# Agricultural and Environmental Systems Career Field

## Science and Technology of Food

**Subject Code: 011010**

**Course and Unit 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.

**Unit: Careers in Food Science and Technology**

Students will explore what is involved in the food science industry along with being introduced to potential careers in this area.

**Outcome 1.1**

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.**

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.

**Unit: Chemistry of Food**

Learners will examine the diverse and complex field of food science and technology and identify and describe the chemical aspects of food composition. Furthermore, learners will describe nature of matter in food in relation to simple chemistry and organic chemistry principles.

**Outcome 3.4**

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

**Competency:**

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 3.6.**

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.

**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.

**Competency:**

7.1.1. Classify components of food into nutrient categories.

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

**Unit: Energy of Food**

Learners will describe the sources and forms of energy in food as well as the metabolic processes and factors in the human body. In addition, learners will calculate the nutritional content of food products.

**Outcome 3.5**

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

**Competency:**

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 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.

**Competency:**

7.1.2. Identify sources and forms of energy in foods.

* **Complex Carbohydrates**

**Unit: Simple and Complex Carbohydrates**

In this unit, learners will investigate and describe the form and function of simple and complex carbohydrates. Learners will describe the biological roles of carbohydrates and enzymes involved in carbohydrate metabolism.

**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.

**Competency:**

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.

**Unit: Lipids**

Learners will describe the differences in functional properties of fats and oils with an emphasis on saturated, unsaturated, and polyunsaturated lipids.

**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.

**Competency:**

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.

**Unit: Proteins**

In this unit, learners will investigate and describe amino acids with emphasis on essential amino acids.

**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:**

7.1.5. 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

**Unit: Vitamins and Minerals**

Learners will describe the role and functional properties of vitamins and minerals in relations to food. Learners will investigate the differences between fat-soluble and water-soluble vitamins with an emphasis on their metabolic roles. In addition, learners will describe the role of minerals as enzyme activators.

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**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.

**Competency:**

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

**Unit: Food Safety and Security**

In this unit, learners will discuss and identify the physical, chemical, and microbiological hazards and their role in foodborne illness and the safety of the food supply. Learners will be introduced to the application of the Hazard Analysis Critical Control Point System.

**Outcome 7.6**

Food Safety and Sanitation: Describe a food safety and sanitation plan, addressing processing facility needs and contamination points.

**Competency:**

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

**Unit: Quality Assurance**

Learners will identify types of spoilage mircroorgisms as well as critical control attributes of food products. Learners will demonstrate methods of evaluating quality applied to food as well as describe the rationale for establishing valid quality assurance programs.

**Outcome 7.2**

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

**Competency:**

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.

**Unit: Introduction to Food Processing**

Learners will be introduced to the specialized techniques, concepts, and practices of food processing to create a food product.

**Outcome 7.4**

Food Production and Processing: Process a safe shelf stable food product for distribution and consumption.

**Competency:**

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.

**11 Food Law and Regulations**

**Unit: Food Law and Regulation**

In this unit, learners will examine the rules and regulations of various governmental agencies with regard to the processing, packaging, labeling, and marketing of food products.

**Outcome 1.3**

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

**Competency:**

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.

**Unit: Food Product Development and Research**

Learners will design and develop basic food products using principles of food chemistry, food processing, nutrition, sensory analysis, and statistics to meet the need of the 21st century consumer, demonstrating creativity.

**Outcome 3.2**

Laboratory Standard Operational Procedures: Conduct experiments using proper industry-based protocols, methods, and techniques.

**Competency:**

3.2.1. Use an aseptic technique 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 3.1**

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

**Competency:**

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 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.

**Competency:**

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

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

**Outcome 7.5**

Food Product Development: Apply principles of nutrition and human behavior to create a new food prototype.

**Competency:**

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.