# Agricultural and Environmental Systems Career Field

# Science & Technology of Food

**Subject Code: 011010**

**Outcome & Competency Descriptions**

**Course Description:**

Students will examine the research, marketing, processing and packaging techniques applied to the development of food products. Learners will examine nutrient content and their chemical makeup, while applying principles of chemistry to the development of food products. They will examine and implement food safety, sanitation, and quality assurance protocols. Government regulations and food legislation will be examined and the implications for food science and technology will be identified.

**Strand 1. Business Operations/21st Century Skills**

Learners apply principles of economics, business management, marketing and employability in an entrepreneur, manager and employee role to the leadership, planning, developing and analyzing of business enterprises related to the career field.

**Outcome: 1.1**  **Employability Skills**

Develop career awareness and employability skills (e.g., face-to-face, online) needed for gaining and maintaining employment in diverse business settings.

**Competencies**

1.1.2. Identify the scope of career opportunities and the requirements for education, training, certification, licensure and experience.

1.1.10. Adapt personal coping skills to adjust to taxing workplace demands.

**Outcome: 1.2. Leadership and Communications**

Process, maintain, evaluate and disseminate information in a business. Develop leadership and team building to promote collaboration.

**Competencies**

1.2.2. Deliver formal and informal presentations.

1.2.5. Communicate information (e.g., directions, ideas, vision, workplace expectations) for an intended audience and purpose.

**Outcome: 1.3. Business Ethics and Law**

Analyze how professional, ethical and legal behavior contributes to continuous improvement in organizational performance and regulatory compliance.

**Competencies**

1.3.1. Analyze how regulatory compliance (e.g., United States Department of Agriculture [USDA], Food and Drug Administration [FDA], United States Department of Interior [USDI], Ohio Livestock Care Standards, water quality standards, local water regulations, building codes) affects business operations and organizational performance.

1.3.2. Follow protocols and practices necessary to maintain a clean, safe and healthy work environment.

1.3.4. Identify how federal and state consumer protection laws affect products and services.

1.3.5. Access and implement safety compliance measures (e.g., quality assurance information, safety data sheets [SDSs], product safety data sheets [PSDSs], United States Environmental Protection Agency [EPA], United States Occupational Safety and Health Administration [OSHA]) that contribute to the continuous improvement of the organization.

**Strand 3. Biotechnology**

Learners engage in the scientific process, learn fundamental processes using modern tools and laboratory techniques, adhere to safety protocols, and bring a biotechnology product to the market.

**Outcome: 3.1 Research and Experiments**

Use scientific methodology to conduct problem-based studies, develop products, and interpret results.

**Competencies**

3.1.3. Apply sampling methods that appropriately represent the population and implement procedures for systematic data collection.

3.1.5. Document results of the experiment in a laboratory notebook, including a statement of purpose, experimental design, observations, results, conclusions and next steps.

3.1.6. Create, interpret and use tabular and graphical displays and describe the data.

3.1.11. Draw conclusions based on observations and data analyses, recognizing that experimental results must be open to the scrutiny of others.

3.1.13. Evaluate experimental failure and use integrity to communicate findings.

**Outcome: 3.2. Laboratory Standard Operational Procedures**

Conduct experiments using proper industry-based protocols, methods and techniques.

**Competencies**

3.2.1. Use aseptic techniques to collect, prepare and test samples.

3.2.5. Perform laboratory measures by calculating and preparing a serial dilution, calculating quantities needed to perform a test analysis and calculating unit conversions and concentrations (graphing results).

3.2.7. Perform separation techniques, including chemical separations, chromatography, centrifugation, distillation and filtration and interpret the results.

**Outcome: 3.4. Applying Chemistry to Laboratory Practices**

Using common laboratory equipment, apply general and organic chemistry concepts to examine the structures, functions, binding of molecules and methodologies for their purity and characterization.

**Competencies**

3.4.2. Use the periodic table to describe atomic structure and to characterize molecules based on functional groups.

3.4.3. Differentiate between organic and inorganic compounds.

**Outcome: 3.5. Microbiology Testing and Technology**

Classify, differentiate between and test for various kinds of microorganisms and microbial by-products.

**Competencies**

3.5.7. Compare and contrast cellular structure and functions of prokaryotic and eukaryotic cells.

3.5.12. Explain how chemical energy operates major cell processes (e.g., biosynthesis, movement, transport, growth).

**Outcome: 3.6. Molecular-Genetics Technology**

Apply knowledge of genetic inheritance and modification to organisms and use genetic information and bioinformatics to analyze specimens.

**Competencies**

3.6.16. Describe molecular behavior and structure of large molecules, including carbohydrates, lipids, proteins and nucleic acids.

**Strand 7. Food Science**

Learners apply principles of biology, chemistry and physics to the research, development, production, processing and distribution of food products meeting food safety and quality assurance standards in a secure system.

**Outcome: 7.1.**  **The Science of Food**

Differentiate the structures, functions and sources of ingredients and the roles they play in food product development for human nutrition.

**Competencies**

7.1.1. Classify components of food into nutrient categories.

7.1.2. Identify sources and forms of energy in foods.

7.1.3. Measure and describe the role of pH in food processing and storage.

7.1.4. Measure and describe water activity and differentiate how water activity affects food functionality and storage.

7.1.5. Describe the composition and structure of sugars, complex carbohydrates, lipids, vitamins, minerals and proteins.

7.1.6. Identify sources of sugars, complex carbohydrates, lipids, vitamins, minerals and proteins, and their nutritional contributions to dietary needs.

7.1.7. Relate the functions and physical properties of simple and complex carbohydrates, lipids, vitamins, minerals and proteins (i.e., functional ingredients) to the manufacturing of food products.

7.1.10. Identify and describe the functions of food additives in food products.

**Outcome: 7.2. Quality Assurance**

Inspect the food production process and locate potential sources of food quality and safety deviations in facilities.

**Competencies**

7.2.1. Describe the types of spoilage (e.g., oxidation, microbial), their sources and impact.

7.2.2. Describe the quality attributes (e.g. color, flavor, texture) that a food product possesses.

7.2.9. Compare and contrast food safety, food fraud and food defense.

7.2.11. Identify the importance of data collection and management and its relationship to a quality assurance program.

**Outcome: 7.4. Food Production and Processing**

Process a safe shelf stable food product for distribution and consumption.

**Competencies**

7.4.1. Describe the processes used in food preservation, control the variables and apply biological processing methods.

7.4.2. Describe the process of dehydration and concentration, control the variables that affect the quality of dried foods and apply the methods.

7.4.4. Process food through mixing, grinding, pumping and washing and describe the physical change in the food product.

7.4.6. Compare and contrast storage and distribution methods for shelf-stable and non-shelf-stable products.

7.4.7. Differentiate among beneficial microorganisms (e.g., bacteria, mold, yeast) and their uses in food production.

7.4.10. Determine the environmental impacts and manage the waste of processing a food product.

**Outcome: 7.5. Food Product Development**

Apply principles of nutrition and human behavior to create a new food prototype.

**Competencies**

7.5.1. Conduct a sensory evaluation of food products.

7.5.2. Identify consumer preferences, trends and opportunities affecting food product development.

7.5.4. Identify nutrient values, serving sizes and nutrient variability for a food product.

7.5.6. Develop a food product package and label according to industry standards.

7.5.7. Estimate the shelf life and potential changes in attributes over time.

**Outcome: 7.6. Food Safety and Sanitation**

Describe a food safety and sanitation plan, addressing processing facility needs and contamination points.

**Competencies**

7.6.1. Identify and control food product allergens.

7.6.2. Establish and implement procedures for preoperational inspection and cleaning.

7.6.3. Identify the sources and most prevalent types of food-borne bacteria and pathogens to account for the potential of their entrance into the food supply.

7.6.4. Describe good manufacturing practices and the correlating corrective actions.

7.6.5. Identify and describe food-borne hazards.

7.6.6. Identify and describe points in production where food safety hazards can be controlled.

7.6.7. Identify and describe critical limits.

7.6.8. Identify and describe a corrective action plan.

7.6.9. Identify the key activities (e.g., recall exercise, regulatory notification) of a recall program.

7.6.10. Identify the government agencies involved in the regulation and governance of food products.

7.6.11. Compare and contrast food security and food defense.

7.6.12. Identify sources of physical, biological, radiological and chemical tampering points.

7.6.13. Manage the biosecurity of raw materials and finished products during transportation.