence in the approved program of study.
Programs of Study and Sequence:	This is the fourth and final course in the *Agricultural Engineering, Industrial, and Mechanical Systems* program of study.
Aligned Student Organization(s):	FFA: http://www.tnffa.org
Coordinating Work-Based Learning:	All Agriculture students are encouraged to participate in a Supervised Agricultural Experience (SAE) program. In addition, teachers who hold an active WBL certificate may offer placement for credit when the requirements of the state board's WBL Framework and the Department's WBL Policy Guide are met. For information, visit https://www.tn.gov/education/educators/career-and-technical-education/work-based-learning.html.
Promoted Tennessee Student Industry Credentials:	Credentials are aligned with postsecondary and employment opportunities and with the competencies and skills that students acquire through their selected program of study. For a listing of promoted student industry credentials, visit https://www.tn.gov/education/educators/career-and-technical-education/student-industry-certification.html.
Teacher Endorsement(s):	048, 150, 448, and 950
Required Teacher Certifications:	None
Required Teacher Training:	None
Teacher Resources:	https://www.tn.gov/education/educators/career-and-technical-education/career-clusters/cte-cluster-agriculture-food-natural-resources.html Best for All Central: https://bestforall.tnedu.gov/

Course at a Glance

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Students engage in industry-relevant content through general education integration and experiences such as career and technical student organizations (CTSO) and work-based learning (WBL). Through these experiences, students are immersed with industry-standard content and technology, solve industry-based problems, meaningfully interact with industry professionals, and use/produce industry-specific, informational texts.

Using a Career and Technical Student Organization (CTSO) in Your Classroom

CTSOs are a great resource to put classroom learning into real-life experiences for your students through classroom, regional, state, and national competitions, and leadership opportunities. Below are CTSO connections for this course, note this is not an exhaustive list.

- Participate in the CTSO Fall Leadership Conference to engage with peers by demonstrating logical thought processes and developing industry-specific skills that involve teamwork and project management.
- Participate in FFA career and leadership events (CDE/LDE) that align with this course including Agriscience Fair, Agricultural Issues, Agronomy, Agricultural Technology and Mechanical Systems, Employment Skills, Environmental & Natural Resources, and Land Evaluation.

Using Work-Based Learning (WBL) in Your Classroom

Sustained and coordinated activities that relate to the course content are the key to successful work-based learning. Possible activities for this course include the following. This is not an exhaustive list.

- **Standards 1.1-2.2** | Have an industry representative as a guest speaker with one of the topics dealing with developing marketability employment skills to be successful in this career field.
- **Standards 3.1-5.2** | Have the students work with a precision agricultural technician on a real project.
- **Standards 6.1-7.2** | Visit a local agricultural machinery dealer and have students see the different aspects of the business in operation and being maintained.
- **Standard 8.1** | Have students do a project that is supervised or evaluated by an agricultural engineer, precision agricultural technician, or qualified technician.

Course Description

Agricultural Fabrication and Biosystems Engineering is an applied course that prepares students for further study or careers in engineering, environmental science, agricultural design and research, and agricultural mechanics and fabrication. Special emphasis is given to the many modern applications of geographic information systems (GIS) and global positioning systems (GPS) to achieve various agricultural goals. Upon completion of this course, proficient students will be able to pursue advanced training in agricultural engineering, industrial, mechanical, and related fields at a postsecondary institution.

Course Standards

1. Safety

1.1 Occupational Safety: Identify **Occupational Safety and Health Administration (OSHA) guidelines** about but not limited to general safety, electric safety, welding, cutting, fabrication, and biosystems. Distinguish between **safety rules and safety requirements**. Identify the benefits of knowing and applying basic safety procedures in both an agricultural laboratory and workplace. Apply safety knowledge to conduct a compliance review of the agricultural laboratory, including a written summary justifying the findings with recommendations for improving the safety of working conditions.

1.2 Safety and Operational Procedures: Review common **laboratory safety procedures for tool and equipment operation** in the agricultural laboratories, including but not limited to **accident prevention and control procedures**. Demonstrate the ability to follow safety and operational procedures in a lab setting and complete a safety test with 100 percent accuracy.

2. Occupational Research and Awareness

2.1 Career Exploration: Explore and compare local and **regional career opportunities** to predict the occupational trends **related to agricultural engineering, industrial, and maintenance system occupations**. Recommend the top occupations that require high school graduation, some college, postsecondary certificate, two-year college degree, four-year degree, and advanced degree.

2.2 Occupational Trends: Evaluate local job postings, labor, and workforce data to analyze the **knowledge, skills, and abilities necessary for employment** in agricultural engineering, industrial, and mechanical systems occupations related to:

a. education and training including admission requirement and tuition requirements,
b. available positions,
c. salaries,
d. cost vs. benefits of education/training,
e. potential lifetime earnings,
f. employment benefits, and
g. possible need for relocation to advance.

3. Project Planning and Management

3.1 Project Planning: Design a project **plan for an agricultural engineering, industrial, and maintenance project**, outlining a strategy for working within a given set of parameters, constraints, and resources. Include at least the following components in the plan: budget, timeline, safety considerations, and strategies to minimize adverse environmental impacts.

3.2 Computer-Aided Design: Evaluate the use of **computer-aided design (CAD) systems** to design projects. Demonstrate the use of a CAD program to create a project plan.

4. Precision Measurements and Management Systems

4.1 Digital Technology Impact: Explain the **impact of geographic information systems (GIS), global positioning systems (GPS), and unmanned aircraft systems (UAS)** on agricultural demographics, precision agriculture, pasture management, water quality, watershed management, and waste pollution. Discuss the implications for industry and labor with the incorporation of these technologies into more facets of agricultural life.

4.2 Applications: Identify various **GIS, GPS, and UAS applications** and explain their **uses in precision agriculture**, including but not limited to the following: precision agriculture management zones, crop water and drought areas, crop imaging, land correlation to crop yields, yield map cleaning and management, drainage analysis and tile mapping, crop data analysis, soil darkness mapping, suitability modeling, and slope angle and accuracy.

4.3 Implementation: Demonstrate the **ability to make land use, management, development, and equipment recommendations** for a specific plot of land in rural and urban settings. Provide graphical and textual evidence to support each recommendation.

4.4 Precision Technology Maintenance: Demonstrate the ability to **troubleshoot and calibrate precision technologies** to ensure the correct data or application method is operating properly. (e.g., GPS receivers, yield monitors, remote sensors, etc.)

5. Drainage and Irrigation Systems

5.1 Drainage Systems Design: Analyze, map, and disseminate geographic information systems (GIS) and global positioning systems (GPS) data portraying a drainage map of a specified region. Recommend engineering **design changes to drainage and irrigation systems**. Explain how the changes will improve compliance with accepted soil erosion control practices.

5.2 Irrigation System Design: Describe the relationships **between concepts of hydrostatics, kinematics, and dynamics of fluid flows** used for agricultural industry **irrigation systems**, including but not limited to pipes and open channels. Design an irrigation, animal waste flush, or misting system for use with plant or animal systems outlining all equipment and operational requirements including but not limited to water pressure (psi) needed or flow rates in gallons per minute (gpm); spray nozzle with discharge pattern; number of nozzles; number of zones required; size of pipe (may vary depending on length and presser requires); runoff containment; etc.

6. Structural Systems: Environmental Impacts, Efficiency, and Certifications

6.1 Efficiency and Sustainability Standards: Research agricultural buildings and facilities that **meet industry benchmarks for energy efficiency and environmental sustainability**. Compare and contrast the costs and **benefits of such structures**. Make recommendations as to the best energy efficiency and environmental practices to include in various building or facility remodeling plans. Explain the impacts such as but not limited to the decrease in operational cost, impact on the environment, etc.

6.2 Green Buildings: Create a detailed **construction plan for an agricultural facility** suitable for a designated site, using **natural systems and renewable energy** where possible, and conserving energy and material resources in construction and maintenance while meeting building certification requirements. Include plans for recreating land or environments impacted by the construction (i.e., replacing the displaced wetland with an artificial wetland).

6.3 **Solar Energy**: Develop an **installation and maintenance plan for a solar energy system**, with an emphasis on projected power output, panel design, energy use, and storage, and a maintenance schedule of the system. Identify potential points of failure and necessary repair measures.

6.4 Production Facilities: Analyze the physical requirements of selected agricultural crops and food products from the farm to the processing facility as they **impact harvesting, storage, processing, and transport**, including but not limited to density, shape, moisture content, stress levels, water potential, friction and flow of particulate solids, terminal velocity, thermal properties, and viscoelastic behavior of solids. Recommend the appropriate harvesting, storage, processing, transportation, and other handling equipment required for the range of crops and products. Provide a cost comparison for each recommendation.

7. Agricultural Fertilizers and Chemicals

7.1 Storage and Disposal: Compare **safety storage and disposal plans** for agricultural chemicals such as pesticides, fertilizers, and veterinary medicines. Outline specific procedures responsible **selection and storage, mixing, transport, application, and disposal of waste**, in compliance with applicable regulatory standards. Calculate the cost associated with the installation or replacement of a safe fertilizer or chemical storage area used within the agricultural industry.

7.2 Application Methods: Analyze the chemical and physical properties of selected **agricultural fertilizer and chemical application methods** for specific crops and determine the most efficient and effective method of application. Determine and explain the calibration procedures to ensure the correct dosage rate is applied in parts per million (ppm) or pounds per acre for liquid, solid, and gaseous applications.

8. Capstone Project

8.1 Project: Participate in a **team-driven agricultural engineering, industrial, and maintenance project** approved by the instructor that includes research, planning, analysis, budget, construction, testing, and evaluation phases to measure success and adherence to legal constraints. Prepare periodic verbal and written reports to demonstrate progress.

Standards Alignment Notes

References to other standards include:

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- P21: Partnership for 21st Century Skills Framework for 21st Century Learning
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Unmanned Aircraft Systems in Agriculture

Primary Career Cluster:	Agriculture, Food, & Natural Resources
Course Contact:	CTE.Standards@tn.gov
Course Code(s):	C18H40
Prerequisite(s):	*Any Level 2 course in an aligned AFNR program of study*
Credit:	1
Grade Level:	12
Elective Focus - Graduation Requirements:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other Agriculture, Food, & Natural Resources courses.
Program of Study (POS) Concentrator	This course satisfies one out of two required courses that must be taken from a single program of study to meet the Perkins V concentrator definition requirements.
Programs of Study and Sequence:	This is the fourth or optional fifth course *within the Agriculture, Food, and Natural Resources* program of studies.
Aligned Student Organization(s):	FFA: http://www.tnffa.org
Coordinating Work-Based Learning:	All Agriculture students are encouraged to participate in a Supervised Agricultural Experience (SAE) program. In addition, teachers who hold an active WBL certificate may offer placement for credit when the requirements of the state board's WBL Framework and the Department's WBL Policy Guide are met. For information, visit https://www.tn.gov/education/educators/career-and-technical-education/work-based-learning.html.
Promoted Tennessee Student Industry Credentials:	Credentials are aligned with postsecondary and employment opportunities and with the competencies and skills that students acquire through their selected program of study. For a listing of promoted student industry credentials, visit https://www.tn.gov/education/educators/career-and-technical-education/student-industry-certification.html.
Teacher Endorsement(s):	048, 150, 448, and 950
Required Teacher Certification:	FAA Remote Pilot Certification (Part 107)
Required Teacher Training:	None
Teacher Resources:	https://www.tn.gov/education/educators/career-and-technical-education/career-clusters/cte-cluster-agriculture-food-natural-resources.html Best for All Central https://bestforall.tnedu.gov/

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Using a Career and Technical Student Organization (CTSO) in Your Classroom

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- Participate in the CTSO Fall Leadership Conference to engage with peers by demonstrating logical thought processes and developing industry-specific skills that involve teamwork and project management.
- Participate in FFA career and leadership events (CDE/LDE) that align with this course including Agriscience Fair, Agricultural Communication, Agricultural Issues, and Employment Skills

Using Work-Based Learning (WBL) in Your Classroom

Sustained and coordinated activities that relate to the course content are the key to successful work-based learning. Possible activities for this course include the following. This is not an exhaustive list.

- **Standards 1.1-2.3** | Invite a drone pilot from the local agribusiness company to discuss career opportunities and safety.
- **Standards 3.1-4.6** | Virtually work with an FAA representative to classify local airspace and outline operating requirements.
- **Standards 5.1-5.8** | Visit a drone pilot from a local agricultural company or agency while delivering payloads directly to a given location.

Course Description

The *Unmanned Aircraft Systems (UAS) in Agriculture* course is an advanced course in *the Agriculture, Food, and Natural Resources* career cluster intended to meet the needs of specific applications of advanced UAS precision technologies specific to the agriculture, food, and natural resources industry. Students will receive rigorous instruction in preparation to take the Federal Aviation Administration (FAA) remote Pilot Certification (Part 107) (less than 55 pounds) exam for commercial drone pilots for small Unmanned Aircraft Systems (sUAS) and develop specific knowledge and skills associated with specific sUAS technologies, platforms and precision attachments to monitor, map, and provide data to make agricultural management and production recommendations.

Course Standards

1. Safety

1.1 Operational Safety: Accurately read and interpret **safety rules related to operating and using small Unmanned Aircraft Systems (sUAS) and attachments**. Demonstrate safe operation procedures with appropriate attitudes and behaviors associated with operating sUAS. Complete the safety test with 100 percent accuracy.

1.2 Emergency Procedures. Employ appropriate **emergency procedures**. Explain reporting requirements for in-flight emergencies and appropriate action during loss of aircraft control link and fly-aways.

1.3 Flight Operations Over People. Explain **safe flight operations over people**. Plan a mission that requires safe flight operations over people.

2. UAS Industry and Occupational Awareness

2.1 Evolution of UAS: Research and summarize the **origins, development, and evolution of commercial small Unmanned Aircraft Systems (sUAS) operations**. Explain the important systems, people, and technologies in the development of the sUAS industry in addition to the following:

a. limitations and constraints placed on the development of commercial sUAS;
b. evolution of sUAS regulatory framework and process, technologies that led to modern-day sUAS;
c. important events leading to the development of sUAS;
d. classification schemes of sUAS; and
e. intelligence modes of control for sUAS.

2.2 Careers: Identify and describe career opportunities using the small Unmanned Aircraft Systems (sUAS) technology field and positions related to the agriculture industry. Analyze current **sUAS jobs, job locations, salaries, and upcoming career shifts**, related to sUAS technology.

2.3 Precision Technologies: Compare and contrast the **types and functions of precision and advanced technologies** (e.g., GIS, GPS, and sensors) available to improve efficiency and efficacy in the agricultural industry.

3. Airspace Classification and Operating Requirements

3.1 Performance: Exhibit a thorough understanding of small Unmanned Aircraft Systems (sUAS) **technologies, platforms, and systems to determine capabilities and limitations,** such as payload elements, stabilization and navigation sensors, environmental operation conditions, life and operational cycles, and operational considerations.

3.2 Operation Requirements: Examine the **operating requirements of small Unmanned Aircraft Systems (sUAS)** including the following:

a. differentiation of the different autonomy levels of sUAS;

b. identify and explain the purpose of a ground control station;
c. operation regulations over human beings;
d. requirements of a visual observer;
e. basic rules of safe operation;
f. aircraft safety of flight principles;
g. requirements for the sUAS to be in a condition for safe operation; and
h. a hazardous operations plan.

3.3 FAA Regulations: Summarize and demonstrate the **Federal Aviation Authority (FAA) regulations associated with the operation of small Unmanned Aircraft Systems (sUAS)** including registration requirements, categories of vehicles, system operators, ramifications of false reporting, accident reporting, and prohibition of operating multiple sUAS.

3.4 Airspace Classification: Classify **airspace, including general, special, and other airspaces**. Describe the operating requirements in airspaces including restrictions due to Notice to Airmen (NOTAM). Given a specific region on aeronautical maps and using researched sources of information, identify authorizations required, maximum altitudes, unauthorized areas, and other points of risk or concerns for the sUAS operator.

3.5 Principles of Flight: Explain the **fundamentals and principles of flight** as they relate to small Unmanned Aircraft Systems (sUAS). Include aeronautical principles, aerodynamics, Lift, drag, thrust, weight, acceleration, objects in motion through the air, and the forces that produce change to such motions.

3.6 Charts: Read and interpret **sectional charts, aeronautical charts, and chart supplements**. Identify classifications of airspace, latitude, longitude, obstacles, and navigation routes, the meaning of symbols, key terms, and other specific words related to small Unmanned Aircraft Systems (sUAS). Examples include ICAO Location Indicator, Warning Areas, Outer Boundaries, and Temporary Flight Restrictions (TFR) Sites.

3.7 Radio Communications: Demonstrate **effective communication skills while using proper radio communication procedures** including Zulu time and the phonetic alphabet. Explain the various transmitters and demonstrate knowledge of aircraft communication equipment.

4. Performance, Weather, and Restrictions

4.1 Human Factors: Compare the differences in **human factors related to the operational control, ground control, and personnel required to operate small Unmanned Aircraft Systems (sUAS).** Summarize how the different types of human actions and automatic sensory factors impact the different types of human operator errors.

4.2 Preflight Planning: Articulate the **components of preflight planning to assess risk.** Be prepared to outline the risk assessment, and a maintenance schedule, and conduct a preflight inspection.

4.3 Devices: Investigate and compare the **various small Unmanned Aircraft Systems (sUAS), cameras, and sensoring systems** to make recommendations for specific agricultural applications.

4.4 Weather: Using Aviation weather reports (METAR), Terminal Aerodrome Forecasts (TAF), and other weather reports from various sources, analyze weather reports to interpret **weather conditions for operating** a small Unmanned Aircraft System (sUAS).

4.5 Pilot in Command: Describe the **responsibility and authority of the pilot in command (PIC)** for a small Unmanned Aircraft System (sUAS) mission. Plan and implement a sUAS mission. The mission will include creating an autonomous flight plan that is safe, fully complies with FAA regulations within the National Airspace, and completes the planned objective. Demonstrate the PIC responsibilities for each step of a mission (e.g., mission planning, pre-flight, normal in-flight, abnormal in-flight, emergency in-flight, and post-flight debrief).

4.6 Night Operations: Explain **night operations** with a small Unmanned Aircraft System (sUAS). Plan the various steps of a night mission with a sUAS.

5. Payload, Stressors, and Data Collection

5.1 Loading: Explain the **processes of loading and payload** as they apply to small Unmanned Aircraft Systems (sUAS), including the historical payload uses and the prohibitions for carrying hazardous materials. Determine the impact of a load on performance by calculating the in-flight weight of the payload using load factor charts to maintain specific altitudes.

5.2 Data Collection – Plant Nutrient: Create a plan for using small Unmanned Aircraft Systems (sUAS) remote sensing technology to **identify nutrient deficiencies to monitor plant growth.** Describe which remote sensing technology should be used to **examine the processes of plant growth** to conduct chlorophyll counts.

5.3 Data Collection – Soils: Describe how small Unmanned Aircraft Systems (sUAS) are used to **analyze soil properties utilizing remote sensing technology**. Develop a plan to use sUAS technology in best management practices for soil moisture and irrigation. Assess irrigation application effectiveness using sUAS technology.

5.4 Data Collection – Animal Production: Determine uses for small Unmanned Aerial Systems (sUAS) to **monitor companion animals, livestock, and wildlife operations**. Differentiate the signs and symptoms of common diseases and other issues including but not limited to identifying herd health issues, nutritional issues, predator issues, and calculating calving percentages by using sUAS remote sensing.

5.5 Data Collection – Crop Production: Determine the small Unmanned Aerial Systems (sUAS) remote sensing applications needed to **identify common forage pests and diseases that impact plant growth and nutritional levels**. Analyze **data to identify and provide management recommendations for forage, hay crops, and food plots** serving as a source of nutrition for animals.

5.6 Data Collection – Pest Management: Identify **pest and disease damage in plants** using small Unmanned Aerial Systems (sUAS) remote sensing technology. Recommend appropriate solutions for pest and disease control by developing an integrated pest management (IPM) plan using information from sUAS technology.

5.7 Data Collection – Crop Management: Determine the proper small Unmanned Aerial Systems (sUAS) **attachment to provide data** on agricultural crops such as but not limited to vegetable, row, nursery, native vegetation, fruit, etc. Develop a **data management report** for a diversified farming operation with at least three different crops, including:

a. identification of common pests and diseases,
b. use of sUAS for early detection of diseases,
c. calculate yield estimates using sUAS data, and
d. evaluate and monitor crops to predict growth and harvest times.

5.8 Data Collection – Forest Management: Identify small Unmanned Aerial Systems (sUAS) **attachments and techniques to provide forest management data** including the identification of economically important tree species, forest pests, insects, and diseases. Create a forest management plan based on images and data from a sUAS.

Standards Alignment Notes

References to other standards include:

- SAE for All: Evolving the Essentials: All Agriculture students are encouraged to participate in a Supervised Agricultural Experience (SAE) program to practice and demonstrate the knowledge and skills learned in their agriculture courses.
- AFNR: National Agriculture, Food, & Natural Resources (AFNR) Career Cluster Content Standards: Students engaged in the activities outlined above should be able to demonstrate fluency in Standards NRS. 02.03, 03.02,04, ESS.01, 02, 05, and PST 05at the conclusion of the course.
- P21: Partnership for 21st Century Skills Framework for 21st Century Learning
    - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

Applied Environmental Science

Primary Career Cluster:	Agriculture, Food, & Natural Resources
Course Contact:	CTE.Standards@tn.gov
Course Code(s):	C18H25
Prerequisite(s):	*Agriscience* (C18H19)
Credit:	1
Grade Level:	10
Elective Focus-Graduation Requirements:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other Agriculture, Food, & Natural Resources courses. In addition, this course satisfies the third lab science credit requirement for graduation.
POS Concentrator:	This course satisfies one out of two required courses to meet the Perkins V concentrator definition when taken in sequence in the approved program of study.
Programs of Study and Sequence:	This is the second course in the *Environmental and Natural Resources Management* program of study.
Aligned Student Organization(s):	FFA: http://www.tnffa.org
Coordinating Work-Based Learning:	All Agriculture students are encouraged to participate in a Supervised Agricultural Experience (SAE) program. In addition, teachers who hold an active WBL certificate may offer placement for credit when the requirements of the state board's WBL Framework and the Department's WBL Policy Guide are met. For information, visit https://www.tn.gov/education/educators/career-and-technical-education/work-based-learning.html.
Promoted Tennessee Student Industry Certifications:	Credentials are aligned with postsecondary and employment opportunities and with the competencies and skills that students acquire through their selected program of study. For a listing of promoted student industry credentials, visit https://www.tn.gov/education/educators/career-and-technical-education/student-industry-certification.html.
Teacher Endorsement(s):	(048 and 015), (048 and 016), (048 and 017), (048 and 081), (048 and 126), (048 and 127), (048 and 128), (048 and 129), (048 and 151), (048 and 211), (048 and 212), (048 and 213), (048 and 214), (048 and 414), (048 and 415), (048 and 416), (048 and 417), (048 and 418), (048 and 449), (048 and 951), (150 and 015), (150 and 016), (150 and 017), (150 and 081), (150 and 126), (150 and 127), (150 and 128), (150 and 129), (150 and 151), (150 and 211), (150 and 212), (150 and 213), (150 and 214), (150 and 414), (150 and 415), (150 and 416), (150 and 417), (150 and 418), (150 and 449), (150 and 951), (448 and 015), (448 and 016), (448 and 017), (448 and 081), (448 and 126), (448 and 127), (448 and 128), (448 and 129), (448 and 151), (448 and 211), (448 and 212), (448 and 213), (448 and 214), (448 and 414), (448 and 415), (448 and 416), (448 and 417), (448 and 418), (448 and 449), (448 and 951), (950 and 015), (950 and 016), (950 and 017), (950 and 081), (950 and 126), (950 and 127), (950 and 128), (950 and 129), (950 and 151), (950 and 211), (950 and 212), (950 and 213), (950 and 214), (950 and 414), (950 and 415), (950 and 416), (950 and 417), (950 and 418), (950 and 449), (950 and 951)
Required Teacher Certification:	None
Required Teacher Training:	None
Teacher Resources:	https://www.tn.gov/education/educators/career-and-technical-education/career-clusters/cte-cluster-agriculture-food-natural-resources.html Best for All Central: https://bestforall.tnedu.gov/

Course at a Glance

CTE courses provide students with an opportunity to develop specific academic, technical, and 21st-century skills necessary to be successful in careers and life. In pursuit of ensuring every student in Tennessee achieves this level of success, we begin with rigorous course standards that feed into intentionally designed programs of study.

Students engage in industry-relevant content through general education integration and experiences such as career and technical student organizations (CTSO) and work-based learning (WBL). Through these experiences, students are immersed with industry-standard content and technology, solve industry-based problems, meaningfully interact with industry professionals, and use/produce industry-specific, informational texts.

Using a Career and Technical Student Organization (CTSO) in Your Classroom

CTSOs are a great resource to put classroom learning into real-life experiences for students through classroom, regional, state, and national competitions, and leadership opportunities. Below are CTSO connections for this course; note this is not an exhaustive list.

- Participate in the CTSO Leadership Conference to engage with peers by demonstrating logical thought processes and developing industry-specific skills that involve teamwork and project management.
- Participate in FFA career and leadership events (CDE/LDE) that align with this course including Agriscience Fair, Agricultural Communications, Agricultural Issues, Agronomy, Employment Skills, Environmental & Natural Resources, and Forestry.

Using Work-Based Learning (WBL) in Your Classroom

Sustained and coordinated activities that relate to the course content are the key to successful work-based learning. Possible activities for this course include the following. This is not an exhaustive list.

- **Standards 1.1-1.2** | Invite an industry representative to talk about skills needed to enter the workforce or postsecondary opportunities.
- **Standards 2.1-2.3** | Have students job shadow a local park or recreation manager.
- **Standards 3.1-4.5 and 6.1-6.4**| Have students work on projects with a parks and recreation department staff member.
- **Standards 5.1-5.3** | Invite a power and energy official to discuss the importance of natural resources on our energy needs.
- **Standards 7.1-7.3** | Work on-site with a governmental agency dealing with environmental issues.

Course Description

Applied Environmental Science focuses on the knowledge, information, and skills related to the fundamental science and management of ecosystems as well as careers, leadership, and history of the industry. This course covers principles of environmental impacts, energy consumption, and ecosystem management. Upon completion of this course, proficient students will be prepared for advanced coursework in the *Environmental and Natural Resources* program of study.

Course Standards

1. Occupational Awareness and Safety

1.1 Career Exploration: Explore and compare local and regional **career opportunities in the environmental science industry** and evaluate labor data to predict the employment outlook. Describe the knowledge, skills, and abilities necessary for a diverse range of careers, including professional occupations, in environmental sciences.

1.2 Safety: Differentiate **general occupational safety prevention and control standards** as related to environmental and natural resources. Apply concepts of safety procedures to complete the safety test with 100 percent accuracy.

a. Review common equipment and proper handling of the equipment used in the natural resources field.
b. Identify common hazards in the field: poisonous plants and animals.
c. Review the standards and procedures of Hunter's Education.
d. Review the standards and procedures of Boater's Education.

1.3 Business and SAE Recordkeeping: Accurately maintain an active **recordkeeping system** and apply proper **research, accounting, and financial records** as they relate to an environmental and national resource-supervised **agricultural experience (SAE) program**. Demonstrate the ability to summarize records such as findings, recommendations, individual enterprise budgets, profit and loss statements, inventory management, and other specific reports by completing SAE and related applications.

2. Studying the Environment

2.1 Interaction of Environmental Science: Define the **scope and impact of contemporary environmental science**. Describe the **interdisciplinary nature** of this field and provide examples of how other sciences such as biology, chemistry, earth science, and physics relate to environmental science.

2.2 Biomes: Define the term biome and identify the location of the **major biomes of the world and in Tennessee.** Compare and contrast the climates, seasons, soil characteristics, water availability, and other defining features of each biome. Differentiate between biomes within the following categories: aquatic, grasslands, forest, desert, and tundra.

3. Human Impact on the Environment

3.1 Human Impact: Evaluate the evolving **impact of humans on the environment**, from primitive societies to contemporary civilizations. Highlight specific milestones and events that had a significant positive and negative impact.

3.2 Population Impact: Compare and contrast U.S. **population statistics** to those of other countries around the world, concerning growth rate, age structure, life expectancy, and total population, among other key parameters. Analyze the factors that impact population growth, and assess the future impact of population growth in the U.S. and the world on the following: availability of natural resources, land usage, waste production and pollution, and global economic health.

4. Ecosystems

4.1 Components of Ecosystems: Synthesize the **components of local ecosystems**. Compare and contrast a local to other state ecosystems as related to the following areas: habitat, niche, producers, consumers, and vertical stratification.

4.2 Components of an Ecosystem: Analyze **grassland, forest, aquatic, and wetland ecosystems,** including Tennessee native and non-native-species, **that fulfill key roles in each ecosystem**. Evaluate the **structure and life processes of ecosystems** of the North American model of wildlife management to other global systems, including but not limited to the following:

a. Grassland: bison, prairie dog, coyotes, red oat grass, quail, wildflowers, milkweed, wild horse and burros, big bluestem, little bluestem, switchgrass, and gamma grass;
b. Forest: black bear, bobcat, chipmunk, cottontail, coyote, elk, gray squirrel, gray wolf, mountain goat, mountain lion, muskrat, opossum, raccoon, skunk, whitetail deer, corn snake, woodchuck, red fox, great horned owl, mourning dove, and woodpecker;
c. Aquatic: blue catfish, bluegill, brown trout, carp, channel catfish, crappie, crayfish, largemouth bass, trout, walleye, freshwater mussel and beaver; and
d. Wetlands: alligator, snapping turtle, crocodile, wood duck, and great blue heron.

4.3 Inaction of Ecosphere Components: Analyze how the **abiotic and biotic components of the ecosphere interact with and impact one another.** Apply knowledge of these interactions to determine the suitability of an area for different types of development (e.g., commercial, industrial, residential, and urban sprawl). Develop a claim about a development issue that impacts a selected ecosphere, supporting the claim with evidence and sound reasoning from research.

4.4 Biome Succession: Determine the significance of **primary and secondary succession in a selected biome**, and the pioneer species for that biome. Evaluate immature and mature ecosystems and discuss indicators that can be observed to determine the maturity and quality of the ecosystem.

4.5 Biodiversity: Determine the importance of **biodiversity in an ecosystem**. Assess how various **land uses might impact biodiversity** in a given area. Summarize findings on one of the following topics:

a. impact of the intentional or unintentional introduction of non-native species to an ecosystem;
b. threatened and endangered species; and
c. agricultural best management practices that promote biodiversity.

5. Energy Consumption

5.1 Energy Resources: Identify **energy resources** used in the United States and abroad, distinguishing between **renewable and nonrenewable resources**. Research the global distribution of energy resources; determine major resource-rich regions and how they intersect with geopolitical boundaries.

5.2 Energy Consumption: Compare **energy consumption** in the United States to the energy consumption of other countries. Explain **energy use trends and statistics**. Investigate the political and economic implications of using foreign energy resources.

5.3 Personal Energy Use: Compile and analyze self-collected **data on total energy use**, including transportation, water, and electricity consumption, among others. Create and implement a plan to reduce personal energy use. Compare the usage data after one month of implementing the plan, and discuss key takeaways learned from the project.

6. Managing Ecosystems

6.1 Environmental Conditions: Identify standard **methods for monitoring a variety of environmental conditions**, including but not limited to air, water, and soil, as well as the biological components of an ecosystem.

6.2 Ecosystem Health: Assess the **ecological health** of an ecosystem to determine if the ecosystem is threatened by insects or diseases. Evaluate a habitat to determine its ecological health referencing any threats.

6.3 Environmental Management Plan: Explain the importance of **ensuring sustainability** when developing a **management plan** for a **specific resource or ecosystem**. Create a management plan and summarize best practices for each ecosystem: forest, wetland, aquatic, and grassland.

6.4 Using Integrated Pest Management: Explain the **history, purpose, and principles of Integrated Pest Management** (IPM). Identify specific IPM strategies for controlling common home and landscape pests. Create additional informational sheets for large-scale pest control in a variety of natural and human-engineered environments.

7. Legal and Civic Responsibility

7.1 Historical, Legislation, and Treaties: Identify specific **legislative policies and international conventions and treaties** to depict the historical development of environmental regulation at the state, national, and global levels. Summarize the intended goals and ultimate impact of the regulations, including policies related to air, water, toxic substances, wastes, energy resources, and mandated environmental impact studies.

7.2 Enforcing Legislation: Describe the role of federal, state, and local governments in **enforcing environmental legislation**. Differentiate between key agencies at each level and justify the need for general regulations of environmental hazards.

7.3 Issues and Solutions: Identify current **environmental issues** and research the **environmental and ethical implications for potential solutions**, such as but not limited to, ecosystem recovery, reforestation, or reclamation. NOTE: Agricultural Issues career development event format can be used as a guide to master this standard.

8. Team Project and Data Analysis

8.1 Team Project with Data Analysis: As a team, **identify a problem** related to the program of study as a whole. **Research and utilize the Engineering Design Process to design a solution**. Document the following steps in an engineering design notebook for inclusion in the program portfolio. When possible, connect the problem to a FFA Career Development Event.

a. **Problem Identification**: Brainstorm specific problems and challenges within the program of study. Conduct basic research to understand the scope and implications of the identified problem. Identify one problem as a focus area.
b. **Research and Analysis**: Conduct in-depth research on chosen topics related to the problem. Locate and analyze a dataset related to the problem.
c. **Review the Stages of the Engineering Design Process**: Define the problem, research, brainstorm solutions, develop prototypes, test and evaluate, and iterate. Consider constraints such as cost, efficiency, and environmental impact during the design process.
d. **Project Implementation**: Assign specific roles within the design teams (e.g., project manager, researcher, designer, tester). Design a solution tailored to address the identified problem or scenario. Document progress through design journals, sketches, diagrams, and digital presentations. (Note: Prototype is optional in the Year 2 course.)
e. **Presentation and Reflection**: Showcase the problem and solution to the class. Share the data that was analyzed and how it affected the solution. Discuss the design process and challenges. As a class, critically evaluate the effectiveness and feasibility of the solutions and propose potential improvements.

Standards Alignment Notes

References to other standards include:

- SAE for All: Evolving the Essentials: All Agriculture students are encouraged to participate in a Supervised Agricultural Experience (SAE) program to practice and demonstrate the knowledge and skills learned in their agriculture courses.

- AFNR: National Agriculture, Food, & Natural Resources (AFNR) Career Cluster Content Standards: Students who are engaging in activities outlined above should be able to demonstrate fluency in Standards ESS.01, .02, .03, .04, .05, .06; NRS.01, .02, .04, and .05 at the conclusion of the course.
- P21: Partnership for 21st Century Skills Framework for 21st Century Learning
    - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

Plant and Soil Science

Primary Career Cluster:	Agriculture, Food, & Natural Resources
Course Contact:	CTE.Standards@tn.gov
Course Code:	C18H15
Prerequisite:	*Applied Environmental Science* (C18H25)
Credit:	1
Grade Level:	11
Elective Focus - Graduation Requirements:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other Agriculture, Food, & Natural Resources courses. In addition, this course satisfies one lab science credit requirement for graduation.
POS Concentrator:	This course satisfies one out of two required courses to meet the Perkins V concentrator definition when taken in sequence in the approved program of study.
Programs of Study and Sequence:	This is the third course in the *Environmental and Natural Resources* Management program of study.
Aligned Student Organization(s):	FFA: http://www.tnffa.org
Coordinating Work-Based Learning:	All Agriculture students are encouraged to participate in a Supervised Agricultural Experience (SAE) program. In addition, teachers who hold an active WBL certificate may offer placement for credit when the requirements of the state board's WBL Framework and the Department's WBL Policy Guide are met. For information, visit https://www.tn.gov/education/educators/career-and-technical-education/work-based-learning.html
Promoted Tennessee Student Industry Credentials:	Credentials are aligned with postsecondary and employment opportunities and with the competencies and skills that students acquire through their selected program of study. For a listing of promoted student industry credentials, visit https://www.tn.gov/education/educators/career-and-technical-education/student-industry-certification.html
Teacher Endorsement(s):	048, 150, 448, and 950
Required Teacher Certification:	None
Required Teacher Training:	None
Teacher Resources:	https://www.tn.gov/education/educators/career-and-technical-education/career-clusters/cte-cluster-agriculture-food-natural-resources.html Best for All Central https://bestforall.tnedu.gov/

Course at a Glance

CTE courses provide students with an opportunity to develop specific academic, technical, and 21st-century skills necessary to be successful in their careers and lives. In pursuit of ensuring every student in Tennessee achieves this level of success, we begin with rigorous course standards that feed into intentionally designed programs of study.

Students engage in industry-relevant content through general education integration and experiences such as career & technical student organizations (CTSO) and work-based learning (WBL). Through these experiences, students are immersed with industry-standard content and technology, solve industry-based problems, meaningfully interact with industry professionals, and use/produce industry-specific, informational texts.

Using a Career and Technical Student Organization (CTSO) in Your Classroom

CTSOs are a great resource to put classroom learning into real-life experiences for your students through classroom, regional, state, and national competitions, and leadership opportunities. Below are CTSO connections for this course. This is not an exhaustive list.

- Participate in the CTSO Fall Leadership Conference to engage with peers by demonstrating logical thought processes and developing industry-specific skills that involve teamwork and project management.
- Participate in FFA career and leadership events (CDE/LDE) that align with this course including Agriscience Fair, Agricultural Communications, Agricultural Issues, Agronomy, Extemporaneous Speaking, Environmental & Natural Resources, Land Judging and Evaluation, and Prepared Public Speaking.

Using Work-based Learning (WBL) in Your Classroom (Need to update)

Sustained and coordinated activities that relate to the course content are the key to successful work-based learning. Possible activities for this course include the following. This is not an exhaustive list.

- **Standards 1.1.1-4** | Invite a guest speaker to talk about the impact and employment opportunities within the plant and soil science industry.
- **Standards 2.1-2.3 |** Have the students work with a soil scientist on a real project.
- **Standards 3.1-3.4** | Have the students conduct a nutrient recommendation based on a soil sample that will be evaluated by a plant scientist.
- **Standards 4.1-4.7** | Have students work with a soil surveyor on multiple soil use projects.

Course Description

Plant and Soil Science is an applied-knowledge course focusing on the science and management of plants and soils, with special attention given to current agricultural practices that support the healthy and sustainable cultivation of major crops. Upon completion of this course, proficient students will have been exposed to a range of careers associated with the science and management of plants and soils and will have developed the essential skills and knowledge to be successful in science- or agriculture-related occupations.

Course Standards

1. History and Importance

1.1. History of Soil Conservation: Determine the **role of plants and soil in maintaining environmental quality**. Trace the **history of soil conservation** in the United States including specific historical events that promoted the development of soil conservation methodologies and regulations.

1.2. Legal Requirement to Maintain Freshwater: Describe current **land management practices** for rural, suburban, and urban settings t**o protect and ensure the quality and quantity of freshwater supply**. Review specific best management practices (BMPs) from production agriculture, forestry, manufacturing, and municipality to identify existing practices governed by local laws and agency policy. Discuss the pros and cons of these required practices.

1.3. Requirements and Employment Trends: Investigate **occupation trends within plant and soil sciences**. Compare and contrast the **knowledge, skills, and abilities necessary for employment**, as well as the typical level of education required.

1.4. Laboratory Safety: Review common **laboratory safety procedures for tool and equipment operation in plant and soil science laboratories**, including but not limited to accident prevention and control procedures. Demonstrate the ability to follow safety and operational procedures in a lab setting and complete a safety test with 100 percent accuracy.

2. Soil Science

2.1. Soil Formation: Differentiate between the **biological, geological, chemical, and physical factors and processes involved in soil formation.**

2.2. Components for Classifying Soils: Communicate the **methods for classifying soils**. Describe **procedures for using each method**. Demonstrate the ability to collect samples and analyze the following: soil pH, texture, permeability, water holding capacity, slope, chemical analyses, and soil organisms.

2.3. Soil Judging and Classification: Explain the components of a **soil profile**. Conduct a basic **soil analysis and available water holding capacity** of different soil types. Synthesize findings to recommend appropriate agricultural, recreational, conservational, and/or aesthetic uses of specific land areas using valid reasoning and citing specific evidence gathered in analyses.

3. Plant Science and Nutrition

3.1. Plant Science: Compare and contrast the **anatomy and physiology of monocot and dicot plants** used for crop production.

3.2. Parts and Function of Plant Cells: Depict the **parts and functions of plant cells**. Identify the structures and describe the **functions of plant cell organelles**.

3.3. Essential Nutrients for Plant Growth: Assess the importance of the **16 (sixteen) nutrients essential to plant growth and development**. Identify nutritional deficiencies and disorders, distinguish among signs of nutrient deficiency in plants, make recommendations for appropriate treatments, and prescribe preventative control measures for major agriculture crops, including corn, soybean, cotton, tobacco, hay, pasture, and forest.

3.4. Fertilizers: Investigate the use of **fertilizers as a source of essential plant nutrients**. Compare and contrast the use of **organic and chemical fertilizers**, assessing claims made by producers and consumers of fertilizer products. Calculate fertilizer formulations and perform various methods of fertilizer application for crops, such as erosion-controlling crops.

4. Agricultural Practices and Environmental Issues

4.1. Agricultural Practices: Research, compare, and contrast **traditional, sustainable, and organic agriculture methods and practices**. Describe how each method aligns with a specific goal, including but not limited to the following: soil fertility and texture maintenance, adequate soil moisture maintenance, erosion prevention, pollution prevention, and weed, insect, and disease management. Assess the costs and benefits of specific methods and practices.

4.2. Pollution and Containment Controls: Identify major agriculture-related **pollutants and isolate practices that contribute to pollution in both urban and traditional agricultural production environments**. Recommend **best practices to reduce pollution** for watering procedures, runoff containment, pest control, and chemical use and disposal in both domestic (home) and agricultural production settings.

4.3. Landscape Practices: Compare and contrast alternative **methods for maintaining home landscapes using sustainable and/or organic products that will reduce pollution and soil erosion and conserve water and energy**. Justify the need for specific practices to maintain a healthy home landscape, developing claim(s) and counterclaim(s) with reasoning and evidence.

4.4. Soil Improvement Methods. Research the use of **compost and mulch in improving and rebuilding soils**. Describe the various **compost methods, including field crop composting, commercial composting, backyard compost piles, vermicomposting, and bokashi**. Compares the inputs, time investment, quality, and quantity of compost prepared by each method.

4.5. Site Selection: Determine characteristics important in **selecting a site for optimal growth of plants and crops in rural, suburban, and urban settings**. Describe the factors that influence the economics of crop production in each setting.

Standards Alignment Notes

References to other standards include:

- SAE for All: Evolving the Essentials: All Agriculture students are encouraged to participate in a Supervised Agricultural Experience (SAE) program to practice and demonstrate the knowledge and skills learned in their agriculture courses.
- AFNR: National Agriculture, Food, & Natural Resources (AFNR) Career Cluster Content Standards:
    - Note: While not directly aligned to one specific standard, students engaged in the activities outlined above should be able to demonstrate fluency in Standards AS.01 and PS.01 at the conclusion of the course.
- P21: Partnership for 21st Century Skills Framework for 21st Century Learning
    - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

Natural Resource Management

Primary Career Cluster:	Agriculture, Food, & Natural Resources
Course Contact:	CTE.Standards@tn.gov
Course Code(s):	C18H28
Prerequisite(s):	*Plant and Soil Science* (C18H15)
Credit:	1
Grade Level:	12
Elective Focus-Graduation Requirements:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other Agriculture, Food, and Natural Resources courses.
POS Concentrator:	This course satisfies one out of two required courses to meet the Perkins V concentrator definition when taken in sequence in the approved program of study.
Programs of Study and Sequence:	This is the fourth course in the *Environmental and Natural Resources Management* program of study.
Aligned Student Organization(s):	FFA: http://www.tnffa.org
Coordinating Work-Based Learning:	All Agriculture students are encouraged to participate in a Supervised Agricultural Experience (SAE) program. In addition, teachers who hold an active WBL certificate may offer placement for credit when the requirements of the state board's WBL Framework and the Department's WBL Policy Guide are met. For information, visit https://www.tn.gov/education/educators/career-and-technical-education/work-based-learning.html.
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Teacher Endorsement(s):	048, 150, 448, and 950
Required Teacher Certifications:	None
Required Teacher Training:	None
Teacher Resources:	https://www.tn.gov/education/educators/career-and-technical-education/career-clusters/cte-cluster-agriculture-food-natural-resources.html Best for All Central: https://bestforall.tnedu.gov/

Course at a Glance

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Using a Career and Technical Student Organization (CTSO) in Your Classroom

CTSOs are a great resource to put classroom learning into real-life experiences for your students through classroom, regional, state, and national competitions, and leadership opportunities. Below are CTSO connections for this course. This is not an exhaustive list.

- Participate in the CTSO Fall Leadership Conference to engage with peers by demonstrating logical thought processes and developing industry-specific skills that involve teamwork and project management.
- Participate in FFA career and leadership events (CDE/LDE) that align with this course including Agriscience Fair, Agricultural Communications, Agricultural Issues, Agronomy, Extemporaneous Speaking, Environmental and Natural Resources, Land Judging and Evaluation, and Prepared Public Speaking.

Using Work-Based Learning (WBL) in Your Classroom

Sustained and coordinated activities that relate to the course content are the key to successful work-based learning. Possible activities for this course include the following. This is not an exhaustive list.

- **Standards 1.1-1.3** | Invite a guest speaker to talk about the impact and employment opportunities within the plant and soil science industry.
- **Standards 2.1-3.2 |** Have the students work with a soil scientist on a real project.
- **Standards 4.1-7.1** | Have the students conduct projects in conjunction with and evaluated by a park ranger or natural resource manager.

Course Description

Environmental and Natural Resource Management is an applied course for students interested in learning more about becoming good stewards of our environment and natural resources. This course covers major types of natural resources and their management, public policy, and the role of public education in managing resources, as well as careers, leadership, and the history of the industry. Upon completion of this course, proficient students will be prepared for further study and careers as environmental scientists, conservationists, foresters, or wildlife managers.

Course Standards

1. Occupational Awareness and Safety

1.1 Safety: Review common laboratory **safety procedures for tool and equipment operation in the natural resource management laboratories**, including but not limited to accident prevention and control procedures. Demonstrate the ability to follow safety and operational procedures in a lab setting and complete a safety test with 100 percent accuracy.

1.2 Record Keeping: Investigate opportunities to expand and diversify a Supervised Agricultural Experience (SAE) program in the area of natural resource management. Demonstrate the ability to **prepare basic personal and business records** to complete employment, taxes, and SAE-related applications, including resumes, budgets, income statements, balance sheets, cash flow statements, profit and loss statements, and equity statements.

1.3 Employment Trends: Investigate **occupation trends in forestry and natural resource management**. Compare and contrast the knowledge, skills, and abilities necessary for employment, as well as the typical level of education required.

2. Managing Water Resources

2.1 Essential Uses: Research the **physical and chemical properties of fresh and salt water**. Create a chart or graph depicting the **essential uses of water**, differentiating the amount of water available for human use from that which is inaccessible to humans.

2.2 Supply Quantity and Quality: Research major issues with water **quantity and quality impacting global water supply** using government reports and news media. Distinguish between **point source and non-point source pollution**. Debate the benefits and costs of various management strategies that have been implemented to solve water quality and quantity issues by creating a rubric that can be used to judge each technique, citing specific textual evidence.

2.3 Available Water Sources: Evaluate **water sources and uses in the local community**. Compare and contrast how various water uses, (such as agricultural, industrial, power-plant cooling, recreational, and public, impact overall water quality and quantity. Describe how legal issues and water costs impact consumption.

3. Managing Mineral Resources

3.1 Distribution of Mineral Resources: Research the global **distribution of mineral resources**. Compare the **distribution of various minerals to the regions of the world with the highest demand and/or usage**. Investigate current and projected rates of depletion and assess the extent to which reasoning and evidence presented by news media on the consequences of the depletion of readily available reserves support claims or recommendations for management of resources.

3.2 Benefits of Minerals: Compare and contrast the c**ost and benefits of extracting minerals and fossil fuels to the impact on the environment, economy, forest, wildlife, and aquatic species**. Evaluate current extracting methods used for minerals and fossil fuels to

prepare a presentation, citing specific textual evidence, to recommend the best environmental and socially sustainable method of extracting minerals or fossil fuels and returning or improving the ecosystems back to the present state.

4. Managing Plant and Animal Resources

4.1 Plant Resources: Apply concepts of scientific taxonomy and industry-specific terminology to **distinguish different species and types of plants**, such as trees, grasses, legumes, and food crops. Compare and contrast common plant species used in the management of environmental and natural resources by classification, care, and use.

4.2 Aquatic Resources: Outline the **impact that aquatic resources** such as fish and wildlife have on ecosystem stability, genetic reserves, and medicinal, agricultural, aesthetic, recreational, and industrial uses.

4.3 Best Management Practices: Investigate r**esearch-based practices in forestry, wildlife management, and conservation** used by governmental agencies and non-profit organizations **dedicated to wildlife preservation and natural resource conservation**. Justify at least one such practice, including but not limited to carrying capacity, population control, disease control, habitat management, and forest management, and make recommendations for improving a local practice or improving an issue.

4.4 Non-Native Species: Research the **accidental or intentional introduction of exotic species** into an environment. Describe the **environmental and economic impact associated with their introduction**, including the management and eradication of exotic plant and animal species but not limited to the following:

a. mimosa tree,
b. kudzu,
c. emerald ash borer,
d. privet,
e. honeysuckle vine,
f. southern pine beetle,
g. silver carp,
h. zebra mussel,
i. fire ant, and
j. feral hog.

4.5 Laws and Regulations: Research, discuss, and evaluate the **effects of fish and game laws and their enforcement on maintaining sustainable wildlife populations**. Complete and pass student certification program(s) for appropriate fish and game certification (i.e. Hunter Education, National Archery in the Schools Program (NASP), Boating Safety, and/or ATV Safety). Compare and contrast specific case studies describing both successful and failed legislation. Analyze how ecological principles are used to inform game management regulation by investigating environmental challenges a specific law is meant to address. Describe unique issues that arise in managing migratory species.

5. Managing Land Resources

5.1 Public Lands: Defend the need for **public, state, and federal lands and forest resources, including but not limited to forests, resource areas, wildlife refuges, parks, and wilderness preservation areas**, developing claim(s) and counterclaim(s) with valid reasoning and evidence. Describe the increasing pressures being placed on the agencies managing these lands to open them for various forms of development.

5.2 State Parks: Explain the **importance and impact of state park systems**, and justify the use of tax dollars to support them. Differentiate between state parks and state natural areas, their uses, and the ways each is managed.

5.3 State Forests: Compare and contrast various **forest management methods** for monitoring ecosystems, harvesting and planting trees, protecting forests from pathogens and insects, managing fire, managing wildlife, and implementing sustainable forestry practices. Evaluate case studies and determine important silviculture practices after recent natural disturbances, such as large wildfires or tornados.

5.4 Stewardship Plans: Describe, in detail, the thirteen components required in developing an **environmental forestry stewardship plan**, including how the components relate to and impact one another. Develop, edit, and revise an environmental forestry stewardship plan for a specific plot of land with peer reviews.

5.5 Rangeland: Describe the **characteristics of rangeland vegetation**, the concept of carrying capacity, and the consequences of overgrazing. Outline specific strategies and management practices to maintain the general quality of the world's rangelands.

5.6 Conservation Issues: Given a real-world **conservation issue dealing with the usage of privately or publicly owned land**, identify and recommend at least two possible mitigation options to present to the land owner or government body, including but not limited to the following:

a. Develop a wetland mitigation plan for a corporate construction project.
b. Explore the development of a private land conservation easement.
c. Recommend mitigation plans for a road /bridge construction project to minimize harm to a specific ecosystem.

6. Impact of Technology on the Management of Natural Resources

6.1 Impact of Using Technology: Research the application of g**eographic information systems (GIS) and global positioning systems (GPS), including GIS software, GPS receivers, data acquisition**, spatial analysis of data, and data from small Unmanned Aircraft Systems (sUAS) to solve problems and increase efficiency in the management of natural resources. Explain the process of how GIS, GPS, and sUAS are used in the environment and natural resource industry.

6.2 Precision Agriculture: Compare and contrast the **types and functions of precision and advanced technologies (such as GIS, GPS, and small unmanned aircraft systems) available to the agriculture industry**. Citing technical data and academic research, debate the legal, ethical, and economic impact of using emerging technologies to improve efficiency

and efficacy within the environment and natural resource industry by making a claim about the implications of technology use and developing it with reasoning and evidence from the text.

7. Policy and Governance

7.1 Policy and Regulations: Compare and contrast Tennessee **policies and regulations on natural resource preservation and management with those of the federal government and international organizations,** such as the World Wildlife Fund (WWF). Articulate the United States' responsibility to cooperate with the global community to solve issues related to natural resource quality and quantity.

7.2 Legal Issues: Compare and contrast **federal and state laws as protecting the rights of private property, forest, or conservation area landowners.** Discuss how these laws protect landowners concerning property rights, boundary disputes, easements, right-of-ways, encroachments, theft, and liability.

Standards Alignment Notes

References to other standards include:

- SAE for All: Evolving the Essentials: All Agriculture students are encouraged to participate in a Supervised Agricultural Experience (SAE) program to practice and demonstrate the knowledge and skills learned in their agriculture courses.
- AFNR: National Agriculture, Food, & Natural Resources (AFNR) Career Cluster Content Standards: Students engaged in activities outlined above should be able to demonstrate fluency in Standards ESS .01, .02, .03, .04, .05, .06; NRS .01, .02, .04, and .05 at the conclusion of the course.
  P21: Partnership for 21st Century Skills Framework for 21st Century Learning
  - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

Principles of Food Production

Primary Career Cluster:	Agriculture, Food, & Natural Resources
Course Contact:	CTE.Standards@tn.gov
Course Code(s):	C18H29
Prerequisite(s):	*Agriscience* (C18H19)
Credit:	1
Grade Level:	10
Elective Focus-Graduation Requirements:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other Agriculture courses.
POS Concentrator:	This course satisfies one of two required courses to meet the Perkins V concentrator definition when taken in sequence in the approved program of study.
Programs of Study and Sequence:	This is the second course in the *Food Science* program of study.
Aligned Student Organization(s):	FFA: http://www.tnffa.org
Coordinating Work-Based Learning:	All Agriculture students are encouraged to participate in a Supervised Agricultural Experience (SAE) program. In addition, teachers who hold an active WBL certificate may offer placement for credit when the requirements of the state board's WBL Framework and the Department's WBL Policy Guide are met. For information, visit https://www.tn.gov/education/educators/career-and-technical-education/work-based-learning.html.
Promoted Tennessee Student Industry Credentials:	Credentials are aligned with postsecondary and employment opportunities and with the competencies and skills that students acquire through their selected program of study. For a listing of promoted student industry credentials, visit https://www.tn.gov/education/educators/career-and-technical-education/student-industry-certification.html.
Teacher Endorsement(s):	048, 150, 448, and 950
Required Teacher Credentials:	None
Required Teacher Training:	None
Teacher Resources:	https://www.tn.gov/education/educators/career-and-technical-education/career-clusters/cte-cluster-agriculture-food-natural-resources.html Best for All Central: https://bestforall.tnedu.gov/

Course at a Glance

CTE courses provide students with an opportunity to develop specific academic, technical, and 21st-century skills necessary to be successful in careers and life. In pursuit of ensuring every student in Tennessee achieves this level of success, we begin with rigorous course standards that feed into intentionally designed programs of study.

Students engage in industry-relevant content through general education integration and experiences such as career and technical student organizations (CTSO) and work-based learning (WBL). Through these experiences, students are immersed with industry-standard content and technology, solve industry-based problems, meaningfully interact with industry professionals, and use/produce industry-specific, informational texts.

Using a Career and Technical Student Organization (CTSO) in Your Classroom

CTSOs are a great resource to put classroom learning into real-life experiences for students through classroom, regional, state, and national competitions, and leadership opportunities. Below are CTSO connections for this course. This is not an exhaustive list.

- Participate in the CTSO Fall Leadership Conference to engage with peers by demonstrating logical thought processes and developing industry-specific skills that involve teamwork and project management.
- Participate in FFA career and leadership events (CDE/LDE) that align with this course including Agriscience Fair, Agricultural Issues, Agronomy, Dairy Evaluation, Farm Business Management, Food Science, Land Judging, Livestock Evaluation, Meats Evaluation, Milk Quality, Poultry Evaluation, Parliamentary Procedure, Public Speaking, and Employment Skills.

Using Work-Based Learning (WBL) in Your Classroom

Sustained and coordinated activities that relate to the course content are the key to successful work-based learning. Possible activities for this course include the following. This is not an exhaustive list.

- **Standards 1.1-1.3** | Invite a farmer to talk about the importance of food production (animal and plant agriculture) on society and government relations.
- **Standards 2.1-2.4** | Have students work with a farmer on developing an annual growing calendar for food crops.
- **Standards 3.1-4.2**| Have the students develop a crop rotation plan for a specific area and have it evaluated by a soil scientist.
- **Standards 5.1-5.5** | Invite a local extension agent to discuss the cattle feed requirements based on their life stages.
- **Standards 6.1-6.3** | Conduct a price point analysis of a food crop and have it evaluated by a farm manager.
- **Standard 7.1** | Develop an informational presentation about the benefits of using biotechnology to produce safe and quality food that is reviewed by industry professionals.

Course Description

Principles of Food Production is an intermediate course in plant and animal agriculture for students interested in pursuing careers in production agriculture or food science. Students study principles related to plant and animal structural anatomy, systems physiology, the economics of production, genetics and biotechnology, and other management approaches associated with plant and animal production. Upon completion of this course, proficient students will be prepared for more advanced coursework in the Food Science program of study.

Course Standards

1. Introduction to Plant and Animal Agriculture and Safety

1.1 Role of Plants and Animals: Research the **roles and contributions of plants and animals in meeting the food and fiber needs of society**. Identify and describe the different aspects of plant and livestock production, such as product selection, site selection, optimal development, harvesting, and marketing, and examine characteristics of occupations in the field.

1.2 Importance of Plant and Animal Agriculture: Describe the **scope and economic importance of plant and animal agriculture** in the United States and the world. Summarize trends in crop and livestock production in Tennessee.

1.3 Safety: Review common **laboratory safety procedures for tool and equipment operation** in agricultural laboratories, including but not limited to accident prevention and control procedures. Demonstrate the ability to follow safety and operational procedures in a lab setting and complete a safety test with 100 percent accuracy.

2. Principles of Plant Science for Agricultural Production

2.1 Plant Science Principles and Plant Species: Differentiate between **major plant species used for vegetable, forage, fruit, and agronomic crop production**. Describe the basic principles of plant science required to produce healthy crops for high-quality food products.

2.2 Plant Growth and Development: Identify and describe the **general growth and development processes of crops** used for food production. Analyze plant anatomy, physiology, genetics, genomics, and reproduction in the context of plant growth and productivity, including the following:

a. Describe different plant types based on their anatomy and physiology.
b. Identify the part of the plant consumed for different vegetables and fruits.
c. Investigate the relationship between form and function for the major plant structures.
d. Examine the components of the plant reproduction system and identify specific anatomical features on different species and varieties of plants.
e. Summarize the process of cross-breeding and genomics techniques to enhance identified traits and characteristics.

2.3 Disease and Pesticides Control: Relate **principles of disease and parasite control** to the health, growth, and maintenance of food crops. Compare and contrast methods for disease and parasite controls, distinguishing between prevention and treatment methods.

2.4 Plant Nutrition and Health: Discuss the optimum levels of specific **nutritional factors influencing plant health**, such as pH, nitrogen, potassium, etc. Identify nutritional deficiencies and disorders and make recommendations for the safe production of major food crops.

3. Principles of Soil Science for Plant and Animal Production

3.1 Soil Classification and Fertility: Evaluate the **physical and chemical properties of soils needed for optimal food crop production**. Perform technical procedures to classify soils for agricultural production by evaluating factors such as soil pH, texture, permeability, drainage class, soil depth, and water holding capacity. Interpret test results and formulate conclusions regarding production use suitability.

3.2 Soil Erosion and Conservation Practices: Evaluate factors that influence **soil erosion rates, and compare soil conservation practices** used to maintain a healthy growing environment for plant and animal production.

3.3 Land Selection and Management Practices: Analyze **land selection and conservation practices that ensure optimal productivity** in crop production and livestock operations. Select best management practices that ensure the appropriate use of land resources and maximize crop yields.

3.4 Site Selection Factors: Identify **environmental factors, such as climate and topography, considered in site selection** to ensure optimal production and economic return in plant and animal production based on intended use and location (rural, suburban, and urban).

4. Principles of Environmental Science for Plant and Animal Production

4.1 Environmental Science Practices and Principles: Explain sustainable **environmental science practices and principles** applicable to food crops and animal production. Recommend management practices for rural, suburban, and urban settings, including a justification that incorporates soil and water conservation principles.

4.2 Pollution: Debate water, air, and noise **pollution issues associated with agricultural production**, and recommend control measures for rural, suburban, and urban areas. Demonstrate adherence to procedures for handling, storing, and disposing of production waste in compliance with relevant laws and regulations in a variety of plant and animal settings.

5. Principles of Animal Science for Agricultural Production

5.1 Breeds: Identify the major **breeds of food production animals**, such as cattle, sheep, goats, poultry, swine, and specialty animals, and their associated food and by-products. Explore the basic principles of animal science needed to produce healthy livestock for high-quality food products such as nutrition, reproduction, and breed selection.

5.2 Animal Science Basics: Identify and describe the **general growth and development processes** of food production animals. Analyze animal anatomy, physiology, genetics,

genomics, and reproduction in the context of animal growth and productivity, including the following:

a. animal types based on their anatomy and physiology;
b. components of animal reproductive systems and specific anatomical features of different food production species; and
c. genomic techniques used to enhance identified traits and characteristics.

5.3 Disease and Parasite Control: Determine **livestock disease and parasite control practices** essential to **maintain proper health and growth** of food production animals. Develop a disease and parasite prevention and treatment program for multiple food production species.

5.4 Nutrition: Research **principles of proper nutrition to maximize livestock gains and cost efficiency**.

a. Develop specific diet recommendations based on animal breed, available resources, costs, and nutritional requirements.
b. Differentiate between various diet alternatives to determine which feed ration is the most cost-effective to obtain maximum production.

5.5 Animal Genetics: Summarize how **heritability, selection intensity, and generation interval are important to genetic change** in food production animals, including the following:

a. Explain how each concept impacts genetic change.
b. Compare and contrast the characteristics of each as a tool for animal producers.
c. Determine how long it will take to get specific traits using each method.

6. Principles of Agribusiness for Plant and Animal Production

6.1 Economics of Crop and Livestock Production: Identify and critique **factors that influence the economics of crop and livestock production** in the United States and the world. Interpret production costs for various types of plant and animal operations that impact the wholesale cost of food.

6.2 Marketing Methods and Strategies: Explore and compare **marketing methods and strategies** to develop opportunities for specialty plant and animal products in niche markets.

6.3 Global Markets: Identify and describe the **American factors impacting global commodity markets**. Compare and contrast different factors that impact food prices in specific scenarios, such as the impact of a pandemic, economic sanctions, or weather on local food prices.

7. Plant and Animal Biotechnology

7.1 Biotechnology: Examine the role and importance of genetic principles in improving plant and animal production. Summarize important historical **achievements in plant and animal biotechnology.** Research current and e**merging plant and animal biotechnologies used in production agriculture**. Justify claims surrounding the ethical, legal, practical, and

economic issues related to food production and biotechnology with evidence drawn from scientific and professional resources.

8. Team Project and Data Analysis:

8.1 Team Project with Data Analysis: As a team, **identify a problem** related to the program of study as a whole. **Research and utilize the Engineering Design Process to design a solution**. Document the following steps in an engineering design notebook for inclusion in the program portfolio. When possible, connect the problem to an FFA Career Development Event.

a. **Problem Identification**: Brainstorm specific problems and challenges within the program of study. Conduct basic research to understand the scope and implications of the identified problem. Identify one problem as a focus area.
b. **Research and Analysis**: Conduct in-depth research on chosen topics related to the problem. Locate and analyze a dataset related to the problem.
c. **Review the Stages of the Engineering Design Process**: Define the problem, research, brainstorm solutions, develop prototypes, test and evaluate, and iterate. Consider constraints such as cost, efficiency, and environmental impact during the design process.
d. **Project Implementation**: Assign specific roles within the design teams (e.g., project manager, researcher, designer, tester). Design a solution tailored to address the identified problem or scenario. Document progress through design journals, sketches, diagrams, and digital presentations. (Note: Prototype is optional in the Year 2 course.)
e. **Presentation and Reflection**: Showcase the problem and solution to the class. Share the data that was analyzed and how it affected the solution. Discuss the design process and challenges. As a class, critically evaluate the effectiveness and feasibility of the solutions and propose potential improvements.

Standards Alignment Notes

References to other standards include:

- SAE for All: Evolving the Essentials: All Agriculture students are encouraged to participate in a Supervised Agricultural Experience (SAE) program to practice and demonstrate the knowledge and skills learned in their agriculture courses.
- AFNR: National Agriculture, Food, & Natural Resources (AFNR) Career Cluster Content Standards: Students engaged in the activities outlined above should be able to demonstrate fluency in Standards AS, BS, and PS at the conclusion of the course.
- P21: Partnership for 21st Century Skills Framework for 21st Century Learning
    - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

Food Science and Safety

Primary Career Cluster:	Agriculture, Food, & Natural Resources
Consultant:	CTE.Standards@tn.gov
Course Code:	C18H26
Prerequisite:	*Principles of Food Production* (C18H29)
Credit:	1
Grade Level:	11
Elective Focus - Graduation Requirements:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other Agriculture, Food, & Natural Resources courses. In addition, this course satisfies the third lab science credit requirement for graduation.
POS Concentrator	This course satisfies one out of two required courses to meet the Perkins V concentrator definition when taken in sequence in the approved program of study.
Programs of Study and Sequence:	This is the third course in the *Food Science* program of study.
Aligned Student Organization(s):	FFA: http://www.tnffa.org
Coordinating Work-Based Learning:	All Agriculture students are encouraged to participate in a Supervised Agricultural Experience (SAE) program. In addition, teachers who hold an active WBL certificate may offer placement for credit when the requirements of the state board's WBL Framework and the Department's WBL Policy Guide are met. For information, visit https://www.tn.gov/education/educators/career-and-technical-education/work-based-learning.html.
Promoted Tennessee Student Industry Credentials:	Credentials are aligned with postsecondary and employment opportunities and with the competencies and skills that students acquire through their selected program of study. For a listing of promoted student industry credentials, visit https://www.tn.gov/education/educators/career-and-technical-education/student-industry-certification.html.
Teacher Endorsement(s):	048, 150, 448, and 950
Required Teacher Certifications/Training:	None
Teacher Resources:	https://www.tn.gov/education/educators/career-and-technical-education/career-clusters/cte-cluster-agriculture-food-natural-resources.html Best for All Central: https://bestforall.tnedu.gov/

Course at a Glance

CTE courses provide students with an opportunity to develop specific academic, technical, and 21st century skills necessary to be successful in career and in life. In pursuit of ensuring every student in Tennessee achieves this level of success, we begin with rigorous course standards which feed into intentionally designed programs of study.

Students engage in industry relevant content through general education integration and experiences such as career and technical student organizations (CTSO) and work-based learning (WBL). Through these experiences, students are immersed with industry standard content and technology, solve industry-based problems, meaningfully interact with industry professionals and use/produce industry specific, informational texts.

Using a Career and Technical Student Organization (CTSO) in Your Classroom

CTSOs are a great resource to put classroom learning into real-life experiences for your students through classroom, regional, state, and national competitions, and leadership opportunities. Below are CTSO connections for this course, note this is not an exhaustive list.

- Participate in CTSO Fall Leadership Conference to engage with peers by demonstrating logical thought processes and developing industry specific skills that involve teamwork and project management.
- Participate in FFA career and leadership events (CDE/LDE) that align with this course including Agriscience Fair, Agricultural Issues, Meats Evaluation and Technology, and Milk Quality and Products

Using Work-Based Learning (WBL) in Your Classroom

Sustained and coordinated activities that relate to the course content are the key to successful work-based learning. Possible activities for this course include the following. This is not an exhaustive list.

- **Standards 1.1-1.4** | Visit a food production facility and have at least one of the manager's talking points include safety in the workplace.
- **Standards 2.1-2.3 and 5.1-5.3** | Have the students work with a food scientist on a real project.
- **Standards 3.1-3.2 and 6.1-7.3** | Have the students work on a real project that is evaluated by a food microbiologist.

Course Description

Food Science and Safety is an applied-knowledge course designed for students interested in careers in food science. The course covers fundamental principles of food science, food safety and sanitation, foodborne pathogens, and food-related standards and regulations. Upon completion of this course, students will be versed in the technical knowledge and skills necessary for further education and careers in food science.

Course Standards

1. Introduction to Food Science Industry and Careers

1.1 <u>Economic Impact:</u> Investigate the **food processing industry and describe its scope and economic importance** in the United States, including imports and exports. Describe how the study of food science and related sciences impacts the quality of life and enhances a Supervised Agricultural Experience (SAE) program.

1.2 Occupational Opportunities: Investigate the **occupational trends and opportunities in food processing and support industries.** Compare and contrast the knowledge, skills, and abilities necessary for employment, as well as the typical level of education required.

1.3 Food Science Industry Trends: Illustrate **significant trends with regard to supply and demand for processed food products across the world's population** and the degree to which these foods are processed. Identify and summarize common environmental and safety concerns regarding food production and the food supply.

1.4 Industry Safety: Review **common laboratory safety procedures** for tool and equipment operation in the food science laboratories, including but not limited to accident prevention and control procedures. Demonstrate the ability to follow safety and operational procedures in a lab setting and complete a safety test with 100 percent accuracy.

1.5 Food Processing Safety: Investigate the **measures taken to ensure the safety of the foods produced by the food processing industry**. Discuss the importance of formal and informal food processing safety training in the industrial environment. Including discussion of standardized training tools such as ServSafe for both food processors and food production retailers.

2. Food Chemistry

2.1 Physical properties: Differentiate between each food group and compare and contrast their nutritive values. Explain how the **chemical and physical properties of foods influence nutritional value and quality**. Examine the basic principles of proper nutrition, including the identification and evaluation of the six essential nutrients needed for good health.

2.2 Basic chemical process: Investigate and apply the **concepts of basic chemical processes and interactions between constituent components of foods**. Through experimentation and observation, identify chemical properties of food that are affected by production, processing, and storage.

2.3 Food additives: Identify **common food additives (preservatives, antioxidants, stabilizers, colors, and flavors) and describe their general purposes**. Summarize safety issues associated with food additives, assessing the extent to which the reasoning and evidence provided support their continued use or potential elimination.

3. Food Microbiology

3.1 Microorganisms: Examine the **role of microorganisms in food products** and evaluate their implications for human consumption.

3.2 Fermentation: Research **common microorganisms that cause fermentation, discuss the benefits or dangers of fermentation in food products and processing**. Illustrate fermentation techniques and the foods they are used to create, describing the basic chemical principles of fermentation and the factors that affect the fermentation process.

4. Food Preservation

4.1 Basic food preservation**:** Describe the **oldest methods of food preservation still in use** today (salting, smoking, drying, fermentation, cooling, and heating). Discuss the degree to which each of these techniques control spoilage and explore limitations to their use.

4.2 High technology food preservation: Explore the range of **food preservation techniques developed in the 20th and 21st** centuries to preserve foods (for example, modified atmosphere storage, irradiation, and chemical preservation). Discuss the advantages and disadvantages of each of these techniques and consumer attitudes toward them.

4.3 Food spoilage: Differentiate among the various **microorganisms that cause food spoilage and determine their life cycles**. Compare and contrast the application of food preservation methods to prevent the growth of microbes in food. Outline the processes for heating, refrigerating, and freezing for food preservation.

5. Food Safety and Sanitation

5.1 Foodborne illness: Identify the types and general **characteristics of microorganisms associated with foodborne illnesses**. Summarize safe food habits and practices by researching proper procedures for safe handling, storage, preparation, and cooking. Compose a checklist of general safety guidelines for different food groups, such as fruits and vegetables, red meat, fish, eggs, or dairy products.

5.2 Sanitation: Describe **procedures and inspection standards for sanitation in the food processing industry.** Demonstrate the ability to follow procedures for appropriate chemical selection, cleaning techniques, and insect and rodent control methods. Identify concepts and principles that provide the scientific foundation for current food sanitation standards.

5.3 Food industry inspection standards: Research principles and applications of the **Hazard Analysis and Critical Control Point (HACCP) system** and describe how they apply to **food safety. Interpret food industry inspection standards** to assess conditions related to food safety and sanitation. Create a model HACCP plan including a summary of procedures to control biological, chemical, and physical hazards in food production.

6. Food Safety Laws and Regulations

6.1 Food inspection standards: Analyze **state and federal laws and regulations governing food inspection standards** and explain their importance to public health. Define the roles of state and government agencies responsible for the establishment and enforcement of food safety regulations. Interpret the regulations governing the “Local Foods for Local Schools” program in Tennessee.

7. Food Science Trends and Issues

7.1 Blockchain: Analyze **blockchain processes being used in the food processing industry** from printed and digital creditable sources. Describe how blockchain technology revolutionizes the food supply chain with respect to food safety issues.

7.2 Current trends: Research **major development trends in the food processing industry** by analyzing documents authored by for-profit companies and lobbying organizations, defining the question(s) each seeks to address. Compare and contrast the use of advanced technologies in food production, such as but not limited to biotechnology, irradiation, and genetically modified organisms (GMOs), citing specific textual evidence. Summarize technological principles, process effects, and consumer concerns, referencing the extent to which reasoning and evidence presented for each supports specific claims.

7.3 Solving food science issues: Formulate a hypothesis regarding a current food related issue. **Design and conduct an original experiment to prove or disprove the hypothesis**. Collect the appropriate data to evaluate claims, synthesizing and communicating results within the broader context of food science.

Standards Alignment Notes

References to other standards include:

- SAE for All: Evolving the Essentials: All Agriculture students are encouraged to participate in a Supervised Agricultural Experience (SAE) program to practice and demonstrate the knowledge and skills learned in their agriculture courses.
- AFNR: National Agriculture, Food, & Natural Resources (AFNR) Career Cluster Content Standards: Students who are engaging in activities outlined above should be able to demonstrate fluency in Standards CR, FPP, and PS at the conclusion of the course.
- P21: Partnership for 21st Century Skills Framework for 21st Century Learning
    - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

Advanced Food Science

Primary Career Cluster:	Agriculture, Food, & Natural Resources
Course Contact:	CTE.Standards@tn.gov
Course Code:	C18H24
Prerequisite:	*Food Science and Safety* (C18H26)
Credit:	1
Grade Level:	12
Elective Focus - Graduation Requirements:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other Agriculture, Food, & Natural Resources courses. In addition, this course satisfies the third lab science credit requirement for graduation.
POS Concentrator:	This course satisfies one out of two required courses to meet the Perkins V concentrator definition when taken in sequence in the approved program of study.
Programs of Study and Sequence:	This is the fourth and final course in the *Food Science* program of study.
Aligned Student Organization(s):	FFA: http://www.tnffa.org
Coordinating Work-Based Learning:	All Agriculture students are encouraged to participate in a Supervised Agricultural Experience (SAE) program. In addition, teachers who hold an active WBL certificate may offer placement for credit when the requirements of the state board's WBL Framework and the Department's WBL Policy Guide are met. For information, visit https://www.tn.gov/education/educators/career-and-technical-education/work-based-learning.html.
Promoted Tennessee Student Industry Credentials:	Credentials are aligned with postsecondary and employment opportunities and with the competencies and skills that students acquire through their selected program of study. For a listing of promoted student industry credentials, visit https://www.tn.gov/education/educators/career-and-technical-education/student-industry-certification.html.
Teacher Endorsement(s):	048, 150, 448, and 950
Required Teacher Certifications/Training:	None
Teacher Resources:	https://www.tn.gov/education/educators/career-and-technical-education/career-clusters/cte-cluster-agriculture-food-natural-resources.html Best for All Central: https://bestforall.tnedu.gov/

Course at a Glance

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Students engage in industry-relevant content through general education integration and experiences such as career and technical student organizations (CTSO) and work-based learning (WBL). Through these experiences, students are immersed with industry-standard content and technology, solve industry-based problems, meaningfully interact with industry professionals, and use/produce industry-specific, informational texts.

Using a Career and Technical Student Organization (CTSO) in Your Classroom

CTSOs are a great resource to put classroom learning into real-life experiences for your students through classroom, regional, state, and national competitions, and leadership opportunities. Below are CTSO connections for this course, note this is not an exhaustive list.

- Participate in the CTSO Fall Leadership Conference to engage with peers by demonstrating logical thought processes and developing industry specific skills that involve teamwork and project management.
- Participate in FFA career and leadership events (CDE/LDE) that align with this course including Agriscience Fair, Agricultural Issues, Meats Evaluation, and Technology and Milk Quality and Products.

Using Work-Based Learning (WBL) in Your Classroom

Sustained and coordinated activities that relate to the course content are the key to successful work-based learning. Possible activities for this course include the following. This is not an exhaustive list.

- **Standards 1.1-1.4** | During a visit to a food processing plant, ask the manager to talk about safety in the workplace.
- **Standards 2.1-2.4, 4.1-4.3** | Have the students work with a butcher or in a meat department to prepare red meat products for retail sale.
- **Standards 3.1-3.5** | Have the students work with a local dairy processing facility or work with an industry representative to develop a value-added dairy product.
- **Standards 5.1-5.2** | Contact an agricultural inspector to talk with the class about equipment, crops, safety, sanitation, and quality control within the vegetable, fruit, and nut industries.
- **Standards 6.1-6.2** | Have the students do a project that is supervised or evaluated by a manager of a local company.
- **Standards 7.1-7.2** | Visit a local farmers market and have the students interview vendors on marketing strategies and develop and present an agricultural product marketing plan.
- **Standards 8.1-8.3** | Discuss consumer-related issues within the food processing industry with the food processing plant manager or marketing department representative.

Course Description

Advanced Food Science is an applied course designed to prepare students for further education and careers in food science and technology. This course covers advanced principles of food science, characteristics and properties of food products, processing, grading techniques and skills, and food labeling and packaging principles. Upon completion of this course, proficient students will be able to pursue advanced training in food science at a postsecondary institution.

Course Standards

1. Introduction to Food Processing

1.1 Occupational Trends: Investigate **real-time and projected local, regional, state, and national occupational trends** in the food science industry. Compare and contrast the **knowledge, skills, and abilities necessary for employment**, as well as the typical **level of education required**.

1.2 Overview of Food Science Principles: Summarize how **principles of food preservation are applied to the conversion of agricultural commodities into consumer products**. Determine how **food safety techniques are applied in the home, at retail establishments, and in commercial food processing environments** to benefit human health.

1.3 Laboratory Safety: Review common **laboratory safety procedures** for tool and equipment operation in food processing facilities and analysis laboratories, including but not limited to accident prevention and control procedures. Demonstrate the ability to follow safety and operational procedures in a lab setting and complete a safety test with 100 percent accuracy.

1.4 Recordkeeping: Demonstrate the ability to prepare **basic personal and business records** to complete taxes, employment, and SAE-related applications, including quality control records, resumes, budgets, income statements, balance sheets, cash flow statements, profit and loss statements, and equity statements.

2. Processing and Evaluation of Red Meat

2.1 Meat protein: Identify the **major species and breeds of livestock** utilized for red meat production. Describe the **fabrication, processing, packaging, and quality assessment** of red meats and their by-products.

2.2 Carcass inspection and grading: Analyze the United States Department of Agriculture (USDA) **inspection and grading procedures** and justify their purpose. Describe the principles of quality and yield grading. Perform the evaluation and grading of carcasses, wholesale cuts, and retail cuts to determine maturity, final quality grade, and final yield grade, and provide written and oral justification for evaluation conclusions.

2.3 Carcass processing: Explain **carcass preparation and fabrication procedures** and identify associated equipment, safety, sanitation, and quality control procedures. Identify **wholesale**

and retail cuts of meat and meat by-products, and correlate them to major muscle groups.

2.4 Further processing and value-added: Describe the different **methods of further processing fabrication for processed and value-added products** including comminuted meat products, emulsions, and cured meats by species. Calculate proper meat product formulations based on required protein levels and USDA allowances for various meat products.

3. Processing and Evaluation of Milk and Dairy Products

3.1 Dairy breeds: Identify major **breeds of livestock utilized for dairy production**. Describe the products, by-products, processing procedures, packaging requirements, and quality analysis associated with each breed.

3.2 Milk storage and transfer from the farm to the processor: Summarize the **requirements for a dairy farm to produce Grade A or Grade B raw milk**. Describe the procedures used to transfer bulk milk from the farm to the processing facility, ensuring quality and safety are conserved.

3.3 Milk and dairy products quality testing: Summarize **quality tests and testing procedures commonly used to produce milk and dairy products**. Perform quality evaluations of milk and dairy products, providing written and oral justification for evaluation conclusions.

3.4 Milk processing procedures: Describe **milk collection and processing procedures**, addressing procedures specific to equipment, safety, sanitation, and quality control. Analyze the composition of milk and examine concepts and principles that verify the scientific foundation for the pasteurization process.

3.5 Cultures and fermentation: Identify **varieties and characteristics of cultured and frozen milk products**. Identify and explain the processes, procedures, and typical microorganisms used to produce buttermilk, yogurt, and sour cream.

3.6 Cheese Processing: Identify **varieties, characteristics, and classifications of cheeses**. Demonstrate in a live setting or presentation format the ability to follow procedures used to process, classify, and grade cheese, attending to appropriate ratios and units.

4. Processing and Evaluation of Poultry, Eggs, and Fish

4.1 Breed and species**:** Identify major **poultry breeds utilized for meat and egg production**. Describe the fabrication, processing, packaging, and quality determination of poultry meat and eggs.

4.2 Inspection and grading: Outline the United States Department of Agriculture (USDA) **inspection procedures and system for classes, standards, and grades of poultry products**. Perform the evaluation and grading of carcasses and parts of chickens and turkeys, pre-cooked, further processed, and poultry meat products, providing written and

oral justification for evaluation and grading scores. Evaluate and grade eggs for interior and exterior quality and provide written and oral justification for evaluation conclusions.

4.3 Breed and species**:** Identify major **fish, shellfish, and crustaceans (seafood) consumed in the US**. Describe the fabrication, processing, packaging, and quality determination of each type of seafood.

4.4 Inspection and grading: Outline the Food and Drug Administration (FDA) **inspection procedures and system for classes, standards, and grades of seafood products**. Perform the evaluation and grading of seafood, providing written and oral justification for evaluation and grading scores. Evaluate and grade seafood products and provide written and oral justification for evaluation conclusions.

4.5 Processing: Compare and contrast the **carcass preparation and fabrication procedures for poultry and seafood**, addressing procedures specific to equipment, safety, sanitation, and quality control.

5. Processing and Evaluation of Vegetables, Fruits, and Nuts

5.1 Processing, packaging, and quality: Explain the **processing, packaging, and quality analysis of vegetables, fruits, and nut products**. Explain the use of various monitoring systems to appraise food quality, such as the Brix scale and USDA grade standards.

5.2 By-products: Describe **preparation and processing procedures for vegetables, fruits, and nut by-products**, addressing procedures specific to equipment, safety, sanitation, and quality control.

6. Food Product Packaging and Labeling

6.1 Packaging and labeling: Identify **laws regulating the packaging and labeling of food products** and summarize industry requirements. Perform packaging and labeling procedures for different food products.

6.2 Storage and transportation: Research **storage and transportation issues about packaged food products** and the extent to which these issues affect safety and quality.

7. Food Product Marketing

7.1 Marketing: Explain the **fundamental economic principles such as supply, demand, and profit to the food science industry**. Describe marketing considerations and methods of merchandising food products. Discuss how quality, yield, and grade factors affect product marketing.

7.2 Blockchain: Compare and contrast various **blockchain technologies used in the food science** industry. Articulate how these technologies are changing, and how foods are produced and marketed in the United States and globally.

8. Consumer Issues

8.1 Consumer interest, trends, and satisfaction: Assess the **impact of organic, natural, ethnic, religion-based, and other specialized processing methods** in the food industry. Compare and contrast the advantages and disadvantages of value-added and specialty products. Evaluate and summarize **consumer interests, trends, and satisfaction as related to these products i**ncluding the impact of product recalls.

8.2 Product development process: Investigate the **food product development process**. Evaluate the use of **food batch procedures** for economic efficiency. Describe the application of **sensory evaluation methods** to test food product flavor, appearance, and texture by quantitative description and simple difference testing.

8.3 Consumer concerns: Identify **consumer concerns related to food quality and safety,** (such as antibiotic use, genetically modified organisms (GMOs), pesticide use, and food-borne illnesses), and discuss the economic implications of low-quality and unsafe foods entering the market.

8.4 Industry response to changing consumer demand: Investigate the **implications of changing consumer demand on the food production industries**. Include issues such as demand for reduced calories, reduced fat, removal of specific fats, carbohydrates, or other ingredients, and preservatives.

Standards Alignment Notes

References to other standards include:

- SAE for All: Evolving the Essentials: All Agriculture students are encouraged to participate in a Supervised Agricultural Experience (SAE) program to practice and demonstrate the knowledge and skills learned in their agriculture courses.
- AFNR: National Agriculture, Food, & Natural Resources (AFNR) Career Cluster Content Standards: Students engaged in the activities outlined above should be able to demonstrate fluency in Standards ABS, CS, and FPP at the conclusion of the course.
- P21: Partnership for 21st Century Skills Framework for 21st Century Learning
    - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

Principles of Plant Science and Hydroculture

Primary Career Cluster:	Agriculture, Food, & Natural Resources
Course Contact:	CTE.Standards@tn.gov
Course Code(s):	C18H30
Prerequisite:	*Agriscience* (C18H19)
Credit:	1
Grade Level:	10
Elective Focus-Graduation Requirements:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other Agriculture, Food, & Natural Resources courses.
POS Concentrator:	This course satisfies one out of two required courses to meet the Perkins V concentrator definition when taken in sequence in the approved program of study.
Programs of Study and Sequence:	This is the second course in the *Horticulture Science* program of study.
Aligned Student Organization:	FFA: http://www.tnffa.org
Coordinating Work-Based Learning:	All Agriculture students are encouraged to participate in a Supervised Agricultural Experience (SAE) program. In addition, teachers who hold an active WBL certificate may offer placement for credit when the requirements of the state board's WBL Framework and the Department's WBL Policy Guide are met. For information, visit https://www.tn.gov/education/educators/career-and-technical-education/work-based-learning.html.
Promoted Tennessee Student Industry Credentials:	Credentials are aligned with postsecondary and employment opportunities and with the competencies and skills that students acquire through their selected program of study. For a listing of promoted student industry credentials, visit https://www.tn.gov/education/educators/career-and-technical-education/student-industry-certification.html.
Teacher Endorsement(s):	048, 150, 448, and 950
Required Teacher Certification:	While not required to teach this course in a greenhouse facility or an outdoor lab (cold frame, nursery, etc.), if chemicals (with an EPA label) are used, the teacher must obtain Commercial Pesticide Applicators License (C10).
Required Teacher Training:	None
Teacher Resources:	https://www.tn.gov/content/tn/education/educators/career-and-technical-education/career-clusters/cte-cluster-agriculture-food-natural-resources.html/ Best for All Central: https://bestforall.tnedu.gov/

Course at a Glance

CTE courses provide students with an opportunity to develop specific academic, technical, and 21st-century skills necessary to be successful in careers and life. In pursuit of ensuring every student in Tennessee achieves this level of success, we begin with rigorous course standards that feed into intentionally designed programs of study.

Students engage in industry-relevant content through general education integration and experiences such as career and technical student organizations (CTSO) and work-based learning (WBL). Through these experiences, students are immersed with industry-standard content and technology, solve industry-based problems, meaningfully interact with industry professionals, and use/produce industry-specific, informational texts.

Using a Career and Technical Student Organization (CTSO) in Your Classroom

CTSOs are a great resource to put classroom learning into real-life experiences for your students through classroom, regional, state, and national competitions, and leadership opportunities. Below are CTSO connections for this course; note this is not an exhaustive list.

- Participate in the CTSO Fall Leadership Conference to engage with peers by demonstrating logical thought processes and developing industry-specific skills that involve teamwork and project management.
- Participate in FFA career and leadership events (CDE/LDE) that align with this course including Agriscience Fair, Agricultural Communications, Agricultural Issues, Agronomy, Extemporaneous Speaking, Environmental & Natural Resources, Land Judging and Evaluation, and Prepared Public Speaking.

For more ideas and information, view https://tnffa.org/.

Using Work-Based Learning (WBL) in Your Classroom

Sustained and coordinated activities that relate to the course content are the key to successful work-based learning. Possible activities for this course include the following. This is not an exhaustive list.

- **Standards 1.1-2.3** | Invite an industry representative to talk about the impact of plant science on our society and environment.
- **Standard 3.1-8.2** | Have the crop specialist or master gardener work with students on a real project.
- **Standard 9.1-9.5** | Participate in virtual or in-person tours with hydroponics and aquaponics facilities and discuss the concepts of growing plants and animals in non-traditional environments.

Course Description

Principles of Plant Science and Hydroculture focus on essential knowledge and skills related to the science of plant growth. This course covers principles of plant health, growth, reproduction, and biotechnology, as well as fundamental principles of hydroponics and aquaponics. Upon completion of this course, proficient students will be prepared for more advanced coursework in horticulture science.

Course Standards

1. Safety

1.1 Safety: Differentiate **general occupational safety prevention and control standards** as related to the plant science and hydroculture industry. Apply concepts of safety procedures to complete the safety test with 100 percent accuracy.

2. Plants, Society, and the Environment

2.1 Plants' Role in Society: Investigate the **roles of cultivated plants** in meeting the **food, fiber, fuel, medicinal, aesthetic, and occupational needs** of society. Identify and describe the different domains of the horticulture industry. Examine **current issues and trends affecting horticultural professionals** in the industry.

2.2 Human Impact: Distinguish between the **psychological and physiological benefits of plants** on humans.

2.3 Environmental Impacts: Summarize the impact and patterns of **environmental factors on plant biodiversity**. Describe important characteristics of the **relationships between plants and other organisms**, including basic plant-human interactions, plant-animal interactions, and plant adaptation.

3. Plant Structure and Function

3.1 Plant Cells: Depict the **parts of plant cells**. Examine the **structure and outline the functions** of plant cell walls, chloroplast, central vacuole, and plasmodesmata.

3.2 Plant Anatomy: Analyze **plant anatomy and physiology** and relate key concepts to the **processes and requirements** involved in plant growth and productivity.

3.3 Vegetable Plants: Differentiate between **monocot and dicot vegetable plants,** including but not limited to root, stem, and leaf modifications.

4. Plant Nutrition

4.1 Essential Nutrients: Analyze the **nutrient requirements of plants** and assess the importance of **essential plant nutrients** to plant growth and development. Illustrate the **chemical and biological processes,** including photosynthesis and nitrogen fixation by bacteria, that make nutrients available to plants for growth and maintenance.

4.2 Fertilizers: Describe the use of **fertilizers as a source of essential plant nutrients**. Describe the **advantages and limitations of various fertilizer application methods**. Calculate **fertilizer formulations** and perform different methods of fertilizer applications.

4.3 Nutritional Plant Health: Research the **nutritional factors that influence plant health** to identify **nutritional deficiencies and disorders**. Distinguish between the signs of different nutrient deficiencies in plants and recommend appropriate treatments.

5. Principles of Soil Science

5.1 Classify Soils: Evaluate the **physical and chemical properties of soils**. Perform technical procedures to classify soils by evaluating **biotic and abiotic factors,** such as soil pH, texture, permeability, and water-holding capacity. Interpret test results to identify deficiencies and formulate appropriate corrective actions.

5.2 Soil Quality: Describe factors that influence **soil quality and erosion**. Assess the extent to which reasoning and evidence support the use of a **specific soil conservation practice** for maintaining healthy growing media for plants.

5.3 Land Selection and Practices: Cite specific evidence for the analysis of **land selection and conservation practices** that ensure optimal productivity and stewardship. Identify factors that affect site selection for plant growth and draw evidence from multiple authoritative sources to appraise and justify management practices that ensure the appropriate use of land resources.

6. Plant Diseases and Pests

6.1 Plant Diseases and Pest Control: Research the principles of **disease and pest control** for plant health, growth, and maintenance. Analyze the effects of **different types of plant pests and diseases**; prescribe **methods** for pest and disease prevention and treatment.

6.2 Chemical Use: Demonstrate an understanding of common classes of **chemicals used for pest management**. Gather and evaluate information regarding **PPE (Personal Protective Equipment) for chemical application** and demonstrate appropriate use of PPE. Create a checklist for safe storage and handling of pesticides.

7. Plant Breeding, Genetics, and Genomics

7.1 Plant Sexual Reproduction: Analyze the **stages of sexual reproductive stages in plants** as they pertain to the following:

a. a plant's life cycle;
b. development of male and female gametophytes (reproductive structures);
c. explain the significance of mitosis and meiosis in the development of reproductive structures; and
d. pollination and the process of self-pollination and cross-pollination.

7.2 Vegetative Plant Propagation: Evaluate **vegetative plant propagation techniques** utilized in both agriculture and horticulture production in the following areas:

a. plant characteristics,
b. natural and artificial asexual methods of reproduction, and
c. advantages and disadvantages of each method.

7.3 Basic Genetics in Plant Breeding: Investigate the role of DNA, heritability, and **genetic applications in plant breeding** and compose an informative essay that describes how mutation, gene flow, and adaption influence plant populations. Identify **desirable traits in various plant species** and predict the probable outcome of genetic crosses based on Mendel's laws.

7.4 Genomics in Plant Science: Explain how the **principles of genetics and genomics** apply to the advances in plant science, including the acceleration of genetic selection, mapping of complex traits, and mapping of disease structures.

8. Plant Biotechnology

8.1 Historical Achievements: Distinguish the branches of science that influence **plant biotechnology** and summarize **important historical achievements**. Examine the **role and importance of genetic principles** to improve plant characteristics and perform basic plant DNA extraction procedures.

8.2 Plant Biotechnologies: Research **current and emerging plant biotechnologies** to support a claim supporting or opposing the use of a specific biotechnology in horticulture. Justify and debate **ethical, legal, and economic issues surrounding plant biotechnology.**

9. Fundamentals of Hydroponics and Aquaponics

9.1 Technologies: Evaluate the significance of **hydroponics and aquaponics technology** as related to sustainable practices and principles. Compare and contrast production systems and techniques utilized in the hydroponics and aquaponics fields, including structures and equipment, production methods, and common crops.

9.2 Soilless Growing: Assess the functions, attributes, and **desirable properties of soilless growing media**. Describe the **major components of soilless media**, identifying basic physical and chemical characteristics.

9.3 Hydroponic and Aquaponics Production: Apply concepts learned in this course to visually identify common plant and animal species used for **hydroponic and aquaponic production**, and distinguish between their **structural and physiological differences**, as well as their specific production applications.

9.4 Water Quality: Examine the role that water chemistry plays in the development of **water quality for plant and animal production**. Demonstrate the ability to perform **common tests to evaluate water quality factors**, including pH, hardness, ammonium, nitrate, nitrite, dissolved oxygen, and ammonia levels.

9.5 Environmental Conditions: Analyze the effects of **environmental conditions on aquatic plant and animal life**. Calculate **proper formulations of chemicals** based on label directions to adjust water quality factors.

10. Team Project and Data Analysis

10.1 Team Project with Data Analysis: As a team, **identify a problem** related to the program of study as a whole. **Research and utilize the Engineering Design Process to design a solution**. Document the following steps in an engineering design notebook for inclusion in the program portfolio. When possible, connect the problem to a FFA Career Development Event.

a. **Problem Identification**: Brainstorm specific problems and challenges within the program of study. Conduct basic research to understand the scope and implications of the identified problem. Identify one problem as a focus area.
b. **Research and Analysis**: Conduct in-depth research on chosen topics related to the problem. Locate and analyze a dataset related to the problem.
c. **Review the Stages of the Engineering Design Process**: Define the problem, research, brainstorm solutions, develop prototypes, test and evaluate, and iterate. Consider constraints such as cost, efficiency, and environmental impact during the design process.
d. **Project Implementation**: Assign specific roles within the design teams (e.g., project manager, researcher, designer, tester). Design a solution tailored to address the identified problem or scenario. Document progress through design journals, sketches, diagrams, and digital presentations. (Note: Prototype is optional in the Year 2 course.)
e. **Presentation and Reflection**: Showcase the problem and solution to the class. Share the data that was analyzed and how it affected the solution. Discuss the design process and challenges. As a class, critically evaluate the effectiveness and feasibility of the solutions and propose potential improvements.

Standards Alignment Notes

References to other standards include:

- SAE for All: Evolving the Essentials: All Agriculture students are encouraged to participate in a Supervised Agricultural Experience (SAE) program to practice and demonstrate the knowledge and skills learned in their agriculture courses.
- AFNR: National Agriculture, Food, & Natural Resources (AFNR) Career Cluster Content Standards: Students engaged in the activities outlined above should be able to demonstrate fluency in Standards BS and PS at the conclusion of the course.
- P21: Partnership for 21st Century Skills Framework for 21st Century Learning
    - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

Greenhouse Management

Primary Career Cluster:	Agriculture, Food, & Natural Resources
Course Contact:	CTE.Standards@tn.gov
Course Code:	C18H17
Prerequisite:	*Principles of Plant Science and Hydroculture* (C18H30)
Credit:	1
Grade Level:	11
Elective Focus - Graduation Requirements:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other Agriculture, Food, & Natural Resources courses
POS Concentrator:	This course satisfies one out of two required courses to meet the Perkins V concentrator definition when taken in sequence in the approved program of study.
Programs of Study (POS) Sequence:	This is the third course in the *Horticulture Science* program of study.
Aligned Student Organization(s):	FFA: http://www.tnffa.org
Coordinating Work-Based Learning:	All Agriculture students are encouraged to participate in a Supervised Agricultural Experience (SAE) program. In addition, teachers who hold an active WBL certificate may offer placement for credit when the requirements of the state board's WBL Framework and the Department's WBL Policy Guide are met. For information, visit https://www.tn.gov/education/educators/career-and-technical-education/work-based-learning.html
Promoted Tennessee Student Industry Credentials:	Credentials are aligned with postsecondary and employment opportunities and with the competencies and skills that students acquire through their selected program of study. For a listing of promoted student industry credentials, visit https://www.tn.gov/education/educators/career-and-technical-education/student-industry-certification.html
Teacher Endorsement(s):	048, 150, 448, and 950
Required Teacher Certification:	While not required to teach the course, teachers who use a greenhouse facility or an outdoor lab (cold frame, nursery, etc.) that uses any type of chemical (with an EPA label) must have the Commercial Pesticide Applicators License for C10.
Required Teacher Training:	None
Teacher Resources:	https://www.tn.gov/education/educators/career-and-technical-education/career-clusters/cte-cluster-agriculture-food-natural-resources.html Best for All Central https://bestforall.tnedu.gov/

Course at a Glance

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Students engage in industry-relevant content through general education integration and experiences such as career & technical student organizations (CTSO) and work-based learning (WBL). Through these experiences, students are immersed with industry-standard content and technology, solve industry-based problems, meaningfully interact with industry professionals, and use/produce industry-specific, informational texts.

Using a Career and Technical Student Organization (CTSO) in Your Classroom

CTSOs are a great resource to put classroom learning into real-life experiences for your students through classroom, regional, state, and national competitions, and leadership opportunities. Below are CTSO connections for this course, note this is not an exhaustive list.

- Participate in the CTSO Fall Leadership Conference to engage with peers by demonstrating logical thought processes and developing industry-specific skills that involve teamwork and project management.
- Participate in FFA career and leadership events (CDE/LDE) that align with this course including Agriscience Fair, Agricultural Communications, Agricultural Issues, Agricultural Sales, Extemporaneous Speaking, Floriculture, and Prepared Public Speaking.

Using Work-Based Learning (WBL) in Your Classroom

Sustained and coordinated activities that relate to the course content are the key to successful work-based learning. Possible activities for this course include the following. This is not an exhaustive list.

- **Standards 1.1.3** | Invite an industry representative site to talk about career opportunities and skills and training required for employment.
- **Standards 2.1-8.4** | Have students develop projects with or evaluated by a greenhouse manager.
- **Standards 9.1-9.2** | Visit virtually or in person a hydroponic facility and discuss the advantages of using hydroponic production systems.
- **Standards 10.1-10.2** | Have a greenhouse manager evaluate student-developed production schedules.

Course Description

Greenhouse Management is an applied knowledge course designed to prepare students to manage greenhouse operations. This course covers principles of greenhouse structures, plant health and growth, growing media, greenhouse crop selection and propagation, and management techniques. Upon completion of this course, proficient students will be equipped with the technical knowledge and skills needed to prepare for further education and careers in horticulture production. Greenhouse Management is a dual credit course with statewide articulation.

Course Standards

1. Introduction to the Greenhouse Industry

1.1 Impact and Advancements: Summarize the historical development of the greenhouse production industry. Analyze the **global nature of the horticulture industry** and explain the **economic impact and technological advancements** associated with the greenhouse industry.

1.2 Recordkeeping and SAE: Accurately maintain **an active recordkeeping system** and apply **proper financial recordkeeping skills** as they relate to the greenhouse industry. Demonstrate the ability to develop, and analyze records, generate reports, and complete related applications and reports. (i.e., employment applications, efficiency reports, SAE applications, and profit and loss statements).

1.3 Safety: Apply the concepts of **occupational safety and safety prevention** and control standards by interpreting industry manuals information.

a. Assess and explain the concepts of the **worker protection standards**.
b. Review common laboratory **safety procedures for tool and equipment** operation in horticulture laboratories, including but not limited to accident prevention and control procedures. Demonstrate the ability to follow **safety and operational procedures** in a lab setting and complete a safety test with 100 percent accuracy.

2. Greenhouse Design, Construction, and Components

2.1 Structures: Classify **structures** by comparing and contrasting their **controlled environment system** (greenhouse, high tunnel, cold frame, vertical farming, hydroponics, etc.), **and construction materials** including but not limited to frames, coverings, and glazing materials. Justify the selection of the structure's construction materials based on cost-effectiveness, stability, maintenance, and function.

2.2 Planning and Design: Describe the **characteristics of successful greenhouses** and create a list of **factors for planning and designing greenhouse facilities**. Factors must include physical location, market potential, utilities, climatic conditions, and production goals.

2.3 Design: Create an annotated model representing research-based practices in **greenhouse planning and design** and justify the process outlined for specific crops. The design must include at least the following items: structure materials, layout, lighting, bench arrangements, traffic flow, and physical location.

2.4 Structure Maintenance: Compare **general maintenance and upkeep requirements for a variety of greenhouses** in relation to the **type of structural framework** and associated systems. Explain prescribed **maintenance**, preventative maintenance, **monitoring, and troubleshooting schedules** for greenhouse facilities and equipment. Demonstrate the **mechanical skills needed** for the general maintenance and repair of greenhouse structures

and associated systems:(such as framework, equipment, electric motors, basic wiring, plumbing, and general construction).

3. Growing Media

3.1 Types of Growing Media: Explain the **types and utility of the attributes of growing media**. Describe the **major components of soil** and other growing media, and identify basic physical and chemical **characteristics** including structure, texture, alkalinity, water holding capacity, and drainage.

3.2 Plant Nutrients and Formulations: Identify the **effects of soil and soilless compositions** (pH, organic matter content, and mineral content) on **plant health and growth**. Perform **basic soil sampling and testing techniques** and interpret test data to formulate corrective actions as needed.

3.3 Preparation of Growing Media: Explain the **principles of media preparation**; develop a **check sheet** to guide media preparation. Describe the purpose, methods, and importance of **sterilizing media**. Compare and contrast the **cost-effectiveness** of premix and personal mix media to soil mix.)

4. Plant Structure, Function, and Growth

4.1 Plant Identification: Apply concepts of **scientific taxonomy and industry-specific terminology** in distinguishing **different species and types of plants grown** in a controlled environment:

a. common vegetable plants,
b. common bedding plants, and
c. common herb plants.

4.2 Plant Structure and Function: Determine the basic **plant structure components that affect plant growth and development**. Differentiate between the:

a. relationship between form and function for major plant structures and
b. anatomical and physiological differences of specific plant species.

4.3 Processes for Plant Life: Explain the **interrelationships between light, temperature, and water to the plant life processes (**such as photosynthesis, respiration, and transpiration), plant growth, and maintenance.

4.4 Growth Regulators: Compare and contrast current industry-approved **methods to regulate plant growth** including, but not limited to, environmental, physical, genetic, and chemical.

5. Plant Nutrition

5.1 Nutrient Requirements and Deficiencies: Analyze the **nutrient requirements of plants** and assess the importance of the 17 essential plant nutrients for plant health. Identify the **chemical and biological processes needed** to make nutrients available for growth and maintenance, and distinguish among **nutrient deficiency and toxicity signs and symptoms** in plants.

5.2 Fertilizer Safety: Determine the significant **safety hazards associated with fertilizer use**. Evaluate the use of different precautions for the prevention or management of hazards and evaluate the efficacy of prevention measures.

5.3 Fertilizer Application: Identify the basic **types of fertilizers and their applications** for greenhouse production crops. Differentiate the effects of **fertilizer ratios** on plant growth and health to hypothesize possible outcomes of each ratio. Calculate **proper formulations** of fertilizers based on label directions using systems of equations. Demonstrate the ability to follow **fertilizer label procedures** precisely as they pertain to the selection, handling, application, storage, and disposal.

6. Plant Propagation

6.1 Plant Propagation Methods: Differentiate between the **methods of sexual and asexual plant propagation**. Compare and contrast the following **techniques of propagation**, explaining the **advantages and disadvantages** of each: cutting, budding, layering, sowing, germination rate calculation, and seed viability.

7. Environmental Control Systems

7.1 Controlled Environment Production: Assess the **procedures** required for **producing multiple commercial plant species in a controlled environment**, and apply these procedures to produce a variety of specific greenhouse crops. Evaluate e**nvironmental factors that affect greenhouse crops** to justify management methods.

7.2 Climate Control Equipment: Evaluate the **greenhouse climate** and recommend the **proper climate control equipment** to maintain an **optimum growing climate**, including but not limited to ventilation, humidifiers, heating, cooling, and shading. Provide written justification for each recommendation.

7.3 Water Management: Demonstrate effective methods to meet **water requirements for healthy plant growth**. Examine and explain how water pH influences plant growth. Research from multiple technical texts on the **function and operating principles of greenhouse irrigation systems** (such as misting, drip, and overhead systems) to meet watering requirements to maintain the optimum moisture level for a variety of plants.

8. Diseases, Disorders, and Pests

8.1 Identification, Prevention, Treatment, and Control: Determine the **economic and aesthetic impact of plant diseases, disorders, and pests**. Identify and diagnose the **symptoms** of common plant diseases, disorders, and pests, and summarize **methods of prevention**, **treatment, and control** by drawing evidence from informational texts and relevant scientific literature.

8.2 Pesticide Application: Identify the **types of pesticides** and their **applications** for greenhouse production. Research the **safety hazards associated with pesticide use** for multiple greenhouse pesticides. Calculate **proper formulations of pesticides** based on label directions for specific pests by creating systems of equations that describe numerical relationships.

8.3 Pesticide Safety: Demonstrate the ability to follow **pesticide procedures** precisely according to **label and safety guidelines**, including selection, handling, personal protective equipment (PPE), application, storage, and disposal.

8.4 Integrated Pest Management: Evaluate the basic principles and assess the overall effectiveness of **integrated pest management (IPM)** for controlling greenhouse pests and diseases. Compare with **traditional chemical controls**.

9. Hydroponic Applications

9.1 Hydroponic Systems: Examine the types of **hydroponic systems** in **greenhouse crop production**. Describe **essential elements** of hydroponic systems; explore **recent trends and advancements** to design a hydroponic system for a specific greenhouse crop.

9.2 Soilless Media Systems: Compare **hydroponic and soil-based growing methods for providing nutrients to plants**. Summarize the **advantages and disadvantages** of using soilless media systems to evaluate the efficacy of specific crops.

10. Greenhouse Business Management

10.1 Business Operations: Debate **laws and regulations affecting horticulture businesses**. Demonstrate the **use of general business, recordkeeping skills, and spreadsheet skills** necessary to manage a horticultural business, including but not limited to marketing, advertising, product displays, scheduling, inventory control, merchandise handling, price point projections, and profit and loss statements.

10.2 Production Schedules: Research, develop, and implement **greenhouse production schedules for a representative sampling of greenhouse crops** that includes at least the following: plant selection, plant material cost (seed, plug, cuttings), growth media, fertilizers, water, testing kits, pricing guides, profit margin, labor, and other expenses.

Standards Alignment Notes

References to other standards include:

- SAE for All: Evolving the Essentials: All Agriculture students are encouraged to participate in a Supervised Agricultural Experience (SAE) program to practice and demonstrate the knowledge and skills learned in their agriculture courses.
- AFNR: National Agriculture, Food, & Natural Resources (AFNR) Career Cluster Content Standards: Students who are engaging in the activities outlined above should be able to demonstrate fluency in Standards AS, CS, and PS at the conclusion of the course.
- P21: Partnership for 21st Century Skills Framework for 21st Century Learning
    - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

Landscaping and Turf Science

Primary Career Cluster:	Agriculture, Food, & Natural Resources
Course Contact:	CTE.Standards@tn.gov
Course Code(s):	C18H16
Prerequisite(s):	*Greenhouse Management* (C18H17) or SDC: Introduction to Plant Science (C18H09)
Credit:	1
Grade Level:	12
Elective Focus - Graduation Requirements:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other Agriculture, Food, & Natural Resources courses. In addition, this course satisfies the *Fine Arts* requirement for graduation.
POS Concentrator:	This course satisfies one out of two required courses to meet the Perkins V concentrator definition when taken in sequence in the approved program of study.
Programs of Study and Sequence:	This is the fourth course in the *Horticulture Science* program of study.
Aligned Student Organization(s):	FFA: http://www.tnffa.org
Coordinating Work-Based Learning:	All Agriculture students are encouraged to participate in a Supervised Agricultural Experience (SAE) program. In addition, teachers who hold an active WBL certificate may offer placement for credit when the requirements of the state board's WBL Framework and the Department's WBL Policy Guide are met. For information, visit https://www.tn.gov/education/educators/career-and-technical-education/work-based-learning.html
Promoted Tennessee Student Industry Credentials:	All Agriculture students are encouraged to participate in a Supervised Agricultural Experience (SAE) program. In addition, teachers who hold an active WBL certificate may offer placement for credit when the requirements of the state board's WBL Framework and the Department's WBL Policy Guide are met. For information, visit https://www.tn.gov/education/educators/career-and-technical-education/student-industry-certification.html
Teacher Endorsement(s):	048, 150, 448, and 950
Required Teacher Certification:	None
Required Teacher Training:	None
Teacher Resources:	https://www.tn.gov/education/educators/career-and-technical-education/career-clusters/cte-cluster-agriculture-food-natural-resources.html Best for All Central https://bestforall.tnedu.gov/

Course at a Glance

CTE courses provide students with an opportunity to develop specific academic, technical, and 21st-century skills necessary to be successful in their careers and lives. In pursuit of ensuring every student in Tennessee achieves this level of success, we begin with rigorous course standards that feed into intentionally designed programs of study.

Students engage in industry-relevant content through general education integration and experiences such as career & technical student organizations (CTSO) and work-based learning (WBL). Through these experiences, students are immersed with industry-standard content and technology, solve industry-based problems, meaningfully interact with industry professionals, and use/produce industry-specific, informational texts.

Using a Career and Technical Student Organization (CTSO) in Your Classroom

CTSOs are a great resource to put classroom learning into real-life experiences for your students through classroom, regional, state, and national competitions, and leadership opportunities. Below are CTSO connections for this course. This is not an exhaustive list.

- Participate in the CTSO Fall Leadership Conference to engage with peers by demonstrating logical thought processes and developing industry-specific skills that involve teamwork and project management.
- Participate in FFA career and leadership events (CDE/LDE) that align with this course including Agriscience Fair, Agricultural Communications, Agricultural Issues, Agricultural Sales, Extemporaneous Speaking, Floriculture, Nursery Landscaping, and Prepared Public Speaking.

Using Work-Based Learning (WBL) in Your Classroom

Sustained and coordinated activities that relate to the course content are the key to successful work-based learning. Possible activities for this course include the following. This is not an exhaustive list.

- **Standards 1.1-1.2** | During a visit to a local industry site, have the manager talk about safety in the workplace.
- **Standards 3.1-4.3 |** Have the students work with a landscaper on a real project.
- **Standards 5.1-5.2** | Have the students work with an interior landscaper in the field.
- **Standards 6.1-6.2** | Contact a nursery manager or landscaper to talk with the class about pest management and include their role as manager.
- **Standards 7.1-8.3** | Work on-site with a nursery or turfgrass technician.
- **Standards 9.1-9.3** | Have the students do a modified internship or a project with a landscaper.

Course Description

Landscaping and Turf Science is an applied course designed to provide challenging academic standards and relevant technical knowledge and skills needed for further education and careers in landscape design, maintenance, and turf management. Content includes site analysis and planning, principles of design, and plant selection and care techniques. Upon completion of this course, proficient students will be prepared to pursue advanced study of landscaping and turf science at a postsecondary institution.

Course Standards

1. Introduction to Landscaping and Turf Management

1.1 Career Awareness: Gather and analyze **labor data** from sources such as the United States Bureau of Labor Statistics and the Tennessee Department of Labor to predict the employment outlook in landscaping and turf management careers. Summarize the **interpersonal, business, and technical skills** needed for a career in landscaping or turf management. Develop a resume for a selected occupation that includes documented development of **industry-related skills** (i.e., work experience, SAE records, and proficiency applications).

1.2 Occupational Safety: Explain **general occupational and horticulture industry safety standards**. Identify commonly used machinery and equipment and develop a checklist of associated safety and maintenance procedures. Assess and explain the concepts of the **worker protection standards**, and complete required safety tests with 100 percent accuracy.

2. Tree and Shrub Selection and Maintenance

2.1 Nursery Plant Identification and Use: Identify the **basic parts of trees and shrubs**. Demonstrate the ability to visually identify and distinguish between the **common tree and shrub species used for landscaping** and describe research-based practices in harvesting, transportation, transplanting, and care.

2.2 Nursery Plant Care and Maintenance: Summarize methods for **general care and maintenance of trees and shrubs**, including planting, pruning, mulching, irrigation, and fertilizing techniques. Justify the importance of **site evaluation, preparation, and consideration of hardiness zones** in the selection of trees and shrubs.

3. Landscaping Plant Selection and Maintenance

3.1 Selection of Ground Cover, Vines, and Plants: Visually **identify and distinguish** among **common ground cover, vines, and plants** used for landscaping. Evaluate the **function, form, and growth requirements** for common **perennials, annuals, and biennials.**

3.2 Care and Maintenance of Ground Cover, Vines, and Plants: Assess methods for **general care and maintenance of ground cover, vines, and plants**, including planting, pruning, mulching, and fertilizing techniques. Recommend **specific vines and ground covers to solve special landscaping issues**, and justify recommendations with technical evidence.

4. Turf Grass Selection and Maintenance

4.1 Turfgrass Species Selection: Compare and contrast the functions and components of common **turfgrass species**. Demonstrate the ability to visually identify and distinguish

between turfgrass species and cultivars. Explain the **applications for specific uses for the different turfgrass species**.

4.2 Establishment and Maintenance: Describe **methods for the establishment and maintenance of turf grasses**, including soil preparation, installation, water, nutrient and pH needs, and fertilization techniques. Analyze **fertilizer requirements** and calculate appropriate **fertilizer ratios**. Conclude the **importance of site selection, site preparation, and consideration of hardiness zones** in the selection of turfgrass species and cultivars.

4.3 Special Turfgrass Management Practices: Evaluate and compare **special management needs of residential, commercial, and sports turf**. Identify management practices and **associated equipment** requirements for mowing, irrigation, and weed, disease, and fungus control for common turfgrass species.

5. Commercial Interior Plantscaping

5.1 Interior Ornamental and Floral Plants: Identify and classify **basic ornamental and floral plants** (i.e. potted, cut) used for the commercial interior plantscapes, and summarize their **propagation, installation techniques, and maintenance requirements.** Construct interior displays using a variety of plant materials, including but not limited to foliage, flowering plants (both cut and potted), live, and permanent/silk plants.

5.2 Managing Interior Plantscapes: Identify and recommend effective **management practices for the interior environment,** including light, humidity, growing media, irrigation, disease, and pest control. Compare and contrast **decorative accessory items** (containers, planters, water features, permanent/silk plants, live plants) in the interior plantscape.

6. Pest Management

6.1 Pest and Pesticide Use: Identify and compare the **common landscape and turfgrass pests** and their respective **prevention and control methods**. Categorize the **basic types of pesticides** and describe their application methods, including but not limited to rate, environmental conditions, and reentry times. Calculate **proper formulations of pesticides** based on label directions for common landscape and turfgrass pests.

6.2 Pesticide Safety: Demonstrate the ability to **properly mix and apply pesticides precisely**, attending to **important safety standards,** selection, handling, application, storage, and disposal.

7. Water Management

7.1 Principles of Xeriscaping: Describe the **seven principles of xeriscaping** and explain the **advantages and use of these principles** in landscapes.

7.2 Water Garden and Pool Management: Examine the various types of **water gardens and pools** and their **applications for landscape enhancement**. Develop a customer information packet outlining best **management practices to maintain a healthy water garden and pool**, addressing at minimum the following considerations: pH, nitrate, dissolved oxygen, algae, pollutants, filter requirements, and feed schedules.

7.3 Irrigation Systems: Compare and contrast different **irrigation systems** and summarize their **advantages and disadvantages**. Identify irrigation tools and system components and their function or application. Applying **basic plumbing principles**, calculate the water supply flow rate, head pressure requirements, and pipe and pump size considerations for a water garden, pool, or irrigation system. Identify and demonstrate the **plumbing skills required to install irrigation and water features** in a landscape or turf setting.

7.4 Designing and Bidding Irrigation Systems: Design an **irrigation system for a residential landscape** and develop a **bid presentation** that identifies the project timeline, required permits, costs of installation, and selected materials.

8. Landscape Design

8.1 Site Analysis: Interpret topographical and soil maps to **evaluate site suitability for selected landscape plants**. Create a **site analysis checklist** to evaluate a proposed landscape site.

8.2 Drafting Landscaping Designs: Develop a list of tools and skills necessary for **drafting landscape designs**, including computer-assisted methods. Demonstrate the **use of drafting tools, design equipment, and software** to create a basic landscape design.

8.3 Principles of Landscape Design: Explore **landscape design principles** to outline the **components of a comprehensive landscape design plan**. Prepare comprehensive landscape plans using prospective residential and commercial plots and develop a **landscape bid package and presentation** for each plan.

9. Business Principles of Landscaping and Turf Management

9.1 Developing A Successful Small Business: Compare and contrast different **small business models**. Illustrate the **use, advantages, and disadvantages of each model.** Research successful local landscaping and turfgrass management businesses and use evidence from research to evaluate the **skills and resources utilized for successful small business implementation.**

9.2 Interpreting Landscape Drawings: Demonstrate the ability to **interpret and read landscape drawings** by measuring and calculating materials needed to execute the plan. Evaluate **factors that affect profitability**.

9.3 Developing Estimates and Bid Packages: Explain the process for preparing a **price estimate for landscape designs and bid packages**. Using self-created or other templates, create a **price estimate and presentation to secure a bid on a landscape project**.

Standards Alignment Notes

References to other standards include:

- SAE for All: Evolving the Essentials: All Agriculture students are encouraged to participate in a Supervised Agricultural Experience (SAE) program to practice and demonstrate the knowledge and skills learned in their agriculture courses.
- AFNR: National Agriculture, Food, & Natural Resources (AFNR) Career Cluster Content Standards:
    - Note: While not directly aligned to one specific standard, students engaged in the activities outlined above should be able to demonstrate fluency in Standards AS.01 and PS.01 at the conclusion of the course.
- P21: Partnership for 21st Century Skills Framework for 21st Century Learning
    - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

Meat Science I

Primary Career Cluster:	Agriculture, Food, & Natural Resources
Course Contact:	CTE.Standards@tn.gov
Course Code(s):	C18HB3
Prerequisite(s):	*Agriscience* (C18H19)
Credit:	1 Credit
Grade Level:	10
Elective Focus - Graduation Requirements:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other Agriculture, Food, & Natural Resources courses
POS Concentrator:	This course satisfies one out of two required courses to meet the Perkins V concentrator definition when taken in sequence in the approved program of study.
Programs of Study and Sequence:	This is the second course in the *Meat Science* program of study.
Aligned Student Organization:	FFA: http://www.tnffa.org
Coordinating Work-Based Learning:	All Agriculture students are encouraged to participate in a Supervised Agricultural Experience (SAE) program. In addition, teachers who hold an active WBL certificate may offer placement for credit when the requirements of the state board's WBL Framework and the Department's WBL Policy Guide are met. For information, visit https://www.tn.gov/education/educators/career-and-technical-education/work-based-learning.html.
Promoted Tennessee Student Industry Credentials:	Credentials are aligned with postsecondary and employment opportunities and with the competencies and skills that students acquire through their selected program of study. For a listing of promoted student industry credentials, visit https://www.tn.gov/education/educators/career-and-technical-education/student-industry-certification.html.
Teacher Endorsement(s):	048, 150, 448, and 950
Teacher Industry Certification:	None
Required Teacher Training:	None
Teacher Resources:	https://www.tn.gov/education/educators/career-and-technical-education/career-clusters/cte-cluster-agriculture-food-natural-resources.html Best for All Central: https://bestforall.tnedu.gov/

Course at a Glance

CTE courses provide students with an opportunity to develop specific academic, technical, and 21st-century skills necessary to be successful in their careers and lives. In pursuit of ensuring every student in Tennessee achieves this level of success, we begin with rigorous course standards that feed into intentionally designed programs of study.

Students engage in industry-relevant content through general education integration and experiences such as career and technical student organizations (CTSO) and work-based learning (WBL). Through these experiences, students are immersed with industry-standard content and technology, solve industry-based problems, meaningfully interact with industry professionals, and use/produce industry-specific, informational texts.

Using a Career and Technical Student Organization (CTSO) in Your Classroom

CTSOs are a great resource to put classroom learning into real-life experiences for students through classroom, regional, state, and national competitions, and leadership opportunities. Below are CTSO connections for this course, note this is not an exhaustive list.

- Participate in the CTSO Fall Leadership Conference to engage with peers by demonstrating logical thought processes and developing industry-specific skills that involve teamwork and project management.
- Participate in FFA career and leadership events (CDE/LDE) that align with this course including Agriscience Fair, Agricultural Communications, Agricultural Issues, Agricultural Sales, Extemporaneous Speaking, Floriculture, and Prepared Public Speaking.

Using Work-Based Learning (WBL) in Your Classroom

Sustained and coordinated activities that relate to the course content are the key to successful work-based learning. Possible activities for this course include the following. This is not an exhaustive list.

- **Standards 1.1-2.3** | Invite an industry representative to talk about career opportunities and skills and training required for employment.
- **Standards 3.1** | Visit a local or regional processing plant and have the plant manager discuss food safety protocols and regulations.
- **Standards 4.1-4.5** | Invite an animal scientist or farmer to discuss the aspects of proper animal health and breed selection.
- **Standards 5.1–5.3 |** In groups, virtually collaborate with an agricultural extension agent or agribusiness representative to prepare a presentation on factors impacting meat protein production.
- **Standards 6.1-6.2** | Invite an animal geneticist to discuss the role of genomics in producing safe high-quality meat proteins.

Course Description

Meat Science I is an applied course for students interested in pursuing careers in meat or food science industries. Students will study principles related to animal structural anatomy, and a broad range of skills to become butchers, meat processors, or meat processor managers in commercial or private meat processing facilities. This course will focus on the principles related to animal structural anatomy, systems physiology, the economics of production, genetics and biotechnology, and other management approaches associated with animal production. Standards in this course are aligned with National Agriculture, Food, and Natural Resources Career Cluster Content Standards.

Course Standards

1. Introduction to Animal Agriculture and Safety

1.1 Safety: Review **common laboratory safety procedures for tool and equipment operation** in the food science laboratories, including but not limited to **accident prevention and control procedures**. Demonstrate the ability to follow safety and operational procedures in a lab setting and complete a safety test with 100 percent accuracy.

2. Introduction to Meat Science Industry and Careers

2.1 Economic Impact: Investigate current food science applications and describe the **scope and economic importance of the food industry in the United States, including imports and exports**. Describe how the study of food science and related sciences impacts the quality of life and enhances a Supervised Agricultural Experience (SAE) program.

2.2 Careers: Investigate occupations within food science and related industries. Compare and contrast the **knowledge, skills, and abilities necessary for employment**, as well as the typical level of education required.

2.3 Supply and Safety Trends: Illustrate significant **trends, in the supply and demand of food products across the world population**. Identify and summarize common **environmental and safety** concerns regarding food production and the food supply.

3. Meat Science Rules and Regulations

3.1 Rules and Regulations: Analyze **state and federal laws and regulations governing food inspection standards**. Define the roles of state and government agencies responsible for the establishment and enforcement of food safety regulations. Interpret the regulations governing the “Local Foods for Local Schools” program in Tennessee.

4. Principles of Animal Science for Agricultural Production

4.1 Meat Production: Identify the **major breeds of production animals**, such as cattle, sheep, swine, and venison, and **their associated food and fiber products**. Explore the basic principles of animal science needed to produce healthy livestock for high-quality food and fiber products, such as nutrition, reproduction, and breed selection.

4.2 Anatomy and Development: Identify and describe the general **growth and development processes** of production animals used for food and fiber production. Analyze animal

anatomy, physiology, genetics, and reproduction in the context of **animal growth and productivity**, including the following:

a. Describe different animal types based on their anatomy and physiology.
b. Examine the components of the animal reproduction system and identify specific anatomical features on different species and varieties of production animals.
c. Demonstrate understanding of crossbreeding techniques to enhance identified traits and characteristics.

4.3 Health: Research principles of **disease and parasite control related to livestock health, growth, and maintenance**. Recommend safe methods for disease and parasite prevention and treatment, citing established scientific and industry guidelines.

4.4 Nutrition: Research and document connections between **proper nutrition and animal health**. Apply principles of proper nutrition to maximize livestock gains and cost efficiency.

a. Make specific diet recommendations based on animal breed, available resources, costs, and nutritional requirements, and justify recommendations with specific textual evidence.
b. Differentiate between various diet alternatives to determine which ration is most cost-effective to obtain maximum production.

4.5 Genetics: Summarize how **heritability, selection intensity, and generation interval are important to genetic change in production animals**, including the following:

a. explaining how each concept impacts genetic change;
b. comparing and contrasting characteristics of each as a tool for animal producers; and
c. determining how long it will take to get specific traits, using each method.

5. Principles of Agribusiness for Animal Production

5.1 Cost Factors: Identify and critique **factors that influence livestock production** in the United States and the world. Interpret production costs for various types of plant and animal operations that impact the wholesale cost of food.

5.2 Marketing: Explore and compare **marketing methods and strategies** to develop opportunities for specialty plant and animal products in niche markets.

5.3 Global Markets: Identify and describe the **American factors impacting global commodity markets**. Compare and contrast different **factors that impact food prices** in specific scenarios, such as the impact of war, economic sanctions, or weather on local food prices.

6. Animal Biotechnology

6.1 Impact of Biotechnology: Examine the **role and importance of genetic principles in improving plant and animal production**. Summarize the **important historical achievements in plant and animal biotechnology**. Research current and emerging plant and animal biotechnologies and craft an argumentative essay to debate the use of biotechnology in production agriculture. Justify claims surrounding the ethical, legal, practical, and economic issues related to food production and biotechnology with evidence drawn from scientific and professional resources.

6.2 Genomics: Compare and contrast the advances in using **genomic markers and genomic EPDS** in the livestock industry. Discuss the acceleration of genetic selection, mapping of complex traits, mapping of disease structures, and improved consistency of progeny outcomes.

7. Team Project and Data Analysis

7.1 Project with Data Analysis: As a team, **identify a problem** related to the program of study as a whole. **Research and utilize the Engineering Design Process to design a solution**. Document the following steps in an engineering design notebook for inclusion in the program portfolio. When possible, connect the problem to a FFA Career Development Event.

a. **Problem Identification**: Brainstorm specific problems and challenges within the program of study. Conduct basic research to understand the scope and implications of the identified problem. Identify one problem as a focus area.
b. **Research and Analysis**: Conduct in-depth research on chosen topics related to the problem. Locate and analyze a dataset related to the problem.
c. **Review the Stages of the Engineering Design Process**: Define the problem, research, brainstorm solutions, develop prototypes, test and evaluate, and iterate. Consider constraints such as cost, efficiency, and environmental impact during the design process.
d. **Project Implementation**: Assign specific roles within the design teams (e.g., project manager, researcher, designer, tester). Design a solution tailored to address the identified problem or scenario. Document progress through design journals, sketches, diagrams, and digital presentations. (Note: Prototype is optional in the Year 2 course.)
e. **Presentation and Reflection**: Showcase the problem and solution to the class. Share the data that was analyzed and how it affected the solution. Discuss the design process and challenges. As a class, critically evaluate the effectiveness and feasibility of the solutions and propose potential improvements.

Standards Alignment Notes

References to other standards include:

- SAE for All: Evolving the Essentials: All Agriculture students are encouraged to participate in a Supervised Agricultural Experience (SAE) program to practice and demonstrate the knowledge and skills learned in their agriculture courses.
- AFNR: National Agriculture, Food, & Natural Resources (AFNR) Career Cluster Content Standards: Students who are engaging in the activities outlined above should be able to demonstrate fluency in Standards CR, FPP, and PS at the conclusion of the course.
- P21: Partnership for 21st Century Skills Framework for 21st Century Learning
    - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

Meat Science II

Primary Career Cluster:	Agriculture, Food, & Natural Resources
Course Contact:	CTE.Standards@tn.gov
Course Code:	C18HB4
Prerequisite:	*Meat Science I* (C18HB3)
Credit:	1 Credit
Grade Level:	11
Elective Focus - Graduation Requirements:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other Agriculture, Food, & Natural Resources courses.
Program of Study (POS) Concentrator:	This course satisfies one out of two required courses to meet the Perkins V concentrator definition when taken in sequence in the approved program of study.
Program of Study Sequence:	This is the third course in the *Meat Science* program of study.
Aligned Student Organization(s):	FFA: http://www.tnffa.org
Coordinating Work-Based Learning:	All Agriculture students are encouraged to participate in a Supervised Agricultural Experience (SAE) program. In addition, teachers who hold an active WBL certificate may offer placement for credit when the requirements of the state board's WBL Framework and the Department's WBL Policy Guide are met. For information, visit https://www.tn.gov/education/educators/career-and-technical-education/work-based-learning.html.
Available Student Industry Certifications:	Credentials are aligned with postsecondary and employment opportunities and with the competencies and skills that students acquire through their selected program of study. For a listing of promoted student industry credentials, visit https://www.tn.gov/education/educators/career-and-technical-education/student-industry-certification.html.
Dual Credit or Dual Enrollment Opportunities:	There are no statewide dual credit/dual enrollment opportunities for this course. If interested in establishing local opportunities, reach out to a local postsecondary institution.
Teacher Endorsement(s):	048, 150, 448, and 950
Required Teacher Certification:	None
Required Teacher Training:	None
Teacher Resources:	https://www.tn.gov/education/educators/career-and-technical-education/career-clusters/cte-cluster-agriculture-food-natural-resources.html Best for All Central: https://bestforall.tnedu.gov/

Course at a Glance

CTE courses provide students with an opportunity to develop specific academic, technical, and 21st-century skills necessary to be successful in their careers and lives. In pursuit of ensuring every student in Tennessee achieves this level of success, we begin with rigorous course standards that feed into intentionally designed programs of study.

Students engage in industry-relevant content through general education integration and experiences such as career and technical student organizations (CTSO) and work-based learning (WBL). Through these experiences, students are immersed with industry-standard content and technology, solve industry-based problems, meaningfully interact with industry professionals, and use/produce industry-specific, informational texts.

Using a Career and Technical Student Organization (CTSO) in Your Classroom

CTSOs are a great resource to put classroom learning into real-life experiences for students through classroom, regional, state, and national competitions, and leadership opportunities. Below are CTSO connections for this course, note this is not an exhaustive list.

- Participate in the CTSO Fall Leadership Conference to engage with peers by demonstrating logical thought processes and developing industry-specific skills that involve teamwork and project management.
- Participate in FFA career and leadership events (CDE/LDE) that align with this course including Agriscience Fair, Agricultural Communications, Agricultural Issues, Agricultural Sales, Extemporaneous Speaking, Floriculture, and Prepared Public Speaking.

Using Work-Based Learning (WBL) in Your Classroom

Sustained and coordinated activities that relate to the course content are the key to successful work-based learning. Possible activities for this course include the following. This is not an exhaustive list.

- **Standards 1.1-1.4** | Invite an industry representative to talk about career opportunities, skills, and training required for employment.
- **Standards 2.1-3.2** | Visit a local or regional processing plant and have the plant manager discuss food safety protocols and product packaging regulations.
- **Standards 4.1-4.2** | Invite a local butcher to review and provide guidance on student-developed processing, packaging, and marketing plans.

Course Description

Meat Science II is an applied course for students interested in pursuing careers in meat or food science industries. Students will study principles related to animal structural anatomy, and a broad range of skills to become butchers, meat processors, or meat processor managers, in commercial or private meat processing facilities. This course will focus on the principles related to food processing, safety, sanitation, preservation, food product packaging, and labeling food product marketing. Standards in this course are aligned with National Agriculture, Food, and Natural Resources Career Cluster Content Standards.

Course Standards

1. Introduction to Food Processing

1.1. Careers: Investigate **occupations in food science**. Compare and contrast the **knowledge, skills, and abilities necessary for employment**, as well as educational levels or other required credentials.

1.2. Principles of Food Science: Summarize how **principles of food science** are applied to the conversion of agricultural commodities into consumer products. Determine how **food safety techniques** applied in the home, at retail establishments, and in industrial food processing environments benefit human health.

1.3. Safety: Review common **laboratory safety procedures** for **tool and equipment operation** in the food science laboratories, including but not limited to accident prevention and control procedures. Demonstrate the ability to follow safety and operational procedures in a lab setting and complete a safety test with 100 percent accuracy.

1.4. Business Records: Demonstrate the ability to prepare **basic personal and business records** to complete **taxes, employment, and SAE-related applications**, including resumes, budgets, income statements, balance sheets, cash flow statements, profit and loss statements, and equity statements.

2. Food Safety, Sanitation, Preservation, and Chemistry

2.1. Food Safety: Research and identify **types and general characteristics of microorganisms associated with foodborne illnesses**. Summarize safe food habits and practices by researching proper procedures for safe handling, storage, preparation, and cooking; to compose a checklist of general safety guidelines for red meat.

2.2. Sanitation: Describe and demonstrate **procedures and inspection standards for sanitation** in the food production industry. Demonstrate in a live setting or in a presentation format the ability to follow procedures for appropriate chemical selection, cleaning techniques, and insect and rodent control methods. Identify concepts and principles that provide the scientific foundation for current food sanitation standards.

2.3. Preservation: Differentiate among the various **microorganisms** that cause food spoilage and determine their life cycles. Compare and contrast the **application of food preservation methods** to prevent the growth of microbes in food. Outline the processes for heating, refrigerating, and freezing for food preservation.

2.4. Food Chemistry: Investigate and apply the concepts of **basic chemical processes and interactions of constituent components of foods**. Through experimentation and observation, identify chemical properties of food that are affected by production, processing, and storage.

3. Food Product Packaging and Labeling

3.1. Packaging and Labeling: Identify laws regulating the **packaging and labeling of food products** and summarize industry requirements. Demonstrate in a live setting or in a presentation the ability to perform packaging and labeling procedures for different food products.

3.2. Storage and Transportation: Research **storage and transportation issues** affecting packaged food products. Outline basic procedures to ensure the safe storage and transportation of meat and meat animal by-products.

4. Food Product Marketing

4.1. Economics: Discuss the **fundamental economic principles** (e.g., supply, demand, and profit) and the impact they have on the food science industry. Describe marketing considerations and methods of merchandising food products. Discuss how quality and yield grade factors affect product marketing.

4.2. Research and Development: Develop a food product and create **processing, packaging, and marketing plans** incorporating the skills learned in this course.

Standards Alignment Notes

References to other standards include:

- SAE for All: Evolving the Essentials: All agriculture students are encouraged to participate in a Supervised Agricultural Experience (SAE) program to practice and demonstrate the knowledge and skills learned in their agriculture courses.
- AFNR: National Agriculture, Food, & Natural Resources (AFNR) Career Cluster Content Standards: Students who are engaging in the activities outlined above should be able to demonstrate fluency in Standards CR, FPP, and PS at the conclusion of the course.
- P21: Partnership for 21st Century Skills Framework for 21st Century Learning
    - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

Meat Science III

Primary Career Cluster:	Agriculture, Food, & Natural Resources
Consultant:	CTE.Standards@tn.gov
Course Code:	C18HB5
Prerequisite:	*Meat Science II* (C18HB4)
Credit:	1 Credit
Grade Level:	12
Elective Focus - Graduation Requirements:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other Agriculture, Food, & Natural Resources courses.
Program of Study (POS) Concentrator:	This course satisfies one out of two required courses to meet the Perkins V concentrator definition when taken in sequence in the approved program of study.
Programs of Study and Sequence:	This is the fourth course in the *Meat Science* program of study.
Aligned Student Organization(s):	FFA: http://www.tnffa.org
Coordinating Work-Based Learning:	All Agriculture students are encouraged to participate in a Supervised Agricultural Experience (SAE) program. In addition, teachers who hold an active WBL certificate may offer placement for credit when the requirements of the state board's WBL Framework and the Department's WBL Policy Guide are met. For information, visit https://www.tn.gov/education/educators/career-and-technical-education/work-based-learning.html.
Available Student Industry Certifications:	Credentials are aligned with postsecondary and employment opportunities and with the competencies and skills that students acquire through their selected program of study. For a listing of promoted student industry credentials, visit https://www.tn.gov/education/educators/career-and-technical-education/student-industry-certification.html.
Dual Credit or Dual Enrollment Opportunities:	There are no statewide dual credit/dual enrollment opportunities for this course. If interested in establishing local opportunities, reach out to a local postsecondary institution.
Teacher Endorsement(s):	048, 150, 448, and 950
Required Teacher Certifications:	None
Required Teacher Training:	None
Teacher Resources:	https://www.tn.gov/education/educators/career-and-technical-education/career-clusters/cte-cluster-agriculture-food-natural-resources.html Best for All Central https://bestforall.tnedu.gov/

Course at a Glance

CTE courses provide students with an opportunity to develop specific academic, technical, and 21st-century skills necessary to be successful in their careers and lives. In pursuit of ensuring every student in Tennessee achieves this level of success, we begin with rigorous course standards that feed into intentionally designed programs of study.

Students engage in industry-relevant content through general education integration and experiences such as career and technical student organizations (CTSO) and work-based learning (WBL). Through these experiences, students are immersed with industry-standard content and technology, solve industry-based problems, meaningfully interact with industry professionals, and use/produce industry-specific, informational texts.

Using a Career and Technical Student Organization (CTSO) in Your Classroom

CTSOs are a great resource to put classroom learning into real-life experiences for your students through classroom, regional, state, and national competitions, and leadership opportunities. Below are CTSO connections for this course, note this is not an exhaustive list.

- Participate in the CTSO Fall Leadership Conference to engage with peers by demonstrating logical thought processes and developing industry-specific skills that involve teamwork and project management.
- Participate in FFA career and leadership events (CDE/LDE) that align with this course including Agriscience Fair, Agricultural Communications, Agricultural Issues, Agricultural Sales, Extemporaneous Speaking, Floriculture, and Prepared Public Speaking.

Using Work-Based Learning (WBL) in Your Classroom

Sustained and coordinated activities that relate to the course content are the key to successful work-based learning. Possible activities for this course include the following. This is not an exhaustive list.

- **Standards 1.1-1.9** | Visit a local or regional processing plant and have the plant manager discuss food safety protocols and regulations.
- **Standards 2.1-2.2** | Invite a USDA inspector or local butcher to discuss the importance and process for being a USDA-approved processing facility.
- **Standards 3.1-3.5** | Invite an animal geneticist to discuss the role of genomics in producing safe, high-quality meat proteins.

Course Description

Meat Science III is an applied course for students interested in pursuing careers in meat or food science industries. Students will study principles related to animal structural anatomy, and a broad range of skills to become butchers, meat processors, or meat processor managers in commercial or private meat processing facilities. This course will focus on the principles related to the processing and evaluation of red meat animals, meat science trends, and customer issues. Standards in this course are aligned with National Agriculture, Food, and Natural Resources Career Cluster Content Standards.

Course Standards

1. Processing and Evaluation of Red Meat

1.1 Beef Breeds: Identify **major species and breeds of beef** utilized for red meat production. Describe and demonstrate the fabrication, processing, packaging, and quality analysis of red meats and their by-products.

1.2 Beef Carcass Processing: Explain **carcass preparation and fabrication procedures and identify associated equipment, safety, sanitation, and quality control procedures**. Identify wholesale and retail cuts of beef and correlate them to major muscle groups.

1.3 Swine Breeds: Identify **major species and breeds of swine** utilized for red meat production. Describe and demonstrate the fabrication, processing, packaging, and quality analysis of red meats and their by-products.

1.4 Swine Carcass Processing: Explain **carcass preparation and fabrication procedures and identify associated equipment, safety, sanitation, and quality control procedures**. Demonstrate in a live setting or in a presentation format, the ability to identify wholesale and retail cuts of meat for swine and correlate them to major muscle groups.

1.5 Sheep Breeds: Identify **major species and breeds of sheep** utilized for red meat production. Describe and demonstrate the fabrication, processing, packaging, and quality analysis of red meats and their by-products.

1.6 Sheep Carcass Processing: Explain **carcass preparation and fabrication procedures and identify associated equipment, safety, sanitation, and quality control procedures**. Demonstrate in a live setting or in a presentation format the ability to identify wholesale and retail cuts of meat for sheep and correlate them to major muscle groups.

1.7 Venison Breeds: Identify **major species and breeds of venison** utilized for red meat production. Describe and demonstrate the fabrication, processing, packaging, and quality analysis of red meats and their by-products.

1.8 Venison Carcass Processing: Explain **carcass preparation and fabrication procedures and identify associated equipment, safety, sanitation, and quality control procedures**. Demonstrate in a live setting or in a presentation format the ability to identify wholesale and retail cuts of meat for venison and correlate them to major muscle groups.

1.9 Further Processing: Demonstrate the ability to perform **methods of further processing fabrication** for **processed and value-added products** including comminuted meat products, emulsions, and cured meats. Using quantitative reasoning and appropriate units, calculate proper meat product formulations based on required protein levels and USDA allowances for various products.

2. Inspection and Grading

2.1 USDA Guidelines: Analyze the United States Department of Agriculture **(USDA) inspection and grading procedures** and explain their purpose in the food industry.

2.2 Quality and Yield Grading: Describe the principles of **quality and yield grading**. Demonstrate the ability to perform the evaluation and grading of carcasses, wholesale cuts, and retail cuts to determine maturity, final quality grade, and final yield grade, and provide written and oral justification for evaluation conclusions.

3. Meat Science Trends and Consumer Issues

3.1 Cultural and Ethical Issues: Review company product recall notices to explore **consumer satisfaction** issues. Analyze the impact of **organic, natural, ethnic, religious-based, and other specialized processing methods** in the food industry. Compare and contrast the advantages and disadvantages of value-added and specialty products and summarize consumer interest and trends related to these products.

3.2 Product Development: Evaluate the use of **food batch procedures** for economic efficiency. Describe the application of sensory evaluation methods to test food product flavor, appearance, and texture by quantitative description and simple difference testing.

3.3 Quality and Safety: Identify consumer concerns related to **food quality and safety** (e.g., antibiotic use, genetically modified organisms (GMOs), pesticide use, and foodborne illnesses), and discuss the economic implications when low-quality and unsafe foods enter the market.

3.4 Advanced Technologies: Compare and contrast the use of **advanced technologies in food production**, such as but not limited to biotechnology, irradiation, and genetically modified organisms (GMOs), citing specific textual evidence. Summarize technology principles, process effects, and consumer concerns, referencing the extent to which reasoning and evidence are presented for each to support the specific claims.

3.5 Research Issues: Formulate a hypothesis regarding current **food science issues**. Design and conduct an original experiment to prove or disprove the hypothesis. Collect the appropriate data to evaluate claims, synthesizing and communicating results within the broader context of food science.

Standards Alignment Notes

References to other standards include:

- SAE for All: Evolving the Essentials: All Agriculture students are encouraged to participate in a Supervised Agricultural Experience (SAE) program to practice and demonstrate the knowledge and skills learned in their agriculture courses.
- AFNR: National Agriculture, Food, & Natural Resources (AFNR) Career Cluster Content Standards: Students who are engaging in the activities outlined above should be able to demonstrate fluency in Standards CR, FPP, and PS at the conclusion of the course.
- P21: Partnership for 21st Century Skills Framework for 21st Century Learning

- Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

Small Animal Science Technologies

Primary Career Cluster:	Agriculture, Food, & Natural Resources
Course Contact:	CTE.Standards@tn.gov
Course Code:	C18H20
Prerequisite:	*Agriscience* (C18H19)
Credit:	1
Grade Level:	10
Elective Focus-Graduation Requirements:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other Agriculture, Food, & Natural Resources courses.
POS Concentrator:	This course satisfies one out of two required courses to meet the Perkins V concentrator definition when taken in sequence in the approved program of study.
Programs of Study and Sequence:	This is the second course in the *Veterinary and Animal Sciences* program of study.
Aligned Student Organization(s):	FFA: http://www.tnffa.org
Coordinating Work-Based Learning:	All Agriculture students are encouraged to participate in a Supervised Agricultural Experience (SAE) program. In addition, teachers who hold an active WBL certificate may offer placement for credit when the requirements of the state board's WBL Framework and the Department's WBL Policy Guide are met. For information, visit https://www.tn.gov/education/educators/career-and-technical-education/work-based-learning.html.
Promoted Tennessee Student Industry Credentials:	Credentials are aligned with postsecondary and employment opportunities and with the competencies and skills that students acquire through their selected program of study. For a listing of promoted student industry credentials, visit https://www.tn.gov/education/educators/career-and-technical-education/student-industry-certification.html.
Teacher Endorsement(s):	048, 150, 448, and 950
Required Teacher Industry Credentials	None
Required Teacher Training:	None
Teacher Resources:	https://www.tn.gov/content/tn/education/educators/career-and-technical-education/career-clusters/cte-cluster-agriculture-food-natural-resources.html/ Best for All Central: https://bestforall.tnedu.gov/

Course at a Glance

CTE courses provide students with an opportunity to develop specific academic, technical, and 21st-century skills necessary to be successful in careers and life. In pursuit of ensuring every student in Tennessee achieves this level of success, we begin with rigorous course standards that feed into intentionally designed programs of study.

Students engage in industry-relevant content through general education integration and experiences such as career and technical student organizations (CTSO) and work-based learning (WBL). Through these experiences, students are immersed with industry-standard content and technology, solve industry-based problems, meaningfully interact with industry professionals, and use/produce industry-specific, informational texts.

Using a Career and Technical Student Organization (CTSO) in Your Classroom

CTSOs are a great resource to put classroom learning into real-life experiences for your students through classroom, regional, state, and national competitions, and leadership opportunities. Below are CTSO connections for this course. This is not an exhaustive list.

- Participate in the CTSO Fall Leadership Conference to engage with peers by demonstrating logical thought processes and developing industry-specific skills that involve teamwork and project management.
- Participate in FFA career and leadership events (CDE/LDE) that align with this course including Agriscience Fair, Agricultural Communications, Agricultural Issues, Dairy Evaluation & Management, Employment Skills, Extemporaneous Speaking, Horse Evaluation, Livestock Evaluation, Meats Evaluation and Technology, Parliamentary Procedure, Poultry Evaluation, Public Speaking, and Veterinary Science.

Using Work-Based Learning (WBL) in Your Classroom

Sustained and coordinated activities that relate to the course content are the key to successful work-based learning. Possible activities for this course include the following. This is not an exhaustive list.

- **Standards 1.1-2.4** | Invite an animal scientist to discuss the history and trends within the industry.
- **Standards 3.1-3.4** | Tour a veterinary hospital or clinic.
- **Standards 4.1-5.2** | In groups, virtually collaborate with animal caretakers or an animal scientist to prepare an educational presentation on how to care for specific small animals properly.
- **Standards 6.1-6.3** | Invite an animal nutritionist to discuss the aspects of proper animal health.
- **Standards 7.1-7.2** | Invite an animal geneticist or breeder to discuss the role of genomics in reducing animal disease.
- **Standards 8.1-10.1** | Invite a pet store manager, veterinarian assistant, or breed representative to present skills associated with fundamental care and health for specific breeds of animals.

Course Description

Small Animal Science Technologies is an intermediate course in animal science and care for students interested in learning more about becoming a veterinarian, vet tech, vet assistant, or pursuing a variety of scientific, health, or agriculture professions. This course covers the anatomy and physiological systems of different groups of small animals, as well as careers, leadership, and history of the industry. Upon completion of this course, proficient students will be prepared for more advanced coursework in veterinary and animal science.

Course Standards

1. History of Domestication

1.1 History of Small Animal Domestication: Research the history of **small animal domestication,** including defining and applying industry-specific terminology to **classify animals** in the correct taxonomy. Justify the **historical uses and roles of domesticated animals**, and compare the historical processes of small animal domestication.

2. Economic, Occupational, and Technological Implications

2.1 Economic Implications: Determine the general **economic impact** of the small animal industry by investigating both **home and business implications**.

2.2 Career Exploration: Explore and compare **local and regional career opportunities** in the small animal industry. Describe the **knowledge, skills, and abilities** necessary for a diverse range of **careers in small animal sciences**.

2.3 Financial and SAE Recordkeeping: Accurately maintain an active **recordkeeping system** and apply proper **accounting and financial records** as they relate to a small animal science **supervised agricultural experience (SAE) program or enterprise**. Demonstrate the ability to summarize business records, such as individual enterprise budgets, profit and loss statements, inventory management, transportation costs, and other specific reports, by completing SAE and related financial applications.

2.4 Emerging Technologies: Examine **specific emerging technologies** that have evolved within the small animal industry, such as, but not limited to, equipment, procedures, and healthcare, and evaluate the economic and societal implications of each.

3. Personal and Occupational Health and Safety

3.1 Diseases: Identify, research, and determine the significance of **zoonotic diseases** associated with small animals. Compare and contrast findings relating to a specific disease. Justify the use of different methods of **infection control** in the prevention or management of zoonotic diseases and evaluate the efficacy of existing **small animal biosecurity measures**.

3.2 Health Requirements and Regulations: Identify and summarize **laws and regulations** that pertain to small animal health and safety from state and national legislation. Describe health requirements and necessary documentation for small animal **transportation and change of ownership**.

3.3 Safety and Operational Procedures: Review common **laboratory safety procedures for tool and equipment** operation in the small animal science laboratories, including but not limited to accident prevention and control procedures. Demonstrate the ability to follow safety and operational procedures in a lab setting and complete a safety test with 100 percent accuracy.

3.4 Personal and Animal Safety Practices: Demonstrate the ability to **follow procedures precisely**, attending to special cases or exceptions noted in the appropriate materials, and apply them to the following areas:

a. animal restraint and handling;
b. techniques for Transportation;
c. appropriate use of chemicals, such as pesticides, fungicides, disinfectants; and
d. differentiate between effective methods for handling small animals and methods proven to be less effective.

4. Responsible Pet Ownership

4.1 Financial and Legal Responsibilities: Research the **benefits and responsibilities of pet ownership**, including factors to consider when choosing a pet. Compare and contrast available **sources for obtaining a pet**, identify and summarize **common laws governing pet ownership**, and investigate the **societal and economic issues** that may impact pet owners.

4.2 Ethical Care: Compare and contrast the **characteristics of responsible pet ownership** with **ownership practices that are negligent or inappropriate**. Explain why certain practices fail and others succeed. Discussion topics may include:

a. training and behavior management;
b. housing, boarding, and transporting;
c. breeding;
d. feeding and nurturing;
e. management of health conditions; and
f. matching of animal type/breed and owner lifestyle, including living conditions, geographic location, and number and age of family members.

5. Animal Ethics

5.1 Fundaments of Animal Rights and Welfare: Identify the **fundamental philosophies related to animal rights and animal welfare**. Compare the impact of specific persons, organizations, and legislation related to animal rights and the welfare of small animals, citing specific textual evidence.

5.2 Analyzing Ethical Issues: Debate specific **issues related to animal rights and animal welfare** by forming claims and counterclaims with **specific data and evidence**. Issues may include, but are not limited to the following:

a. abuse and/or neglect,
b. illegal capture and/or trade,
c. overpopulation,
d. control of populations,

e. euthanasia,
f. exhibiting and showing, and
g. global issues in small animal ethics and their relation to local problems.

6. Nutrition and Digestive Systems

6.1 Digestive System Identification: Differentiate between **ruminant and non-ruminant animals**, comparing and contrasting their anatomical and physiological differences of small animals.

6.2 Nutritional Requirements: Research **nutrient requirements of small animal diets** and organize these into various nutrient groups. Interpret **feed labeling** and evaluate factors such as **life stage and activity level** to determine the nutritional needs to recommend balanced rations for small animals, justifying recommendations with evidence.

6.3 Nutritional Diseases: Distinguish among the **symptoms of nutritional diseases** relevant to small animals and recommend the appropriate control procedures.

7. Genetics, Reproduction, and Genomics

7.1 Reproductive Systems: Research the **major components of male and female reproductive systems** in small animals and prepare a short narrative to distinguish the function of reproductive organs, endocrine glands, and hormones. Summarize the **physiological changes that occur during reproductive phases**, including the estrus cycle, fertilization, gestation, parturition, and lactation.

7.2 Principles of Genetics and Genomics: Explain how the **fundamental principles of genetics and genomics** apply to the study of small animals. Principles should include aspects of the concepts of inheritance, gene transfer, lineage tracing of bloodlines, mapping of traits, and mapping of diseases.

8. Fundamental Care and Health of Dogs and Cats

8.1 Domestication, Care, and Health: Synthesize research on the **historical importance of dogs and cats, noting major economic, social, and medical advances impacting domestication**. Differentiate between the defining characteristics of the common dog and common cat breeds. Demonstrate conceptual understanding and technical skill in current practices of comprehensive health care and management.

a. Precisely follow effective grooming procedures and techniques to maintain healthy skin, coat, nails, eyes, and ears.
b. Design appropriate facilities based on an assessment of needs.
c. Identify appropriate owner/handler responses to behaviors and instincts to ensure the safety of both individual and small animals in a variety of situations.
d. Distinguish between clinical signs of proper health and poor health, justifying explanations with data and evidence.
e. Calculate feed rations based on animal characteristics: age, weight, breed, activity level, and nutritional needs.

f. Illustrate the reproductive cycle graphically, and summarize available breeding methods and current reproductive technologies.
g. Research common diseases and parasites and their effects on the health of dogs and cats, and draw evidence from relevant medical literature to recommend the best prevention or control measures.

9. Fundamental Care and Health of Rabbits, Guinea Pigs, Chinchillas, and Rodents

9.1 Domestication, Care, and Health: Synthesize research on the **historical importance of rabbits, guinea pigs, chinchillas, and rodents, noting major economic, social, and medical advances** impacting domestication. Differentiate between their defining characteristics. Demonstrate conceptual understanding and technical skill in current practices of comprehensive **health care and management**.

a. Precisely follow effective grooming procedures and techniques to maintain healthy skin, coat, nails, eyes, and ears.
b. Design appropriate facilities based on an assessment of needs.
c. Identify appropriate owner/handler responses to behaviors and instincts to ensure the safety of both individual and small animals in a variety of situations.
d. Distinguish between clinical signs of proper health and poor health, justifying explanations with data and evidence
e. Calculate feed rations based on animal characteristics: age, weight, breed, activity level, and nutritional needs.
f. Illustrate the reproductive cycle graphically, and summarize available breeding methods and current reproductive technologies.
g. Research common diseases and parasites and their effects on the health of rabbits, guinea pigs, chinchillas, and rodents, and draw evidence from the most recent medical literature to recommend the best prevention or control measures.

10. Fundamental Care and Health of Avians, Fish, Amphibians, and Reptiles

10.1 Domestication, Care, and Health: Synthesize research on the **historical importance of avians, fish, amphibians, and reptiles, noting major economic, social, and medical advances** impacting domestication. Differentiate between their defining characteristics. Demonstrate conceptual understanding and technical skill in current practices of comprehensive **health care and management**.

a. Precisely follow effective grooming procedures and techniques for applicable species.
b. Design appropriate facilities based on an assessment of needs.
c. Identify appropriate owner/handler responses to behaviors and instincts to ensure the safety of both individual and small animals in a variety of situations.
d. Distinguish between clinical signs of proper health and poor health, justifying explanations with data and evidence.
e. Calculate feed rations based on animal characteristics: age, weight, breed, activity level, and nutritional needs.
f. Illustrate the reproductive cycle graphically, and summarize available breeding methods and current reproductive technologies.

g. Research common diseases and parasites and their effects on the health of birds, fish, amphibians, and reptiles, and draw evidence from the most recent medical literature to recommend the best prevention or control measures.

11. Team Project and Data Analysis:

11.1 Team Project with Data Analysis: As a team, **identify a problem** related to the program of study as a whole. **Research and utilize the Engineering Design Process to design a solution**. Document the following steps in an engineering design notebook for inclusion in the program portfolio. When possible, connect the problem to a FFA Career Development Event.

a. **Problem Identification**: Brainstorm specific problems and challenges within the program of study. Conduct basic research to understand the scope and implications of the identified problem. Identify one problem as a focus area.
b. **Research and Analysis**: Conduct in-depth research on chosen topics related to the problem. Locate and analyze a dataset related to the problem.
c. **Review the Stages of the Engineering Design Process**: Define the problem, research, brainstorm solutions, develop prototypes, test and evaluate, and iterate. Consider constraints such as cost, efficiency, and environmental impact during the design process.
d. **Project Implementation**: Assign specific roles within the design teams (e.g., project manager, researcher, designer, tester). Design a solution tailored to address the identified problem or scenario. Document progress through design journals, sketches, diagrams, and digital presentations. (Note: Prototype is optional in the Year 2 course.)
e. **Presentation and Reflection**: Showcase the problem and solution to the class. Share the data that was analyzed and how it affected the solution. Discuss the design process and challenges. As a class, critically evaluate the effectiveness and feasibility of the solutions and propose potential improvements.

Standards Alignment Notes

References to other standards include:

- SAE for All: Evolving the Essentials: All Agriculture students are encouraged to participate in a Supervised Agricultural Experience (SAE) program to practice and demonstrate the knowledge and skills learned in their agriculture courses.
- AFNR: National Agriculture, Food, & Natural Resources (AFNR) Career Cluster Content Standards: Students engaged in activities outlined above should be able to demonstrate fluency in Standards AS at the conclusion of the course.
- P21: Partnership for 21st Century Skills Framework for 21st Century Learning
    - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

Large Animal Science Technologies

Primary Career Cluster:	Agriculture, Food, & Natural Resources
Course Contact:	CTE.Standards@tn.gov
Course Code:	C18H27
Prerequisite:	*Small Animal Science* Technologies (C18H20)
Credit:	1
Grade Level:	11
Elective Focus - Graduation Requirements:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other Agriculture, Food, & Natural Resources courses.
POS Concentrator:	This course satisfies one out of two required courses to meet the Perkins V concentrator definition when taken in sequence in the approved program of study.
Programs of Study (POS) Sequence:	This is the third course in the *Veterinary and Animal Science* program of study.
Aligned Student Organization(s):	FFA: http://www.tnffa.org
Coordinating Work-Based Learning:	All Agriculture students are encouraged to participate in a Supervised Agricultural Experience (SAE) program. In addition, teachers who hold an active WBL certificate may offer placement for credit when the requirements of the state board's WBL Framework and the Department's WBL Policy Guide are met. For information, visit https://www.tn.gov/education/educators/career-and-technical-education/work-based-learning.html
Promoted Tennessee Student Industry Credentials:	Credentials are aligned with postsecondary and employment opportunities and with the competencies and skills that students acquire through their selected program of study. For a listing of promoted student industry credentials, visit https://www.tn.gov/education/educators/career-and-technical-education/student-industry-certification.html
Teacher Endorsement(s):	048, 150, 448, and 950
Required Teacher Certification:	None
Required Teacher Training:	None
Teacher Resources:	https://www.tn.gov/education/educators/career-and-technical-education/career-clusters/cte-cluster-agriculture-food-natural-resources.html Best for All Central https://bestforall.tnedu.gov/

Course at a Glance

CTE courses allow students to develop specific academic, technical, and 21st-century skills necessary to succeed in their careers and lives. In pursuit of ensuring every student in Tennessee achieves this

level of success, we begin with rigorous course standards that feed into intentionally designed programs of study.

Students engage in industry-relevant content through general education integration and experiences such as career & technical student organizations (CTSO) and work-based learning (WBL). Through these experiences, students are immersed with industry-standard content and technology, solve industry-based problems, meaningfully interact with industry professionals, and use/produce industry-specific, informational texts.

Using a Career and Technical Student Organization (CTSO) in Your Classroom

CTSOs are a great resource to put classroom learning into real-life experiences for your students through classroom, regional, state, and national competitions, and leadership opportunities. Below are CTSO connections for this course. This is not an exhaustive list.

- Participate in the CTSO Fall Leadership Conference to engage with peers by demonstrating logical thought processes and developing industry-specific skills that involve teamwork and project management.
- Participate in FFA career and leadership events (CDE/LDE) that align with this course including Agriscience Fair, Agricultural Communications, Agricultural Issues, Dairy Evaluation & Management, Dairy Cattle Handlers, Employment Skills, Extemporaneous Speaking, Horse Evaluation, Livestock Evaluation, Meats Evaluation & Technology, Parliamentary Procedure, Poultry Evaluation, Public Speaking, and Veterinary Science.

Using Work-Based Learning (WBL) in Your Classroom

Sustained and coordinated activities that relate to the course content are the key to successful work-based learning. Possible activities for this course include the following. This is not an exhaustive list.

- **Standards 1.1-2.2, 2.4 |** Invite an animal scientist to discuss the history and trends within the industry.
- **Standard 2.3 |** Have students work with an agribusiness accounting specialist to conduct a self-audit of SAE records.
- **Standards 3.1-3.4 |** Tour a veterinary hospital or clinic.
- **Standards 4.1-4.2 |** In groups, virtually collaborate with animal caretakers and scientists to prepare an educational health care presentation for a specific animal.
- **Standards 5.1-5.4 |** Invite an animal nutritionist to discuss the aspects of proper animal health.
- **Standards 6.1-6.3 |** Invite an animal geneticist to discuss the role of genomics in reducing animal disease.
- **Standards 7.1-11.1 |** Invite a breed representative to present skills associated with fundamental care and health for specific breeds of animals.

Course Description

Large Animal Science Technologies is an applied course in veterinary and animal science for students interested in learning more about becoming a veterinarian, vet tech, or vet assistant, or pursuing a variety of scientific, health, or agriculture professions. This course covers the anatomy and physiological systems of different groups of large animals, as well as careers, leadership, and history of the industry. Upon completion of this course, proficient students will be prepared for success in the level-four *Veterinary Science* course and further postsecondary training.

Course Standards

1. History of Domestication

1.1 History of Large Animal Domestication: Research the history of **large animal domestication** including defining and applying industry-specific terminology to classify animals in the correct taxonomy. Justify the historical uses and roles of domesticated animals, and compare the historical processes of large animal domestication.

2. Economic, Occupational, and Technological Implications

2.1 Economical Implications: Determine the general **economic impact of the large animal industry** by investigating both the recreational and business implications of large animal domestication.

2.2 Career Exploration: Explore and compare **local and regional career opportunities** in the large animal industry and evaluate labor data to predict the employment outlook. Describe the **knowledge, skills, and abilities necessary for a diverse range of careers** in large animal sciences.

2.3 Business and SAE Financial Recordkeeping: Accurately maintain an active **recordkeeping system** and apply proper **accounting and financial records** as they relate to a large animal science **supervised agricultural experience (SAE) program or enterprise**. Demonstrate the ability to summarize business records such as individual enterprise budgets, profit and loss statements, inventory management, transportation cost, and other specific reports by completing SAE and related financial applications.

2.4 Emerging Technologies: Examine **specific technologies** that have evolved within the large animal industry (such as, but not limited to equipment, housing, procedures, and healthcare) and evaluate the economic and societal implications of each.

3. Personal and Occupational Health and Safety

3.1 Diseases: Identify, research, and determine the significance of **zoonotic diseases** associated with large animals. Compare and contrast findings relating to a specific disease. Justify the use of different **methods of infection control** in the prevention or management of zoonotic diseases and evaluate the efficacy of existing large animal biosecurity measures.

3.2 Health Requirements and Regulations: Correctly identify and summarize **laws and regulations that pertain to large animal health and safety** from state and national legislation. Describe **health requirements and necessary documentation** for large animal transportation and change of ownership.

3.3 Safety and Operational Procedures: Review common **laboratory safety procedures for tool and equipment operation** in large animal laboratories, including but not limited to

accident prevention and control procedures. Demonstrate the ability to follow safety and operational procedures in a lab setting and complete a safety test with 100 percent accuracy.

3.4 Personal and Animal Safety: Demonstrate the ability to **follow procedures precisely**, attending to **special cases or exceptions** noted in appropriate materials, and apply them to the following areas:

a. Animal restraint and handling
b. Techniques for Transportation
c. Appropriate use of chemicals (such as pesticides, fungicides, disinfectants)
d. Differentiate between effective methods for handling large animals and methods proven to be less effective.

4. Animal Ethics

4.1 Fundamental of Animal Rights and Welfare: Identify the **fundamental philosophies related to animal rights and animal welfare**. Compare the impact of specific persons, organizations, and legislation related to animal rights and welfare of large animals.

4.2 Analyzing Ethical Issues: Debate specific **issues** by forming and supporting claims and counterclaims with **specific data and evidence**. Issues related to animal rights and animal welfare may include, but are not limited to:

a. Abuse and/or neglect
b. Environmental implications
c. Consumer product implications
d. Exhibiting and showing
e. Global animal ethics issues and their relation to local problems

5. Nutrition and Digestive Systems

5.1 Digestive Systems: Differentiate between **ruminant and non-ruminant animals and monogastric and polygastric animals**, comparing and contrasting their anatomical and physiological differences. Explain the relationships of **digestive system types** to the ability of an animal to digest and absorb different classes of feed.

5.2 Nutritional Requirements: Research **nutrient requirements of the large animal diets** and organize them into various nutrient groups. Differentiate between **roughages and concentrates and their nutritional values**.

5.3 Interpreting and Recommending Feed Rations: Interpret **feed labeling** and evaluate factors such as life stage and activity level to determine the **nutritional needs** and then recommend balance rations for each large animal species, justifying recommendations with evidence from the text.

5.4 Nutritional Diseases: Diagnose the **symptoms of nutritional diseases** relevant to large animals and recommend the appropriate control procedures.

6. Genetics, Reproduction, and Genomics

6.1 Reproductive Systems: Research the **major components of male and female reproductive systems** in large animals to distinguish the function of reproductive organs, endocrine glands, and hormones. Compare the **physiological changes that occur across different species during reproductive phases**, including the estrous cycle, fertilization, gestation, parturition, and lactation.

6.2 Principles of Genetics and Genomics: Explain how the role of **heritability, selection intensity, generation interval, and other advanced principles of genetics** (such as DNA testing for disorders) apply to predict gene and trait transfer in large animal species. Principles include but are not limited to:

a. Economically important traits in production animals (i.e. artificial reproduction methods)
b. Interpretation and utilization of animal performance records (i.e. Expected Progeny Difference [EPD])
c. Hybrid vigor

6.3 Advancements with Genomics: Compare and contrast the **advances in the livestock industry** by using **genomic markers and genomic EPDS**. Explain how genomics impacts the acceleration of genetic selection, mapping of complex traits, mapping of disease structures, and improved consistency of progeny outcomes.

7. Fundamental Care and Health of Horses

7.1 Domestication, Care, and Health: Synthesize research on the **historical importance of horses**, noting major economic, social, and medical advances impacting domestication. Compare and contrast the different **horse breeds and hybrids**. Demonstrate conceptual understanding and technical skill in current practices of comprehensive health care and management for the following:

a. Design appropriate facilities based on an assessment of needs and present plans in a visual format
b. Compare appropriate owner/handler responses to behaviors and instincts to ensure the safety of both handler and animal in a variety of situations
c. Distinguish between clinical signs of proper health and poor health, justifying explanations with data and evidence
d. Using quantitative reasoning and appropriate units, calculate appropriate rations based on animal characteristics (age, weight, breed, activity level) and nutritional needs
e. Illustrate the reproductive cycle graphically, and summarize available breeding methods and current reproductive technologies

f. Research common diseases and parasites and their effects on the health of horses, and draw evidence from the most recent medical literature to recommend the best prevention or control measures.

8. Fundamental Care and Health of Cattle

8.1 Domestication, Care, and Health: Synthesize research on the **historical importance of cattle**, noting **major economic, social, and medical advances impacting domestication**. Compare and contrast among different **cattle breeds**. Demonstrate conceptual understanding and technical skill in current practices of **comprehensive health care and management** for the following:

a. Design appropriate facilities based on an assessment of needs and present plans in a visual format
b. Compare appropriate owner/handler responses to behaviors and instincts to ensure the safety of both handler and animal in a variety of situations
c. Distinguish between clinical signs of proper health and poor health, justifying explanations with data and evidence
d. Using quantitative reasoning and appropriate units, calculate rations based on animal characteristics (age, weight, breed, activity level) and nutritional needs by creating systems of equations that describe numerical relationships
e. Illustrate the reproductive cycle graphically, summarize available breeding methods, and current reproductive technologies
f. Research common diseases and parasites and their effects on the health of cattle, and draw evidence from the most recent medical literature to recommend the best prevention or control measures
g. Evaluate the economic implications of livestock management practices (such as dehorning)

9. Fundamental Care and Health of Small Ruminants (Sheep, Goats, Alpacas, and Llamas)

9.1 Domestication, Care, and Health: Synthesize research on the **historical importance of small ruminant breeds**, noting major economic, social, and medical advances impacting domestication. Compare and contrast among different sheep, and goats. alpaca, and llama breeds. Demonstrate **conceptual understanding and technical skill in current practices of comprehensive health care and management** for the following:

a. Design appropriate facilities based on an assessment of needs and present plans in a visual format
b. Compare appropriate owner/handler responses to behaviors and instincts to ensure the safety of both handler and animal in a variety of situations
c. Distinguish between clinical signs of proper health and poor health, justifying explanations with data and evidence
d. Using quantitative reasoning and appropriate units, calculate appropriate rations based on animal characteristics (age, weight, breed, activity level) and nutritional needs by creating systems of equations that describe numerical relationships
e. Illustrate the reproductive cycle graphically, and summarize available breeding methods and current reproductive technologies

f. Research common diseases and parasites and their effects on the health of sheep and goats, and draw evidence from the most recent medical literature to recommend the best prevention or control measures

10. Fundamental Care and Health of Swine

10.1 Domestication, Care, and Health of Swine: Synthesize research on the **historical importance of swine**, noting major economic, social, and medical advances impacting domestication. Compare and contrast among different **swine breeds**. Demonstrate **conceptual understanding and technical skill in current practices of comprehensive health care and management** for the following:

a. Design appropriate facilities based on an assessment of needs and present plans in a visual format
b. Compare appropriate owner/handler responses to behaviors and instincts to ensure the safety of both handler and animal in a variety of situations
c. Distinguish between clinical signs of proper health and poor health, justifying explanations with data and evidence
d. Using quantitative reasoning and appropriate units, calculate appropriate rations based on animal characteristics (age, weight, breed, activity level) and nutritional needs by creating systems of equations that describe numerical relationships
e. Illustrate the reproductive cycle graphically, and summarize available breeding methods and current reproductive technologies
f. Research common diseases and parasites and their effects on the health of swine, and draw evidence from the most recent medical literature to recommend the best prevention or control measures

11. Fundamental Care and Health of Poultry

11.1 Domestication, Care, and Health of Poultry: Synthesize research on the **historical importance of poultry**, noting major economic, social, and medical advances impacting domestication. Compare and contrast among different **poultry breeds**. Demonstrate **conceptual understanding and technical skill in current practices of comprehensive health care and management** for the following:

a. Design appropriate facilities based on an assessment of needs and present plans in a visual format
b. Compare appropriate owner/handler responses to behaviors and instincts to ensure the safety of both handler and bird in a variety of situations
c. Distinguish between clinical signs of proper health and poor health, justifying explanations with data and evidence
d. Using quantitative reasoning and appropriate units, calculate appropriate rations based on bird characteristics (age, weight, breed, activity level) and nutritional needs by creating systems of equations that describe numerical relationships
e. Illustrate the reproductive cycle graphically, and summarize available breeding methods and current reproductive technologies
f. Research common diseases and parasites and their effects on the health of poultry, and draw evidence from the most recent medical literature to recommend the best prevention or control measures

Standards Alignment Notes

References to other standards include:

- SAE for All: Evolving the Essentials: All Agriculture students are encouraged to participate in a Supervised Agricultural Experience (SAE) program to practice and demonstrate the knowledge and skills learned in their agriculture courses.
- AFNR: National Agriculture, Food, & Natural Resources (AFNR) Career Cluster Content Standards:
    - Note: While not directly aligned to one specific standard, students engaged in the activities outlined above should be able to demonstrate fluency in Standards AS.01 and PS.01 at the conclusion of the course.
- P21: Partnership for 21st Century Skills Framework for 21st Century Learning
    - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

Veterinary Science Technologies

Primary Career Cluster:	Agriculture, Food, & Natural Resources
Course Contact:	CTE.Standards@tn.gov
Course Code:	C18H21
Prerequisite:	*Large Animal Science Technologies* (C18H27)
Credit:	1
Grade Level:	12
Elective Focus - Graduation Requirements:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other Agriculture, Food, & Natural Resources courses. In addition, this course satisfies one credit of laboratory science required for graduation.
Program of Study (POS) Concentrator:	This course satisfies one out of two required courses to meet the Perkins V concentrator definition when taken in sequence in the approved program of study.
Programs of Study and Sequence:	This is the fourth course in the *Veterinary and Animal Science* program of study.
Aligned Student Organization(s):	FFA: http://www.tnffa.org
Coordinating Work-Based Learning:	All Agriculture students are encouraged to participate in a Supervised Agricultural Experience (SAE) program. In addition, teachers who hold an active WBL certificate may offer placement for credit when the requirements of the state board's WBL Framework and the Department's WBL Policy Guide are met. For information, visit https://www.tn.gov/education/educators/career-and-technical-education/work-based-learning.html
Promoted Tennessee Student Industry Credentials:	Credentials are aligned with postsecondary and employment opportunities and with the competencies and skills that students acquire through their selected program of study. For a listing of promoted student industry credentials, visit https://www.tn.gov/education/educators/career-and-technical-education/student-industry-certification.html
Teacher Endorsement(s):	(048 and 015), (048 and 016), (048 and 017), (048 and 081), (048 and 126), (048 and 127), (048 and 128), (048 and 129), (048 and 151), (048 and 211), (048 and 212), (048 and 213), (048 and 214), (048 and 414), (048 and 415), (048 and 416), (048 and 417), (048 and 418), (048 and 449), (048 and 951) (150 and 015), (150 and 016), (150 and 017), (150 and 081), (150 and 126), (150 and 127), (150 and 128), (150 and 129), (150 and 151), (150 and 211), (150 and 212), (150 and 213), (150 and 214), (150 and 414), (150 and 415), (150 and 416), (150 and 417), (150 and 418), (150 and 449), (150 and 951), (448 and 015), (448 and 016), (448 and 017), (448 and 081), (448 and 126), (448 and 127), (448 and 128), (448 and 129), (448 and 151), (448 and 211), (448 and 212), (448 and 213), (448 and 214), (448 and 414), (448 and 415), (448 and 416), (448 and 417), (448 and 418), (448 and 449), (448 and 951), (950 and 015), (950 and 016), (950 and 017), (950 and 081), (950 and 126), (950 and 127), (950 and 128), (950 and 129), (950 and 151), (950 and 211), (950 and 212), (950 and 213), (950 and 214), (950 and 414), (950 and 415), (950 and 416), (950 and 417), (950 and 418), (950 and 449), (950 and 951)
Required Teacher Certification/Training:	None
Required Teacher Training:	None
Teacher Resources:	https://www.tn.gov/education/educators/career-and-technical-education/career-clusters/cte-cluster-agriculture-food-natural-resources.html Best for All Central https://bestforall.tnedu.gov/

Course at a Glance

CTE courses provide students with an opportunity to develop specific academic, technical, and 21st-century skills necessary to be successful in their careers and lives. In pursuit of ensuring every student in Tennessee achieves this level of success, we begin with rigorous course standards that feed into intentionally designed programs of study.

Students engage in relevant industry-relevant content through general education integration and experiences such as career & technical student organizations (CTSO) and work-based learning (WBL). Through these experiences, students are immersed with standard industry-standard content and technology, solve industry-based problems, meaningfully interact with industry professionals, and use/produce industry-specific, informational texts.

Using a Career and Technical Student Organization (CTSO) in Your Classroom

CTSOs are a great resource to put classroom learning into real-life experiences for your students through classroom, regional, state, and national competitions, and leadership opportunities. Below are CTSO connections for this course; note this is not an exhaustive list.

- Participate in the CTSO Fall Leadership Conference to engage with peers by demonstrating logical thought processes and developing industry-specific skills that involve teamwork and project management.
- Participate in FFA career and leadership events (CDE/LDE) that align with this course including Agriscience Fair, Agricultural Communications, Agricultural Issues, Dairy Evaluation & Management, Dairy Cattle handlers, Employment Skills, Extemporaneous Speaking, Horse Evaluation, Livestock Evaluation, Meats Evaluation & Technology, Parliamentary Procedure, Poultry Evaluation, Public Speaking, and Veterinary Science.

Using Work-Based Learning (WBL) in Your Classroom

Sustained and coordinated activities that relate to the course content are the key to successful work-based learning. Possible activities for this course include the following. This is not an exhaustive list.

- **Standards 1.1-2.3 |** Invite a vet tech or veterinarian to discuss the history and trends within the industry including animal and personal safety.
- **Standards 3.1-3.2 |** Interview veterinary health care professionals about veterinary laws and ethics.
- **Standards 4.1-9.5 |** Participate in an abbreviated internship to practice approved veterinary care skills.
- **Standards 10.1-10.2 |** Participate in an employee orientation at a veterinarian office or clinic to focus on communication and recordkeeping.

Course Description

Veterinary Science is an advanced course in animal science and care for students interested in learning more about becoming a veterinarian, vet tech, vet assistant, or pursuing a variety of scientific, health, or agriculture professions. This course covers principles of health and disease, basic animal care and nursing, clinical and laboratory procedures, and additional industry-related career and leadership knowledge and skills. Upon completion of this course, students will be able to pursue advanced study of veterinary science at a postsecondary institution.

Course Standards

1. Economic, Occupational, and Technological Implications

1.1 Career Exploration: Explore and compare **local and regional career opportunities in the veterinary science industry** using information from local job postings and Tennessee labor data**. Describe the knowledge, skills, and abilities necessary for a selected occupation** in veterinary and related careers.

1.2 Emerging Technologies: Examine specific **technologies** that have evolved within the veterinary science industry including but not limited to advances in **equipment and procedures** in healthcare, and evaluate the economic and societal implications of each. Explain how these **advances have impacted the veterinary science industry**.

2. Personal and Occupational Health and Safety

2.1 Occupational Safety: Compare and contrast the **safety hazards associated with clinical and field settings**. Review safety hazard case studies and recommend research-based practices to prevent the safety hazard in the future.

2.2 Safety and Operational Procedures: Review common **laboratory safety procedures for tool and equipment operation** in the veterinary science laboratories, including but not limited to **accident prevention and control procedures.** Demonstrate the ability to follow safety and operational procedures in a lab setting and complete a safety test with 100 percent accuracy.

2.3 Personal and Animal Safety: Demonstrate the ability to **follow procedures precisely** for the following areas:

a. Animal restraint and handling in clinical or field settings
b. Sanitation, disinfection, and sterilization procedures to prevent the transfer of zoonotic diseases

3. Globally Harmonized System (GHS) chemical data sheets interpretation**Veterinary Law and Ethics**

3.1 Ethical Issues: Gather and compare information on the **philosophical, social, moral, and ethical issues** encountered in the veterinary profession. Debate their implications for practitioners of veterinary science by developing claim(s) and counterclaim(s) supported by reasoning and evidence from research.

3.2 Legal Regulations: Research **legislation, local, state, and federal laws** that regulate policies and procedures in veterinary medicine to summarize the following:

a. Animal rights and welfare
b. Professional licensing
c. Liability of veterinary staff
d. U.S. Food and Drug Administration (FDA), U.S. Department of Agriculture (USDA), and U.S. Environmental Protection Agency (EPA) regulations for veterinary drugs and biologicals
e. Occupational Safety and Health Administration (OSHA) regulations for workplace safety

4. Clinical Anatomy and Physiology

4.1 Clinical Terminology: Identify common **clinical terminology, abbreviations, and symbols** relating to the diagnosis, pathology, and treatment of animals.

4.2 Cellular Homeostasis: Recognize various states of **cellular homeostasis** to identify infections, diseases, and mutations.

4.3 Tissue Anatomy: Review fundamental concepts about **tissue and organ systems** by comparing and contrasting the structure and function of different tissue types, including epithelial, connective, muscle, and nervous tissues. Explain **how cellular differentiation** allows for specialized tissue development.

4.4 Body Systems: Identify and research the **major body systems**, including the skeletal, muscular, respiratory, digestive, nervous, integumentary, urinary, and reproductive systems. Develop models to compare and contrast between different **species of small and large domesticated animals.**

5. Clinical Nutrition

5.1 Nutritional Assessment: Perform **nutritional assessment techniques**, including body condition scoring and life stage to determine the nutritional status of animals. Apply this information to recommend **balanced rations,** and justify the recommendations.

6. Diseases and Disorder: Research the **relationships of diseases and disorders to digestion, absorption, and metabolic processes**. Assess the impact of various diseases and disorders on the **maintenance of optimum nutrition levels** in the animal's body. **Clinical Procedures**

6.1 Equipment: Correctly identify and describe the **function of common equipment** used in the clinical area of a veterinary practice, including but not limited to examination tools, radiology equipment, ultrasound equipment, surgical equipment, and testing equipment. Develop a checklist including safe use and maintenance for specific equipment.

6.2 Procedures: Demonstrate, in a live setting or a presentation, **physical examination procedures** in the following areas:

a. Identification of exam purpose, importance, and routine tasks
b. Completion of new client health history report
c. Identification and evaluation of factors affecting the physiological state of animals
d. Identification of characteristics and signs of healthy animals
e. Demonstration of procedures to accurately obtain and record vital signs
f. Identification and evaluation of effects of age, stress, and environmental factors on vital signs

6.3 Vaccines and Injections: Identify and recommend the optimum timeline for administering different **types of vaccines** suitable for different species. Demonstrate, in a live setting or a presentation, the ability to:

a. Identify injection methods
b. Identify appropriate anatomical injection sites
c. Administer the injection, including the selection of appropriate equipment

6.4 Contamination Prevention: Explain the importance of **contamination prevention** as related to the veterinary industry. Demonstrate the ability to explain and follow contamination control procedures relating to the following areas:

a. Principles of sanitation, disinfection, antiseptics, and sterilization
b. Exam room care and sanitation procedures
c. Classification of sterilants, antiseptics, disinfectants, and their appropriate applications
d. Hazardous waste management
e. Proper techniques to fill a syringe for a prescribed dosage

7. Animal Nursing

7.1 Plan of Care: Design a **care plan** by interpreting patient records and treatment plans, and performing basic nursing and patient monitoring tasks.

7.2 Basic First Aid: Outline **basic first aid, wound care, and bandaging procedures** and compare the different procedures for small and large animals. Demonstrate, in a live setting or a presentation, the ability to follow these procedures precisely, while distinguishing between small and large animals for the following areas:

a. Canine cardiopulmonary resuscitation (CPR) procedures
b. Assessment and care of common physical injuries such as cuts, abrasions, and contusions
c. Wound therapies at different phases of healing
d. Types and purposes of bandages, splints, slings, and casts, and indications for use
e. Techniques for application and removal of bandages
f. Caring for animals during the birthing process

7.3 Pharmaceutical: Research and explain **laws and regulations related to the administration of prescription and over-the-counter medication** within the veterinary industry.

Demonstrate the ability to follow **medication administration procedures** precisely, including:

a. Identification of common medications and their required storage, handling, and disposal
b. Demonstration of administration techniques for topical and oral medications
c. Interpretation of medication label and packaging information
d. Calculate proper dosages of medications based on label directions

8. Laboratory Procedures

8.1 Biological Samples: Compare and contrast appropriate **laboratory quality control procedures** such as the proper collection, preparation, handling, and storage of biological samples, and describe their effects on obtaining accurate data from laboratory procedures.

8.2 Hematology: Develop a procedural check sheet to aid in conducting **veterinary clinical hematology procedures** such as complete blood count (CBC). Using the check sheet, demonstrate the ability to follow clinical hematology procedures precisely in the following areas:

a. Sample collection, preparation, and storage
b. Microscopic examination to identify blood cells
c. Interpretation of normal and abnormal results

8.3 Urinalysis and Fecal Analysis: Explain and justify the need for conducting **urinalysis and fecal analysis** as related to animal health. Outline procedures for conducting clinical urinalysis to include the following:

a. Sample collection, preparation, and storage
b. Physical, chemical, and microscopic examination procedures
c. Interpretation of normal and abnormal results

9. Principles of Disease

9.1 Disease Prevention and Control: Compare and contrast the **role of the USDA, state veterinarians, state animal disease laws, and diagnostic labs i**n disease prevention and control. Explain the classification of diseases and disease processes, and identify causative factors and agents of disease.

9.2 Disease – Signs and Symptoms: Explain how diseases affect the body and **differentiate between clinical signs and symptoms of diseases**. Identify and describe the differences between clinical signs and symptoms of proper health and poor health.

9.3 Prevention Methods: Identify symptoms of common **animal diseases and their causative agents,** and summarize **methods of prevention, treatment, and control** by drawing evidence from informational texts or recent medical literature.

9.4 Parasite Infections: Describe the clinical signs of an animal with a **parasite infection**. Compare and contrast the symptoms of common internal and external parasite infections and summarize **methods of prevention, treatment, and control** between small and large animals.

9.5 Genomics: Research how **genomics** can be used to reduce animal diseases, citing credible sources. Compare the different approaches genomics have on disease tolerance in both small and large animals.

10. Clinic Management

10.1 Front Office Operations: Demonstrate effective **oral and written communication skills** needed in clinical settings, including but not limited to client greeting, telephone answering, appointment scheduling and management, and admission and discharge procedures. Outline the **procedures for euthanasia and post-mortem customer care and** role-play appropriate grief counseling services for clients.

10.2 Business Operations: Identify the types of **medical, financial records, and recordkeeping platforms** required to ensure a viable veterinary practice. Explain, justify, and demonstrate correct procedures for the completion and filing of veterinary records, required business operational records including inventory management documents, and related documentation in a legal manner to ensure a sound business.

Standards Alignment Notes

References to other standards include:

- SAE for All: Evolving the Essentials: All Agriculture students are encouraged to participate in a Supervised Agricultural Experience (SAE) program to practice and demonstrate the knowledge and skills learned in their agriculture courses.
- P21: Partnership for 21st Century Skills Framework for 21st Century Learning
    - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

Equine Science

Primary Career Cluster:	Agriculture, Food, & Natural Resources
Course Contact:	CTE.Standards@tn.gov
Course Code:	C18H60
Prerequisite:	*Agriscience C18H19*
Credit:	1
Grade Level(s):	10,11, or 12
Programs of Study and Sequence:	This is an optional elective course to support a special program of study within the Agriculture, Food, and Natural Resources career cluster.
Aligned Student Organization(s):	FFA: http://www.tnffa.org
Coordinating Work-Based Learning:	All Agriculture students are encouraged to participate in a Supervised Agricultural Experience (SAE) program. In addition, teachers who hold an active WBL certificate may offer placement for credit when the requirements of the state board's WBL Framework and the Department's WBL Policy Guide are met. For information, visit https://www.tn.gov/education/educators/career-and-technical-education/work-based-learning.html
Promoted Tennessee Student Industry Credentials:	Credentials are aligned with postsecondary and employment opportunities and with the competencies and skills that students acquire through their selected program of study. For a listing of promoted student industry credentials, visit https://www.tn.gov/education/educators/career-and-technical-education/student-industry-certification.html
Teacher Endorsement(s):	048, 150, 448, and 950
Required Teacher Certifications:	None
Required Teacher Training:	None
Teacher Resources:	https://www.tn.gov/education/educators/career-and-technical-education/career-clusters/cte-cluster-agriculture-food-natural-resources.html Best for All Central: https://bestforall.tnedu.gov/

Course at a Glance

CTE courses provide students with an opportunity to develop specific academic, technical, and 21st-century skills necessary to be successful in their careers and lives. In pursuit of ensuring every student in Tennessee achieves this level of success, we begin with rigorous course standards that feed into intentionally designed programs of study.

Students engage in industry-relevant content through general education integration and experiences such as career & technical student organizations (CTSO) and work-based learning (WBL). Through these experiences, students are immersed with industry-standard content and technology, solve industry-based problems, meaningfully interact with industry professionals, and use/produce industry-specific, informational texts.

Using a Career and Technical Student Organization (CTSO) in Your Classroom

CTSOs are a great resource to put classroom learning into real-life experiences for your students through classroom, regional, state, and national competitions, and leadership opportunities. Below are CTSO connections for this course, note this is not an exhaustive list.

- Participate in the CTSO Fall Leadership Conference to engage with peers by demonstrating logical thought processes and developing industry-specific skills that involve teamwork and project management.
- Participate in CTSO events that align with this course including Agriscience Fair, Agricultural Issues, Employment Skills, and Horse Evaluation.

Using Work-Based Learning (WBL) in Your Classroom

Sustained and coordinated activities that relate to the course content are the key to successful work-based learning. Possible activities for this course include the following. This is not an exhaustive list.

- **Standards 1.1-2.3**| Panel of guest speakers from the equine industry to discuss career options, training, credentials, education requirements, etc. with students.
- **Standards 3.1-9.2 |** Integrated project with multiple interactions with equine industry professionals that focus on breed selection, anatomy, nutrition, genetics, and reproduction.
- **Standards 10.1-12.1 |** Virtual exchanges with an industry professional to discuss equine ethics, animal rights & welfare, equine competitions, and give feedback on students' work.

Course Description

Equine Science is designed to introduce students to the history and domestication, scientific principles of breeding, and husbandry of horses, including the production, care, and management of horses. Upon completion of this course, proficient students will be equipped with the technical knowledge and skills needed to prepare for further education and careers in the equine industry.

Course Standards

1. Domestication and Equine Organizations

1.1 History of Equine Domestication: Research the **history of equine evolution** including the domestication and historic value of equine. Identify the **important trends in *Equus* evolution** and explain **their significance**.

1.2 SAE Opportunities: Identify and describe **Supervised Agricultural Experience (SAE) opportunities** in the field of equine science. Evaluate, identify, and develop an SAE into one of the immersion SAE programs.

2. Economic and Occupational Implications

2.1 Economic Impact of the Equine Industry: Determine the **economic impact of the equine industry** by investigating, **implications** for racing, rodeo, equestrian therapy, law enforcement, and recreation industries.

2.2 Career and Entrepreneurship Opportunities: Explore and compare **local and regional career opportunities** in the equine industry including entrepreneurship opportunities and evaluate labor data to **predict the employment outlook.** Describe the **knowledge, skills, and abilities necessary for a diverse range of careers** citing specific textual evidence from local job postings and Tennessee labor data.

2.3 Business and SAE Financial Recordkeeping: Accurately maintain an active **recordkeeping system** and apply **proper accounting and financial records** as they relate to an equine-supervised agricultural experience (SAE) program or enterprise. Demonstrate the ability to summarize business records such as individual enterprise budgets, profit and loss statements, inventory management, transportation cost, and other specific reports by completing SAE and related financial applications.

3. Behavior

3.1 Behavior: Describe the **relationship between the different equine behavioral categories** and how behavior can influence training. Explain the **importance of reading the emotions of a horse** as it relates to safe handling, working, and riding the horse. Identify **common body positioning for the horse** in terms of their senses, as well as how their herd tendencies determine much about their behavior.

4. Personal and Occupational Health and Safety

4.1 Health Requirements and Regulations: Correctly identify and summarize **laws and regulations** that pertain to equine health and safety from state and national legislation. Describe **health requirements** and necessary **documentation for equine transportation and change of ownership.**

4.2 Safety and Operational Procedures: Review common **laboratory safety procedures for operating tools and equipment** in equine laboratories or facilities, including but not limited to accident prevention and control procedures. Demonstrate the ability to follow safety and operational procedures in a lab setting and complete a safety test with 100 percent accuracy.

4.3 Personal and Animal Safety: Demonstrate the ability to follow **procedures** precisely, attending to **special cases or exceptions** noted in appropriate materials, and apply them to the following:

e. Various types of behavior
f. Animal restraint and handling
g. Techniques for Transportation
h. Appropriate use of chemicals (such as pesticides, fungicide, disinfectants)
i. Differentiate between effective restraint methods for handling equine and methods proven to be less effective.

5. Anatomy and Physiology

5.1 Functional Anatomy: Summarize **the functional anatomy of the horse** as it relates to growth, aging, movement, selection, nutrition, health, breeding, and behavior. Identify the **function and the components of the skeletal, muscular, digestive, urinary, respiratory, circulatory, nervous, reproductive, and endocrine systems.**

5.2 Confirmation: Research the **importance of confirmation** when selecting an animal. Distinguish the characteristics that make the different equine breeds desirable for their specific uses. Discuss the following as it pertains to ideal confirmation:

a. Breed type
b. Balance
c. Structure correctness
d. Muscling
e. Movement
f. Quality
g. Sex character, and
h. Size

5.3 Soundness and Unsoundness: Classify common structural problems of a horse including the **problems caused by unsoundness.** Determine how to methodically examine the soundness of a horse. Describe **solutions for soundness problems** that should be **treated by a veterinarian** and explain solutions for these problems.

6. Health and Basic Management

6.1 Overall Health: Describe the relationship between **the horse's look and physical condition** and its **overall health**. Compare and contrast **equine diseases** to develop a prevention/vaccination program.

6.2 Facilities: Research **appropriate equine facilities** based on housing, space, safety, feeding, breeding, and general care requirements. Compare the **proper procedures for building a horse fence**.

6.3 Hoof Care: Summarize the **importance of healthy feet** as it relates to the overall health of the horse. Distinguish the **function of the hoof's various parts**. Outline a **hoof care inspection process**, including tools and equipment to prevent or treat common hoof problems.

7. Nutrition and Digestive Systems

7.1 Digestive Systems: Explain the **relationships of digestive system types to the ability of the equine to digest and absorb different classes of feed**. Differentiate between ruminant, non-ruminant, and cecum digestive systems**,** comparing and contrasting their anatomical and physiological differences.

7.2 Nutritional Requirements: Research **nutrient requirements of the diets of horses** and organize these into various nutrient groups. Differentiate between **roughages and concentrates** and their nutritional values.

7.3 Feed Rations: Interpret **feed labeling** and evaluate factors such as **life stage** and **activity level** to determine the **nutritional needs of the equine**. Recommend a **balanced ration feeding program.**

7.4 Managing Health through Nutrition: Classify the **symptoms of diseases** that can be **managed with nutrition**, and recommend the appropriate control procedures.

8. Breeds and Genetics

8.1 Breed Identification: Explain the **development of different breeds, types, and classes of equine**, including the unique **characteristics of each breed**. Analyzing the **historical role** of each in the development of various societies.

8.2 Principles of Genetics: Explain how the **roles of heritability, selection intensity, generation interval, and other advanced principles of genetics** (such as DNA testing for disorders) apply to predict gene and trait transfer in equine. Principles include but are not limited to the following:

- 8.2.1. Economically important traits
- 8.2.2. Interpretation and utilization of animal performance records

8.3 Color and Markings: Identify the **common coat colors, face and leg markings, and coat color patterns**. Determine genetic pairings that make up different equine color patterns.

9. Reproduction

9.1 Reproductive Systems: Research and illustrate the major components of **equine male and female reproductive systems.** Distinguish the **function of reproductive organs**, **endocrine glands, and hormones**. Compare and contrast the **physiological changes** that

occur during reproductive phases, including the estrous cycle, fertilization, gestation, parturition, and lactation.

9.2 Reproductive Methods: Discuss **methods of equine reproduction**, including semen handling, artificial insemination, embryo transfer, cloning, and neonatal care.

10. Animal Ethics

10.1 Fundamental of Animal Rights and Welfare: Identify the **fundamental philosophies related to animal rights and animal welfare**. Compare the **impact** of specific persons, organizations, and legislation related to animal rights and welfare, specific **to equine issues**.

f. Abuse and/or neglect
g. Environmental implications
h. Exhibiting and showing
i. Global equine ethic issues and their relation to local problems

11. Equine Organizations

11.1 Professional Organizations: Explain the **significance of professional organizations** to the equine industry. Identify **industry-related professional organizations** and describe their benefits.

12. Equitation

12.1 Equitation: Compare and contrast the two common **styles of riding horses**, English and Western. Identify the proper **tack and equipmen**t for the different styles of riding, discuss the **history of the different styles** and their **competitions**, and discuss the s**imilar practices** amongst the different styles to display quality horsemanship.

Standards Alignment Notes

*References to other standards include:

- SAE for All: Evolving the Essentials: All Agriculture students are encouraged to participate in a Supervised Agricultural Experience (SAE) program to practice and demonstrate the knowledge and skills learned in their agriculture courses.
- AFNR: National Agriculture, Food, & Natural Resources (AFNR) Career Cluster Content Standards: Students who are engaging in the activities outlined above should be able to demonstrate fluency in Standards AS, CS, and PS at the conclusion of the course.
- P21: Partnership for 21st Century Skills Framework for 21st Century Learning
    - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

Floral Design and Operations

Primary Career Cluster:	Agriculture, Food, & Natural Resources
Course Contact:	CTE.Standards@tn.gov
Course Code:	C18H59
Prerequisite:	*Agriscience C18H19*
Credit:	1
Grade Level(s):	10-11-12
Programs of Study and Sequence:	This is an optional elective to support an approved special program of study.
Aligned Student Organization(s):	FFA: http://www.tnffa.org
Coordinating Work-Based Learning:	All Agriculture students are encouraged to participate in a Supervised Agricultural Experience (SAE) program. In addition, teachers who hold an active WBL certificate may offer placement for credit when the requirements of the state board's WBL Framework and the Department's WBL Policy Guide are met. For information, visit https://www.tn.gov/education/educators/career-and-technical-education/work-based-learning.html
Promoted Tennessee Student Industry Credentials:	Credentials are aligned with postsecondary and employment opportunities and with the competencies and skills that students acquire through their selected program of study. For a listing of promoted student industry credentials, visit https://www.tn.gov/education/educators/career-and-technical-education/student-industry-certification.html
Teacher Endorsement(s):	048, 150, 448, and 950
Required Teacher Certification:	None
Required Teacher Training:	None
Teacher Resources:	https://www.tn.gov/education/educators/career-and-technical-education/career-clusters/cte-cluster-agriculture-food-natural-resources.html Best for All Central https://bestforall.tnedu.gov/

Course at a Glance

CTE courses provide students with an opportunity to develop specific academic, technical, and 21st-century skills necessary to be successful in their careers and lives. In pursuit of ensuring every student in Tennessee achieves this level of success, we begin with rigorous course standards that feed into intentionally designed programs of study.

Students engage in industry-relevant content through general education integration and experiences such as career & technical student organizations (CTSO) and work-based learning (WBL). Through these experiences, students are immersed with industry-standard content and technology, solve industry-based problems, meaningfully interact with industry professionals, and use/produce industry-specific, informational texts.

Using a Career and Technical Student Organization (CTSO) in Your Classroom

CTSOs are a great resource to put classroom learning into real-life experiences for students through classroom, regional, state, and national competitions, and leadership opportunities. Below are CTSO connections for this course; note this is not an exhaustive list.

- Participate in the CTSO Fall Leadership Conference to engage with peers by demonstrating logical thought processes and developing industry-specific skills that involve teamwork and project management.
- Participate in CTSO events that align with this course including Agriscience Fair, Agricultural Issues, Agricultural Sales, Cooperative Development Challenge, Employment Skills, and Floriculture

Using Work-Based Learning (WBL) in Your Classroom

Sustained and coordinated activities that relate to the course content are the key to successful work-based learning. Possible activities for this course include the following. This is not an exhaustive list.

- **Standards 1.1-1.4** | Panel of guest speakers from the floral design industry to discuss career options, training, credentials, education requirements, etc. with students.
- **Standards 2.1-5.5 |** Integrated project with multiple interactions with floral industry professionals that focus on plant material selection, care, designs, and special events.
- **Standards 6.1-6-8 |** Virtual exchanges with a florist or industry professionals to discuss successful advertising methods, contract negotiations, business plan development, drafting financial documents, and giving feedback on students' work.

Course Description

Floral Design and Operations is designed to identify and demonstrate the principles and techniques related to floral design as well as develop the skills needed to manage floral enterprises. This course covers the analysis of artistic floral styles, historical periods, and diverse cultures. Upon completion of this course, proficient students will be equipped with the technical knowledge and skills needed to prepare for further education and careers in floral design.

Course Standards

1. Introduction to the Field of Floral Design

14.2 History and Significance of Floral Design: Research the history and significance of the **field of floral design**, including regional, state, national, global, and cultural influences.

14.3 Career and Entrepreneurship Opportunities: Explore the **local, regional, state, national, and global career and entrepreneurship opportunities** in the field of floral design. Use multiple printed, online, and/or personal interview sources, to capture at a minimum the following:

g. Job description
h. Employer expectations and/or work habits
i. Essential knowledge and skills
j. Program or path of study to reach occupational goals, starting with high school through postsecondary options
k. Credentialing and/or licensure requirements
l. Non-educational job requirements such as minimum age, experience in the field, physical fitness tests, background checks, or other notable evaluations

1.3 SAE Opportunities in Floral Design: Identify and describe the types of **Supervised Agricultural Experience (SAE) opportunities** in the field of floral design. Evaluate and identify the **opportunities to develop into an immersion SAE program**.

1.4 Professional Organizations: Explain the **significance of professional organizations** to the floral design industry. Identify **industry-related professional organizations** and describe the **benefits** provided by each.

2. Plant Identification and Management

2.1 Plant Identification: Apply concepts of **scientific taxonomy and industry-specific terminology** to classify and identify flowers, foliage, greenery, and potted plants according to their use in designs.

a. Cut flowers
b. Silk flowers
c. Filler plants
d. Live plants

2.2 Plant Form and Textures: Categorize common cut **flowers and foliage based on their form and texture**. Create an **identification portfolio** of the most commonly used cut flowers and foliage.

2.3 Plant Health and Longevity: Determine the **basic plant components that affect plant growth and health**. Differentiate between:

a. The relationship among fertilizer, preservatives, and cutting techniques to increase the longevity of floral plant materials, and

b. The use of temperature and preservatives to increase the life of cut flowers and foliage.

3. Elements of Floral Art and Design

3.1 Floral Art: Differentiate the **aesthetic benefits of floral design** as they relate to the design, harmony, and unity. Determine the **principles of design and elements of art** in floral arrangements.

3.2 Design Styles: Compare and contrast common **floral design styles and their characteristics.** Analyze the effective use of design schema, sources of inspiration, design proportions, form, line, space, color, and texture in various floral designs.

3.3 Contemporary Design: Explain the **purpose of contemporary floral design** including specific details on the classic mass style, naturalistic design, linear/architectural style, modernistic design, and the Japanese style. Design and create various contemporary designs and establish a suggested retail price for each.

3.4 Design Techniques: Prepare and evaluate **floral designs** using various **basic and advanced design techniques**, including abstract, assemblage, asymmetrical, cascade, elliptical, layering, terracing, pave, pillowing, s-grouping, banding, framing, parallelism, thematic, and seasonal designs.

3.5 Floral Materials and Equipment: Compare and contrast **floral design materials** such as the types of floral foam, florist wire, florist tapes, adhesives, ribbons, floral bows, and other **equipment used to properly create and design floral arrangements**. Describe and demonstrate the **ability to select the appropriate materials** to complement specific floral designs.

4. Preservation Techniques

4.1 Floral Preservation: Research and explain the **process for the preservation of floral arrangements**. Demonstrate the **use of preserving flowers** using one or more of the preservation techniques.

a. Air drying
b. Desiccant
c. Microwaving
d. Pressing
e. Treating with glycerin
f. Bleaching/drying

5. Special Events

5.1 Weddings: Identify **wedding-related events that require a floral designer**. Outline a list of wedding-related events that require floral arrangements (i.e. bridal luncheon, rehearsal dinner, etc.).

5.2 Wedding Arrangements: Develop a list of **basic flower arrangements and individual flowers used for the venue and by the wedding party**. Design and create different bouquets and wedding arrangements.

5.3 Funerals: Compare and contrast the **history of flowers used in the funeral industry**. Summarize current **trends in sympathy designs** distinguishing between the different styles of sympathy tributes.

5.4 Sympathy Tributes: Identify **foliage, cut flowers, and live plants commonly used as sympathy tributes**. Design and create a sympathy tribute.

5.5 Special Event Planning: Evaluate and select **floral design elements that achieve the objectives and budget expectations of an occasion or event**. Present a proposal that showcases at least the floral design elements, installation, dismantling of flora décor, production schedules, and procurement plan.

6. Floral Business Operations

6.1 Advertising Media: Compare and contrast **types of floral advertising media,** analyzing which types are best suited for certain, services or events by citing authentic examples.

6.2 Social Media Advertising: Explain the **impact of social media advertising** on increasing market reach and customer interaction. Compare and contrast **features and benefits** of major social media platforms (e.g., Facebook, Instagram, LinkedIn, TikTok, etc.), synthesizing **characteristics and components** of each to determine which platforms will lead to effective promotions.

6.3 Communication and Customer Service: Contrast appropriate **verbal and non-verbal communication skills** when interacting with customers, peers, and, supervisors using both traditional and digital methods, including social media. Evaluate the **impact** each skill has on customer relations/service standards.

6.4 Contract Documents: Analyze basic **contractual principles and procedures** entrepreneurs and small businesses can apply toward events and services. Demonstrate **contract negotiation** techniques within set pricing policies for a special event.

6.5 Business Plan: Explain the **purpose and main parts of a business plan** (i.e. business description, management plan, marketing plan, and financial plan). And describe the **importance of developing a business plan** for securing potential investors or lenders. Develop an original **business philosophy** detailing one's beliefs for how a business should run.

6.6 Fixed and Variable Expenses: Differentiate between **fixed and variable expenses** on a business income statement. Select three of the expenses listed and determine their

importance to the business. Analyze **cost-cutting strategies** a florist might take to minimize expenses in each category.

6.7 Financial Documents: Prepare a **mock purchase order, invoice,** and/or **sales receipt** (including shipping and taxes) for a sample product/package. Explain the **elements of the financial document** and identify any **mistakes and miscalculations** to assist a mock client.

6.8 Budget Planning: Describe the process of **developing a budget**, and identifying its **elements**, including income statement, balance sheet, and cash flow. Plan a budget for a special event or occasion. Create a comprehensive **budget narrative**, including both a written statement and a summary worksheet listing all expenses, to justify each cost.

Standards Alignment Notes

References to other standards include:

- SAE for All: Evolving the Essentials: All Agriculture students are encouraged to participate in a Supervised Agricultural Experience (SAE) program to practice and demonstrate the knowledge and skills learned in their agriculture courses.
- AFNR: National Agriculture, Food, & Natural Resources (AFNR) Career Cluster Content Standards: Students who are engaging in the activities outlined above should be able to demonstrate fluency in Standards AS, CS, and PS at the conclusion of the course.
- P21: Partnership for 21st Century Skills Framework for 21st Century Learning
    - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

Introduction to Geographic Information Systems (GIS)

Primary Career Cluster:	**Agriculture, Food, and Natural Resources**
Course Contact:	CTE.Standards@tn.gov
Course Code:	C18H39
Prerequisite(s):	*Algebra I* (G02X02, G02H00) and *Geometry* (G02H11, G02X03)
Credit:	1
Grade Level(s):	11-12
Elective Focus-Graduation Requirements:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other Agriculture, Food, & Natural Resources, *Architecture & Construction, IT, or STEM,* courses.
POS Concentrator:	This course satisfies one out of two required courses to meet the Perkins V concentrator definition when taken in sequence in the approved special program of study.
Programs of Study (POS) Sequence:	This is an optional elective to support multiple special programs of study.
Aligned Student Organization(s):	FFA: http://www.tnffa.org SkillsUSA: http://www.skillsusatn.org/ Technology Student Association (TSA): http://www.tntsa.org
Coordinating Work-Based Learning:	All Agriculture students are encouraged to participate in a Supervised Agricultural Experience (SAE) program. In addition, teachers who hold an active WBL certificate may offer placement for credit when the requirements of the state board's WBL Framework and the Department's WBL Policy Guide are met. For information, visit https://www.tn.gov/education/educators/career-and-technical-education/work-based-learning.html.
Promoted Tennessee Student Industry Credentials:	Credentials are aligned with postsecondary and employment opportunities and with the competencies and skills that students acquire through their selected program of study. For a listing of promoted student industry credentials, visit https://www.tn.gov/education/educators/career-and-technical-education/student-industry-certification.html
Teacher Endorsement(s):	013, 014, 015, 016, 017, 018, 022, 047, 048, 070, 078, 081, 125, 126, 127, 128, 129, 131, 150, 151, 157, 210, 211, 212, 213, 214, 230, 232, 233, 413, 414, 415, 416, 417, 418, 422, 448, 470, 477, 519, 531, 595, 596, 700, 740, 760, 950, 951, 982
Required Teacher Certification:	None
Required Teacher Training:	Teachers who have never taught this course MUST attend GIS training approved by the Department of Education or successfully complete Esri Technical certification.
Teacher Resources:	https://www.tn.gov/education/educators/career-and-technical-education/career-clusters/cte-cluster-agriculture-food-natural-resources.html Best for All Central https://bestforall.tnedu.gov/

Course at a Glance

CTE courses provide students with an opportunity to develop specific academic, technical, and 21st-century skills necessary to be successful in their careers and lives. In pursuit of ensuring every

student in Tennessee achieves this level of success, we begin with rigorous course standards that feed into intentionally designed programs of study.

Students engage in industry-relevant content through general education integration and experiences such as career and technical student organizations (CTSO) and work-based learning (WBL). Through these experiences, students are immersed with industry-standard content and technology, solve industry-based problems, meaningfully interact with industry professionals, and use/produce industry-specific, informational texts.

Using a Career and Technical Student Organization (CTSO) in Your Classroom

CTSOs are a great resource to put classroom learning into real-life experiences for students through classroom, regional, state, and national competitions, and leadership opportunities. Below are CTSO connections for this course, note this is not an exhaustive list.

- Participate in the CTSO Fall Leadership Conference to engage with peers by demonstrating logical thought processes and developing industry-specific skills that involve teamwork and project management.
- Participate in CTSO events that align with this course including Agriscience Fair, Agricultural Issues, Employment Skills, and Geospatial Technology.

Using Work-Based Learning (WBL) in Your Classroom

Sustained and coordinated activities that relate to the course content are the key to successful work-based learning. Possible activities for this course include the following. This is not an exhaustive list.

- **Standards 1.1-1.3** | Tour the city's emergency management command center and have the manager discuss the different careers needing this type of experience.
- **Standard 2.1-4.6** | Have the students work on projects that are supervised or evaluated by a geographic information systems (GIS) technician.

Course Description

Introduction to Geographic Information Systems is an applied course for students who have already mastered basic computer skills and wish to apply those skills in novel contexts with the use of geographic information systems (GIS) and geospatial technologies. Upon completion of this course, proficient students will develop the ability to reason spatially and analyze relationships among concepts; capture, store, validate, integrate, analyze, and display data related to locations on Earth; and create, query, maintain, and modify geospatial datasets. They will learn how GIS is used as a decision-making and data management tool to solve problems in various industries and fields. Furthermore, students will use GIS software to create a spatially accurate map with data retrieved from online or locally available resources.

Course Standards

1. Geographic Information Systems Overview

1.1 Elevation: Research the **history of mapping, geographic information systems (GIS)**, global positioning systems (GPS), remote sensing, and other geospatial technologies. Examine how these technologies have evolved, concentrating on their recent migration towards online platforms, and evaluate their influence on present-day society.

1.2 Careers: Explore several **occupations related to the GIS and geospatial technologies fields** (e.g., GIS analyst, GIS technician, cartographer, geospatial information scientist, geospatial information technologist, geographer, engineer, and urban and regional planner) and describe the many **sources and types of information**, such as **government, private, and open-source data**, that these occupations use. Determine how various industries employ different kinds of data to meet their needs.

1.3 Occupational Requirements: Investigate an assortment of **skills and education required for GIS and geospatial technology professionals**. Write an informative text that identifies the typical educational and certification requirements, working environments, and career opportunities for these occupations. For example, participate in an information-gathering tour of a local organization that uses GIS technology, and report on the roles and responsibilities of GIS professionals on staff, including the kinds of software and equipment they use.

2. Geography

2.1 Mapping Systems: Distinguish among the **characteristics of various types of maps**, including but not limited to topographic maps, physical maps, choropleth maps, and heat maps. Explain how they are used to conduct different types of GIS analysis, as well as what types of information they communicate. For example, look at how census data can be displayed as choropleth maps representing various data fields (e.g., average household income, household size, etc.). Identify key elements of a map, demonstrate how to read a topographic map, and explain how maps can be derived from aerial photography.

2.2 Coordinate Systems: Identify locations within various coordinate systems such as the Geographic Coordinate System, Universal Transverse Mercator (UTM), and the State Plane Coordinate System. Explain the difference between a **Cartesian and a geographic**

coordinate system. Demonstrate the ability to convert latitude and longitude information between degree-minute-second (DMS) and decimal-degree (DD) forms.

2.3 Vector Data: Distinguish among the **characteristics of various types of data such as vector data** (i.e., points, lines, polygons) **and raster data**, and explain how they are used to conduct GIS research and analysis. For example, using GIS software demonstrates how to select layers to create various views of a location or create buffers around vector data features.

3. Database Management

3.1 Database Systems: Find common **data sources that can be used to conduct geospatial analysis**. Compare and contrast government versus open-source databases for retrieving a range of geospatial data. For example, compare the validity of data retrieved from OpenStreetMap (OSM) with data retrieved from the Census Bureau.

3.2 Data Management: Apply data entry **techniques to enter and manipulate text and data** using various software applications (e.g., spreadsheets, presentations, word processing, and database management systems). For example, create a spreadsheet with coordinate data and upload the data to a GIS. Review and evaluate the input for accuracy, quality, and completeness of documentation.

3.3 Filing Systems: Understand and demonstrate the **effective use of file and folder management techniques** for either Windows or Mac environments. For example, demonstrate knowledge of the interoperability between Microsoft Office and Esri products or the use of cloud computing and a GIS.

4. Software Applications and GIS Analysis

4.1 Geospatial Database: Perform a multistep procedure that a GIS technician would follow to build a **geospatial database and manipulate the data within a GIS software package**. For example, implement a workflow to use GPS equipment to collect data and transfer that data to a GIS. Use the GIS to measure distance, calculate area, edit feature data, and display features and map elements.

4.2 Data analysis: Demonstrate how to **symbolize, edit, sort, and query data in GIS software**, and how to effectively use **zooming, identifying, selecting, and panning tools**. Practice communicating the procedures to others in a mock workplace scenario, such as a situation when a geospatial technologist must provide technical support to a telecommunications client.

4.3 Summary Reports and Illustrations: Analyze spatially based data to **create reports and construct graphic illustrations** (e.g., bar graphs, scatter plots, histograms, and maps) for a technical or lay audience using GIS software and other technologies. Interpret the information assembled in the form of summary and descriptive statistics (e.g., mean, median, mode, and range), and discuss how the results could be used as decision-making tools in various fields (e.g., agriculture, health care, community planning, engineering, banking and financial services, transportation, or public safety).

4.4 Map Development: Plan and implement a multistep **procedure to layout and print maps**, including the development of map templates. This procedure should include but is not limited to defining page margins and parameters for printing a specific size, effectively using required map elements (e.g., title, author, data sources, legend, north arrow, and scale bar), and creating digital archives of maps.

4.5 Identifying Trends: Develop a research question that will guide an **examination and analysis of a geographic trend or phenomenon occurring in society**. Research findings and represent data in maps and other graphic illustrations (e.g., bar graphs, scatter plots, histograms). For example, investigate how industrial development affects the population of various animals in a specified area.

4.6 Project: Research an **issue affecting the community that can be analyzed using GIS**. Define the scope of the problem and develop a research question that will guide a service-learning project to address the problem. Using public data such as the American Community Survey, conduct an original analysis of the problem, engage community members and affected populations, and deliver the results in the form of a poster or multimedia presentation. The presentation should be of academic competition quality and should discuss the problem statement/research question, descriptive information on the community, the methodology used to explore the problem, and a recommended solution justified by GIS analysis.

Standards Alignment Notes

*References to other standards include:

- SAE for All: Evolving the Essentials: All Agriculture students are encouraged to participate in a Supervised Agricultural Experience (SAE) program to practice and demonstrate the knowledge and skills learned in their agriculture courses.
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Agriculture, Food, and Natural Resources Practicum

Primary Career Cluster:	Agriculture Food and Natural Resources
Course Contact:	CTE.Standards@tn.gov
Course Code:	TBD
Prerequisite:	Minimum of two credits in an Agriculture, Food, and Natural Resources program of study.
Credit:	1 credit
Grade Level:	12
Elective Focus-Graduation Requirements:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other Agriculture, Food, and Natural Resources courses.
POS Concentrator:	This course satisfies one out of two required courses to meet the Perkins V concentrator definition when taken in sequence in the approved program of study.
Programs of Study and Sequence:	This is the fourth course in the *Agribusiness, Agriculture Engineering, Industrial and Mechanical Systems, Environmental and Natural Resource Management, Food Science, Horticulture Science, and Veterinary and Animal Science* program of study.
Aligned Student Organization:	National FFA Organization (https://www.tnffa.org)
Coordinating Work-Based Learning:	Teachers are encouraged to use embedded WBL activities such as informational interviewing, job shadowing, and career mentoring. For information, visit https://www.tn.gov/education/educators/career-and-technical-education/work-based-learning.html.
Promoted Tennessee Student Industry Credentials:	Credentials are aligned with postsecondary and employment opportunities and with the competencies and skills that students acquire through their selected program of study. For a listing of promoted student industry credentials, visit https://www.tn.gov/content/tn/education/educators/career-and-technical-education/student-industry-certification.html.
Teacher Endorsement(s):	048, 150, 448, and 950
Required Teacher Certifications:	None
Required Teacher Training:	If students are assigned to work-based learning settings, teachers must attend WBL training and earn the WBL Certificate provided by the Tennessee Department of Education.
Teacher Resources:	https://www.tn.gov/education/educators/career-and-technical-education/career-clusters/cte-cluster-agriculture-food-natural-resources.html Best for All Central: https://bestforall.tnedu.gov/

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Using a Career and Technical Student Organization (CTSO) in Your Classroom

CTSOs are a great resource to put classroom learning into real-life experiences for students through classroom, regional, state, and national competitions, and leadership opportunities. Below are CTSO connections for this course. Note this is not an exhaustive list.

- Participate in the CTSO Leadership Conference to engage with peers by demonstrating logical thought processes and developing industry-specific skills that involve teamwork and project management.
- Participate in contests that highlight job skill demonstrations such as Nursery and Landscape, Veterinary Science, Floriculture, Agriculture Mechanics, Agricultural Communications, Cooperative Development Challenge, and Marketing Plan.
- Participate in leadership activities such as Prepared Public Speaking, Extemporaneous Public Speaking, Parliamentary Procedure, and Employment Skills.

For more ideas and information, visit Tennessee FFA at www.tnffa.org and the national organization at National FFA (www.ffa.org/participate/cde-lde/).

Using Work-Based Learning (WBL) in Your Classroom

Sustained and coordinated activities related to the course content are the key to successful work-based learning. Possible activities for this course include the following. This is not an exhaustive list.

- **Standard 4.1-4.2** | Partner with a local business or agency for the final project.
- **Standard 5.1-5.3**| Participate in a mock interview using the finalized portfolio.
- **Standard 6.1-6.4** | Critically problem-solve for a solution to the project.

Course Description

Agriculture, Food, and Natural Resource Practicum is a fourth-year course designed to prepare students to pursue careers in the fields of agriculture-related industries. Upon completion of this course, proficient students will be able to explain advanced agriculture problems and practices. In addition, students will add artifacts and finalize a portfolio for use when applying for scholarships and/or jobs.

Course Requirements

This capstone course aligns with the requirements of the Work-Based Learning Framework (established in Tennessee State Board High School Policy), with the Tennessee Department of Education's Work-Based Learning Policy Guide, and with state and federal Child Labor Law. As such, the following components are course requirements.

Course Standards

1. Professional Standards and Employability Skills

1.1 **Practice Personal and Occupational Health and Safety:** Demonstrate **personal and occupational health and safety practices in the workplace** to ensure their well-being and that of others.

1.2 **Examine Employer Expectations:** Examine and understand **employer expectations and demonstrate appropriate work habits** accordingly.

1.3 **Pursue Licensing, Certification, and Credentialing:** Actively **pursue and meet appropriate licensing, certification, and credentialing** requirements relevant to their field of study or occupation.

2. Critical Thinking and Problem-Solving

2.1 **Analysis of Problem Elements:** Analyze the **components of a problem to develop creative and innovative solutions.**

2.2 **Information Analysis:** Analyze information to **determine its relevance** and value in addressing the problem at hand.

2.3 **Comparison of Alternatives: Compare and contrast various alternatives** using a range of problem-solving and critical-thinking skills.

2.4 **Technical Research:** Conduct technical research to **gather necessary information for making informed decisions and solving problems** effectively.

3. Teamwork and Leadership Skills

3.1 Teamwork Skills: Work cooperatively with others to accomplish tasks, showcasing their ability to **collaborate effectively to promote team building**, consensus, continuous improvement, respect for others' opinions, cooperation, adaptability, and conflict resolution. Exhibit responsibility for both individual and shared group work tasks, contributing to the collective effort.

a. **Career Development Event**: Complete the **Team Activity** Portion of an aligned Career Development Event (CDE).
b. **Program of Activities**: **Plan and conduct** an event in one of the following areas:
    - growing leaders,
    - building communities, or
    - strengthening agriculture.

3.2 Communication Skills: Apply appropriate **technical concepts and vocabulary** when analyzing information, including the following:

a. **Verbal Skills:** Demonstrate proficiency in **employing verbal skills to gather and convey information** effectively.
b. **Utilization of Informational Texts:** Review, use, and **apply information from various sources** such as texts, websites, or technical materials for occupational tasks.
c. **Evaluation of Information:** Assess the **reliability of information** obtained from different sources.
d. **Interpretation of Cues:** Interpret both **verbal and nonverbal cues and behaviors** to enhance communication effectiveness.
e. **Active Listening:** Apply **active listening skills to obtain and clarify information** during communication.
f. **Effective Written and Oral Communication: Facilitate effective communication using appropriate academic skills**, both in written and oral forms.

4. Final Project

4.1 Research Project: Choose or build on a prior **Agriscience Project or Supervised Agricultural Experience (SAE)** and apply advanced engineering principles and science techniques to solve a real-world challenge. Include problem identification and research to design, implement, and evaluate.

a. **Effectively use technology**, search engines, databases, and any other electronic tool to locate information.
b. **Evaluate quality, accuracy, completeness, reliability, and currency of information** from any source.
c. **Prepare, organize, present, and apply independent research,** accept constructive criticism, and revise personal views when warranted by valid evidence.
d. **Report all evidence** and findings in a digital portfolio.

5. Personal Portfolio

5.1 Portfolio Development: Create a **personal digital portfolio**, or similar collection of work, that illustrates mastery of skills and knowledge in the program of study.

5.2 Artifact Collection: Identify and **collect artifacts and/or work products that reflect the skills developed and knowledge gained** through the program of study. Artifacts might include the following:

a. document attainment of technical skill competencies;
b. document licensures or certifications;
c. showcase recognitions, awards, and scholarships;
d. demonstrate extended learning experiences such as community service and active participation in career and technical student organizations and professional organizations;
e. highlight key points of the practicum;
f. document samples of work; and
g. demonstrate partnership with interested stakeholders.

5.3 Self-Assessment: Assess personal growth through thoughtful reflection and accurately self-assess to **identify opportunities for further growth and development** in the future. Products may include but are not limited to the following:

a. career and professional development plan,
b. resume and/or references,
c. examples of materials developed and used throughout the program,
d. project planning documents,
e. journal entries reflective of tasks and activities, and
f. projects that document skill development.

Standards Alignment Notes

*References to other standards include:

- SAE for All: Evolving the Essentials: All Agriculture students are encouraged to participate in a Supervised Agricultural Experience (SAE) program to practice and demonstrate the knowledge and skills learned in their agriculture courses.
- AFNR: National Agriculture, Food, & Natural Resources (AFNR) Career Cluster Content Standards: Students who are engaging in the activities outlined above should be able to demonstrate fluency in Standards AS, CS, and PS at the conclusion of the course.
- P21: Partnership for 21st Century Skills Framework for 21st Century Learning
    - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

Exploring Agricultural Education

Primary Career Cluster:	Agriculture, Food, & Natural Resources
Course Contact:	CTE.Standards@tn.gov
Course Code:	C18X01
Prerequisite:	None
Credit:	1
Grade Level:	6
Graduation Requirements:	This course does not satisfy credit attainment for concentrator status, because it is not part of an approved program of study.
Programs of Study and Sequence:	This course serves as a middle school primer for all programs of study in the Agriculture, Food, & Natural Resources career cluster.
Aligned Student Organization(s):	FFA: http://www.tnffa.org
Supervised Agricultural Experience:	All Agriculture students are encouraged to participate in a Supervised Agricultural Experience (SAE) program. In addition, teachers who hold an active WBL certificate may offer placement for credit when the requirements of the state board's WBL Framework and the Department's WBL Policy Guide are met. For information, visit https://www.tn.gov/education/educators/career-and-technical-education/work-based-learning.html.
Available Student Industry Certifications:	None
Teacher Endorsement(s):	048, 150, 448, and 950
Required Teacher Certification:	None
Required Teacher Training:	None
Teacher Resources:	https://www.tn.gov/education/educators/career-and-technical-education/career-clusters/cte-cluster-agriculture-food-natural-resources.html Add "Best for All Central: https://bestforall.tnedu.gov/

Course at a Glance

CTE courses provide students with an opportunity to develop specific academic, technical, and 21st-century skills necessary to be successful in their careers and lives. In pursuit of ensuring every student in Tennessee achieves this level of success, we begin with rigorous course standards that feed into intentionally designed programs of study.

Students engage in industry-relevant content through general education integration and experiences such as career and technical student organizations (CTSO) and work-based learning (WBL). Through these experiences, students are immersed with industry-standard content and technology, solve industry-based problems, meaningfully interact with industry professionals, and use/produce industry-specific, informational texts.

Using a Career and Technical Student Organization (CTSO) in Your Classroom

CTSOs are a great resource to put classroom learning into real-life experiences for students through classroom, regional, state, and national competitions, and leadership opportunities. Below are CTSO connections for this course, note this is not an exhaustive list.

- Participate in the CTSO Fall Leadership Conference to engage with peers by demonstrating logical thought processes and developing industry-specific skills that involve teamwork and project management.
- Participate in FFA career and leadership events (CDE/LDE) that align with this course including but not limited to Agriscience Fair, Agricultural Communications, Agricultural Issues, Conduct of Meetings, Creed Speaking, Dairy Cattle handlers, Employment Skills, and Extemporaneous Speaking.

Using Work-Based Learning (WBL) in Your Classroom

Sustained and coordinated activities that relate to the course content are the key to successful work-based learning. Possible activities for this course include the following. This is not an exhaustive list.

- **Standards 1.1-1.3** | Invite an industry representative as a guest speaker to discuss the history and impacts made because of the agriculture industry.
- **Standard 4.1-4.2** | Interview local agricultural professionals to determine career opportunities and skills needed to secure employment.
- **Standard 5.1-12.1** | Job shadow virtually or in person an industry representative to focus on their roles and responsibilities.

Course Description

Exploring Agricultural Education analyzes the different aspects of the agricultural industry. This course is designed to provide a general introduction to the diverse career opportunities in the agriculture, food, and natural resource industry. This course helps students understand the importance of agriculture in daily life by exploring basic principles of agribusiness, agricultural mechanics, animal science, natural resources, horticulture/plant science, technology, and supply chain.

Course Standards

1. Definition and History of Agriculture

1.1 Define Agriculture: Research the term **agriculture** to develop a working definition.*

1.2 Comprehensive Definition: Create a written report of all the areas of agriculture to condense your report into a **comprehensive definition of agriculture**.*

1.3 History: Prepare a timeline of the **major events or milestones in the history of agriculture** in the world.*

2. Agriscience Investigations Methods and Engineering Design Process

2.1 Science and Engineering Design: Using a Venn diagram to compare and contrast the **science method and engineering design process**.*

2.2 Agriscience Fair Projects: Select, design, and conduct an **Agriscience Fair project using a science practice**. Your project should be aligned to one of the following categories:

a. animal systems;
b. environmental and natural resource systems;
c. food products and processing systems;
d. plant systems;
e. power, structural, and technical systems; and
f. social science.

Your project should include a written report using the FFA Agriscience Fair template suggested for divisions 1-2.

2.3 Engineering Design Problems: Choose an **agriculture problem** that can be **solved using the engineering design process** (this can be a class project). Follow these steps:

a. identify the problem,
b. identify criteria and constraints,
c. brainstorm possible solutions,
d. generate ideas,
e. select an approach,
f. develop a model or prototype; test and evaluate, and
g. communicate your results.

Reflect on whether the solution solved the problem, as well as what improvements could be made to the solution.*

3. Safety

3.1 Safety: Accurately **read and interpret safety rules**. Identify and explain the intended use of safety equipment available in the classroom. Demonstrate how to properly use and maintain power tools.*

4. Career Opportunities

4.1 Careers: Research **career opportunities** in the following areas of agriculture:

a. agribusiness,
b. agricultural mechanics,
c. animal science,
d. environmental and natural resources,
e. horticulture/plant science, and

f. food science.*

4.2 Career Opportunities: Identify and research one **career opportunity and its related fields** through a Foundational SAE.

5. Agribusiness

5.1 Agribusiness Finance: Explain the purpose of a **balance sheet and income statement**. Explain the **concepts of assets, liabilities, and equity**. Distinguish between **current and non-current assets and liabilities**. Prepare an income statement for a real or fictitious agribusiness that includes sales, cost of sales, gross profit, operating expenses, and net income.*

5.2 Communication: **Communicate effectively** through writing, speaking, and interpersonal abilities found within the agribusiness industry.

6. Animal Science

6.1 Animal Welfare and Rights: Describe the difference between **animal welfare and animal rights**.

6.2 Animal Care: Select a domestic animal and research its **needs to maintain a healthy and comfortable life**. Develop an annual plan of care and a list of owner responsibilities to properly care for the selected animal.*

6.3 Anatomy: Demonstrate your understanding of **basic animal parts** by preparing a detailed diagram.*

6.4 Digestive Systems: Explain the differences between the **four main digestive systems**: avian, monogastric, ruminant, and pseudo-ruminant.

7. Environmental and Natural Resources Systems

7.1 Forest Regions: Identify the **major forest regions of the United States and Tennessee**.*

7.2 Importance: Describe the **importance of forest and forestry products**.*

7.3 Climate: Research the case for and against **climate change**, choose a position, and present your argument in a presentation. Include the availability and sustainability of renewable and non-renewable resources.

7.4 Agricultural Impacts: Select an **agricultural activity that impacts the environment** and research the current practices used to minimize that impact.

7.5 Biogeochemical Cycles: Demonstrate your understanding of the **major biogeochemical cycles** by preparing detailed diagrams of the following:

a. water cycle,
b. carbon cycle, and

c. nitrogen cycle.

8. Horticulture and Plant Science

8.1 Photosynthesis: Explain the **process of photosynthesis** and the interdependence between producers, consumers, and decomposers.*

8.2 Plant Anatomy: Demonstrate your understanding of **basic plant parts** by preparing a detailed diagram.*

8.3 Pesticides: Identify the recommended **uses and safety precautions from a pesticide label**.

8.4 Soils: Describe the **major components of soil**.*

8.5 Plant Reproduction: Select a **plant that can be grown from seed** and plant it in the classroom, or a raised bed or container.

8.6 Horticulture Industry: Demonstrate knowledge of the **three main areas of the horticulture industry**: ornamental horticulture, olericulture, and pomology.

8.7 Interpret Weather Maps: Identify the major symbols on a traditional weather map. Research how weather data is collected and used to **forecast weather**. Discuss how this information is used by farmers and agriculturalists.

9. Technology in Agriculture

9.1 Technology In Agriculture: Research recent **technological advances in agriculture**. Select one technological advance and prepare a presentation that includes how it was developed, how it benefited society, and how the role of science, technology, engineering, and math was used in its development.*

10. Agricultural Mechanics and Power

10.1 Mechanics and Power: Select a common **mechanical device available in both gas-powered and electric models** (e.g., lawn mowers) and list and explain the advantages and disadvantages of each.*

11. Agricultural Construction

11.1 Bill of Materials: Design a simple farm building such as a shed using common materials (2x4s, plywood sheets, metal roofing). Use the following framing terminology: headers, double top plates, studs every 16” on center, king studs, cripple studs, etc. Prepare a **material list and an estimated bill of materials**. Identify the aspects of science, technology, engineering, and math involved in this process.

12. Transportation

12.1 Agricultural Supply Value Chain: Explain the importance of **transportation and distribution in agriculture**. Select a food product and research where it is grown or raised. Compare and contrast the steps necessary to transport the product to a supermarket versus a local farmer's market. Identify the aspects of science, technology, engineering, and math involved in this process.*

Implementation Notes

*Marked areas to be taught in a nine-week rotation format.

Standards Alignment Notes

References to other standards include:

- SAE for All: Evolving the Essentials: All Agriculture students are encouraged to participate in a Supervised Agricultural Experience (SAE) program to practice and demonstrate the knowledge and skills learned in their agriculture courses.
- AFNR: National Agriculture, Food, & Natural Resources (AFNR) Career Cluster Content Standards: Students who are engaging in the activities outlined above should be able to demonstrate fluency in Standards AS, CS, and PS at the conclusion of the course.
- P21: Partnership for 21st Century Skills Framework for 21st Century Learning
    - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

Introduction to Agricultural Education

Primary Career Cluster:	Agriculture, Food, & Natural Resources
Course Contact:	CTE.Standards@tn.gov
Course Code:	C18X02
Prerequisite:	None
Credit:	½ - 1
Grade Level:	7
Graduation Requirements:	This course does not satisfy credit attainment for concentrator status, because it is not part of an approved program of study.
Programs of Study and Sequence:	This course serves as a middle school primer for all programs of study in the Agriculture, Food, & Natural Resources career cluster.
Aligned Student Organization(s):	FFA: http://www.tnffa.org
Coordinating Work-Based Learning:	All Agriculture students are encouraged to participate in a Supervised Agricultural Experience (SAE) program. In addition, teachers who hold an active WBL certificate may offer placement for credit when the requirements of the state board's WBL Framework and the Department's WBL Policy Guide are met. For information, visit https://www.tn.gov/education/educators/career-and-technical-education/work-based-learning.html.
Available Student Industry Certifications:	None
Teacher Endorsement(s):	048, 150, 448, and 950
Required Teacher Certification:	None
Required Teacher Training:	None
Teacher Resources:	https://www.tn.gov/education/educators/career-and-technical-education/career-clusters/cte-cluster-agriculture-food-natural-resources.html Add "Best for All Central: https://bestforall.tnedu.gov/

Course at a Glance

CTE courses provide students with an opportunity to develop specific academic, technical, and 21st-century skills necessary to be successful in careers and life. In pursuit of ensuring every student in Tennessee achieves this level of success, we begin with rigorous course standards that feed into intentionally designed programs of study.

Students engage in industry-relevant content through general education integration and experiences such as career & technical student organizations (CTSO) and work-based learning (WBL). Through these experiences, students are immersed with industry-standard content and technology, solve industry-based problems, meaningfully interact with industry professionals, and use/produce industry-specific, informational texts.

Using a Career and Technical Student Organization (CTSO) in Your Classroom

CTSOs are a great resource to put classroom learning into real-life experiences for students through classroom, regional, state, and national competitions, and leadership opportunities. Below are CTSO connections for this course; note this is not an exhaustive list.

- Participate in the CTSO Fall Leadership Conference to engage with peers by demonstrating logical thought processes and developing industry-specific skills that involve teamwork and project management.
- Participate in FFA career and leadership events (CDE/LDE) that align with this course including but not limited to Agriscience Fair, Agricultural Communications, Agricultural Issues, Conduct of Meetings, Creed Speaking, Dairy Cattle handlers, Employment Skills, Public Speaking, and Extemporaneous Speaking.

Using Work-Based Learning (WBL) in Your Classroom

Sustained and coordinated activities that relate to the course content are the key to successful work-based learning. Possible activities for this course include the following. This is not an exhaustive list.

- **Standards 1.1-3.2** | Invite an industry representative as a guest speaker to discuss the history and impacts made because of the agriculture industry.
- **Standard 5.1-11.2** | Job shadow virtually or in person an industry representative to focus on career opportunities and skills needed to secure employment and their professional roles and responsibilities.

Course Description

Introduction to Agricultural Education analyzes the different aspects of the agricultural industry. It is a middle school course designed to introduce students to the vast opportunities available in Agricultural Education to make informed decisions regarding their future academic and occupational goals in the agriculture, food, and natural resource career cluster. Students will have the opportunity to participate in FFA activities. Upon completion of this course, students will understand the importance of agriculture in daily life by exploring basic principles of agribusiness, agricultural mechanics, animal science, natural resources, and horticulture systems, and will be prepared for high school coursework in agriculture.

Course Standards

1. Agriculture Importance and Trends

1.1 Comprehensive Definition: Research the term agriculture to **develop a comprehensive definition** that includes all aspects of the industry.*

1.2 Importance of Agriculture: Create an accurate summary of the **importance of agriculture in daily life**. Identify sources of different types of food, fiber, or by-products, and depict them in a visual representation.*

1.3 Major Trends: Identify the **major changes and advancements** that have occurred in agriculture over the last 200 years, specifying the societal and economic impacts of these advancements.

2. Career and Employment Skills

2.1 Career Interest: Complete a **career awareness interest survey,** such as AgExplorer to identify your top career focus areas. Identify the educational, work experience, and skills needed for the top three occupations in each focus area.*

2.2 Career Opportunities and Industry Importance: Explore local **career opportunities in agriculture and examine the importance of the agriculture industry** to Tennessee's economy. Use local job postings and Tennessee labor and workforce data.*

2.3 Employment Skills Development: Enhance or develop a **Supervised Agricultural Experience (SAE) program based on career goals and industry needs** for every individual.*

3. Principles of Leadership, Personal Growth, and Career Success

3.1 Organizational Membership: Explain the **benefits of participating in FFA and other civic and community organizations** and their activities as an active member.*

3.2 Knowledge and Skill Development: Describe the knowledge and skills needed for Leadership Development Events (LED) and Career Development Events (CDE). Identify **LEDs and CDEs that align with the individual's career goals**.

4. Safety

4.1 Safety: Accurately **read and interpret safety rules**. Identify and explain the intended use of safety equipment available in the classroom. Demonstrate ability to pass a safety test at 100 percent accuracy on all lab equipment.*

5. Agribusiness

5.1 Agribusiness Careers: Identify types of agribusinesses and explore the different roles of **local and regional career opportunities related to agribusiness**. Use local job postings and Tennessee labor and workforce data.*

5.2 Communication Skills: Demonstrate **effective communication skills** through the delivery of a presentation, speech, or demonstration.

6. Introduction to Animal Science

6.1 Animal Science Careers: Investigate **local and regional career opportunities in animal science**, drawing on information from multiple resources such as local job postings, and Tennessee labor and workforce data.*

6.2 Breeds: Compare and contrast **small companion and large domesticated animals**, to describe the following:

a. identify important breeds and their historical and contemporary roles in society and the agriculture industry specifically;
b. the social and economic implications for maintaining animal health; and
c. common domesticated breeds and their use in society.*

6.3 Animal Body Systems: Review illustrative models of **major animal body systems** (i.e., skeletal, muscular, respiratory, digestive, nervous, integumentary, urinary, reproductive) in conjunction with technical information from scientific texts to establish a basic knowledge of animal anatomy and physiology.

7. Introduction to Environmental and Natural Resources

7.1 Environmental and Natural Resources Careers: Compare and contrast information gathered from a variety of sources to identify **local and regional career opportunities in environmental and natural resources systems**.*

7.2 Ecosystems: Explore the **major ecosystems** in Tennessee and discuss their importance to agriculture. Define Best Management Practices (BMP) and explain their benefits to agriculture.*

7.3 Environmental and Economic Impacts: Describe the interrelationships among plants and animals. Identify native wildlife species and describe their **environmental and economic impacts** in Tennessee, incorporating visual representations such as diagrams or models.

7.4 Types of Pollution: Identify the **types of pollution found in air and water**. Determine pollution sources and the general effects of pollutants on the environment.

8. Introduction to Horticulture and Plant Science

8.1 Horticulture Careers: Compare and contrast **local and regional career opportunities in horticulture** using local job postings, and Tennessee labor and workforce data.*

8.2 Plant Structures: Describe how **the form and function of plant structures** are related. Explain each component and their processes involved in plant reproduction and growth.*

8.3 Soils: Analyze the **relationship between soil quality and plant health and growth**, including the impact of pH, organic matter content, and mineral content.

9. Food Science

9.1 Food Careers: Compare and contrast **local and regional career opportunities in food science** using local job postings, and Tennessee labor and workforce data.*

9.2 Career Pathways: Create a web chart showing the **various career pathways of a food scientist** including the sequential steps for education and training for studying food science.

9.3 Meat Breeds: Identify the different **meat breeds for beef, swine, and poultry**.*

9.4 Sanitation Practices: Explain the techniques of **basic handwashing and proper sanitation practices** within the kitchen.

10. Agriculture Supply Value Chain

10.1 Agriculture Supply Value Chain Careers: Compare and contrast **local and regional career opportunities** in the agriculture supply value chain using local job postings, and Tennessee labor and workforce data.*

10.2 Importance of Agriculture Supply Value Chain: Explain the **importance of agriculture supply value chain**. Select an agricultural product and research where it is grown or raised. Compare and contrast the steps necessary to transport the product to a supermarket versus a local farmer's market. Identify the aspects of science, technology, engineering, and math involved in this process.

11. Introduction to Agricultural Mechanics (Machines)

11.1 Impact of Agricultural Mechanic: Examine the **impact of the agricultural mechanics industry** on United States society and the economy at large, addressing technological developments and career options. Produce an informational essay or model (e.g., timeline, graphic illustration, or presentation) to illustrate findings.*

11.2 Agricultural Mechanics Practices: Demonstrate a conceptual understanding of the following **current practices in agricultural mechanics**:

a. Calculate linear measurements and simple angles using approved methods of measurement.
b. Calculate horsepower and explain its importance and uses.
c. Investigate the concepts of the different types of power, structural, and technical systems.
d. Demonstrate the safe use and maintenance of basic hand and power tools, including passing a safety test at 100 percent accuracy.*

Implementation Notes

*Marked areas to be taught in a single grade level nine-week rotation format.

Standards Alignment Notes

References to other standards include:

- SAE for All: Evolving the Essentials: All Agriculture students are encouraged to participate in a Supervised Agricultural Experience (SAE) program to practice and demonstrate the knowledge and skills learned in their agriculture courses.
- AFNR: National Agriculture, Food, & Natural Resources (AFNR) Career Cluster Content Standards:
    - Note: While not directly aligned to one specific standard, students engaged in the activities outlined above should be able to demonstrate fluency in Standards AS.01 and PS.01 at the conclusion of the course.
- P21: Partnership for 21st Century Skills Framework for 21st Century Learning
    - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

Introduction to Agricultural Sciences

Primary Career Cluster:	Agriculture, Food, & Natural Resources
Consultant:	CTE.Standards@tn.gov
Course Code:	C18X00
Prerequisite:	None
Credit:	½ - 1
Grade Level:	8
Graduation Requirements:	This course does not satisfy credit attainment for concentrator status, because it is not part of an approved program of study.
Programs of Study (POS) Sequence:	This course serves as a middle school primer for all programs of study in the Agriculture, Food, & Natural Resources career cluster.
Aligned Student Organization(s):	FFA: http://www.tnffa.org
Coordinating Work-Based Learning:	All Agriculture students are encouraged to participate in a Supervised Agricultural Experience (SAE) program. In addition, teachers who hold an active WBL certificate may offer placement for credit when the requirements of the state board's WBL Framework and the Department's WBL Policy Guide are met. For information, visit https://www.tn.gov/education/educators/career-and-technical-education/work-based-learning.html.
Available Student Industry Certifications:	None
Teacher Endorsement(s):	048, 150, 448, and 950
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Required Teacher Training:	None
Teacher Resources:	https://www.tn.gov/education/educators/career-and-technical-education/career-clusters/cte-cluster-agriculture-food-natural-resources.html Best for All Central https://bestforall.tnedu.gov/

Course at a Glance

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Using a Career and Technical Student Organization (CTSO) in Your Classroom

CTSOs are a great resource to put classroom learning into real-life experiences for your students through classroom, regional, state, and national competitions, and leadership opportunities. Below are CTSO connections for this course; note this is not an exhaustive list.

- Participate in the CTSO Fall Leadership Conference to engage with peers by demonstrating logical thought processes and developing specific industry-specific skills that involve teamwork and project management.
- Participate in FFA career and leadership events (CDE/LDE) that align with this course including but not limited to Agriscience Fair, Agricultural Communications, Agricultural Issues, Conduct of Meetings, Creed Speaking, Dairy Cattle Handlers, Employment Skills, Public Speaking, and Extemporaneous Speaking.

Using Work-Based Learning (WBL) in Your Classroom

Sustained and coordinated activities that relate to the course content are the key to successful work-based learning. Possible activities for this course include the following. This is not an exhaustive list.

- **Standards 1.1-3.1** | Invite an industry representative as a guest speaker to discuss the history and impacts made because of the agriculture industry.
- **Standard 5.1-11.1** | Interview or job shadow local agricultural professionals to determine career opportunities and skills needed to secure employment.
- **Standard 11.2** | Have students do a project that is supervised or evaluated by an agricultural engineer, agricultural technician, or qualified technician.

Course Description

Introduction to Agricultural Sciences is a middle school course designed to assist students in making informed decisions regarding their future academic and occupational goals and to provide information about careers in the agriculture, food, and natural resource career cluster. This course helps students understand the importance of agriculture in daily life by exploring basic principles of agribusiness, agricultural mechanics, animal science, natural resources, and horticulture systems. Depending on LEA capacity and preference, the course may be tailored for sixth, seventh, and eighth grades, with the additional option for flexible implementation schedules. Upon completion of this course, proficient students will be prepared for high school coursework in agriculture.

Course Standards

1. Agricultural Science Impact and Trends

1.1 Three Components: Illustrate and describe the **three components of the total agricultural education program** (e.g., classroom instruction, FFA, and Supervised Agricultural Experience).*

1.2 Impact: Describe and discuss how **agriculture provides the basic human needs and their impact** on Tennessee's economy and workforce.*

1.3 Commodities: Identify the **top ten agricultural commodities in Tennessee** and summarize their importance to Tennessee's economy.

2. Agricultural Science Employment Skill and Requirements

2.1 Career Exploration: Complete a **career awareness interest survey** such as AgExploror to identify your top career focus areas. Identify the educational, work experience, and skills needed for the top three occupations in each focus area.*

2.2 Employability Skills: Identify three possible Supervised Agricultural Experience (SAE) programs aligned to the **student's top three occupations**. Discuss a possible plan for the student to become **employable in each identified occupation**.*

2.3 Business and Skill Attainment: Create, implement, and maintain **business and skill attainment records** for an SAE related to the student's career goals and needs.

3. Agriscience Investigation

3.1 Scientific Investigation: Conduct an Agriscience Fair project, either building on an existing project or designing a new project, using the **scientific investigation process aligned to one of the following categories**:*

a. animal systems;
b. environmental and natural resource systems;
c. food products and processing systems;
d. plant systems;
e. power, structural, and technical systems; and
f. social science.

Your project should include a written report using the FFA Agriscience Fair template suggested for divisions 1-2.*

4. Safety

4.1 Safety: Accurately **read and interpret safety rules**. Identify and explain the intended use of safety equipment available in the classroom. Demonstrate the ability to pass a safety test at 100 percent accuracy on all lab equipment.*

5. Agribusiness

5.1 Fundamental Agribusiness Skills: Discuss and demonstrate the **fundamental agribusiness skills**, including but not limited to:

a. leadership roles,
b. organizational structures,
c. efficient teamwork skills,
d. types of communication,
e. recordkeeping processes and reports,
f. basic public speaking skills.*

5.2 Parliamentary Procedure: Identify and demonstrate **basic parliamentary procedure skills** needed to conduct a business meeting.

6. Introduction to Veterinary and Animal Science

6.1 Health and Restraints: Identify the **signs and symptoms of good animal health**. Explain or demonstrate the **proper restraint methods** used for basic animal care.*

6.2 Animal Systems: Distinguish between the functions of the **components of the digestive, reproductive, and other major systems of animals**.*

6.3 Feed Rations: Create a **feed ration for livestock or companion animals** based on the animal's stage of life.

6.4 Animal Evaluation: **Evaluate livestock or companion animals** based on the breed's confirmation standards. Provide either written or oral justification for the evaluation.

7. Introduction to Environmental and Natural Resources Systems

7.1 Industry Aspects: Compare and contrast the **aspects of the forestry and natural industry** including but not limited to best management practice.*

7.2 Forestry: Explain various **forest management practices** including but not limited to prescribed burns, wildfires, clear-cut, thinning, and reforestation.*

7.3 Soils: Explore the basic principles of soil science by analyzing **soil structure and formations, and research common soil conservation solution methods**.*

7.4 Dendrology: Summarize the **basic principles of dendrology** including the parts of a tree, treetops, and physiological processes of tree growth.

8. Introduction to Horticulture and Plant Science

8.1 Plant Propagation: Create new plants through **asexual and sexual propagation** techniques.*

8.2 Environmental Conditions: Summarize **environmental conditions** for plant growth (e.g., light, air, water, and soil).*

8.3 Plant Uses: Describe the general characteristics of **common plants** used in food production, greenhouse, landscaping, and turfgrass applications.*

8.4 Aquaculture and Hydroponics: Research the **general principles of aquaculture and hydroponics** to explain their contribution to sustainable agriculture practices for future generations.

9. Food Science

9.1 Food-Born Bacteria: Research and identify the most recent **food-borne bacteria outbreaks** in the United States and identify their associated pathogen, foods associated, their method of transportation, and their living conditions.*

9.2 Conditions for Bacterial Growth: Identify and discuss the conditions that are favorable for **bacterial growth** in food.*

9.3 Enzyme: Define **enzymes** and research examples of their **role in food processing and food quality**.

10. Agriculture Supply Value Chain

10.1 Career Opportunities: Compare and contrast **local and regional career opportunities** in the agriculture supply value chain using local job postings and Tennessee labor and workforce data.*

10.2 Agriculture Supply Value Chain: Explain the **importance of the agriculture supply value chain**. Select an agriculture by-product and research where or how it is produced or manufactured. Compare and contrast the steps necessary to transport the product to a supermarket versus a local farmer's market. Identify the aspects of science, technology, engineering, and math involved in this process.*

11. Introduction to Agricultural Mechanical Systems

11.1 Mechanical Practices: Demonstrate a conceptual understanding of the following **current practices in agricultural mechanics systems**:

a. functions of basic hand and power tools;
b. demonstrate the safe use and maintenance of basic hand and power tools, including passing a safety test at 100 percent accuracy;
c. describe common building methods and materials used in the agricultural industry; and
d. appropriately apply unit conversions and calculate acreage, length, and volumes.*

11.2 Projects: Plan and construct a **basic agricultural mechanic project** utilizing a bill of materials.

Implementation Notes

*Marked areas to be taught in a single grade level nine-week rotation format.

Standards Alignment Notes

References to other standards include:

- SAE for All: Evolving the Essentials: All Agriculture students are encouraged to participate in a Supervised Agricultural Experience (SAE) program to practice and demonstrate the knowledge and skills learned in their agriculture courses.
- AFNR: National Agriculture, Food, & Natural Resources (AFNR) Career Cluster Content Standards:
    - Note: While not directly aligned to one specific standard, students engaged in the activities outlined above should be able to demonstrate fluency in Standards AS.01 and PS.01 at the conclusion of the course.
- P21: Partnership for 21st Century Skills Framework for 21st Century Learning
    - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.