

Applications of Food Science and Technology

Subject Code: 011030

Course & Unit Descriptions

Course Description:

Learners will use principles and practices of food processing and packaging to develop solutions for problems in food production, handling and storage. Learners will examine heat preservation, cold processing, food irradiation, fermentation, milling, and hydrogenation processing techniques. Learners will examine the process of food product development and techniques used to measure food sensory aspects, shelf life and food stability. Learners will examine government regulation impact on labeling, new packaging technologies, harvesting, transportation, and the environment.

Unit: Food Chemistry

Learners will examine the chemical aspects of food with an emphasis on the functional properties and chemical reactions of the major components during food processing and storage. Furthermore, learners will examine functions of key food additives and other ingredients.

Benchmark: 6.1 The Science of Food

Level 1: Differentiate the structure, function and sources of basic functional ingredients and the role they play in human nutrition

Level 2: Manipulate temperature, pH, and/or water content to determine their effect on functional ingredients

Indicators

- 6.1.01 Describe the nature of matter in foods (e.g. elements, compounds, mixtures, chemical bonds, classification of matter, physical and chemical changes)
- 6.1.02 Describe sources and forms of energy, the relationship between heat and temperature, how heat is transferred and the factors that affect rates of reaction in food processing
- 6.1.03 Measure the acidity and alkalinity of food products and describe the role of pH in food processing and storage
- 6.1.04 Describe water's function in food processing, distinguish between moisture content and water activity, and demonstrate how water activity affects food functionality and storage.
- 6.1.05 Describe composition, structure and sources of sugars, complex carbohydrates, lipids and proteins (functional ingredients) and their nutritional contribution to dietary needs
- 6.1.06 Describe functions and physical properties of simple and complex carbohydrates, lipids and proteins (functional ingredients) in the manufacturing of food products
- 6.1.08 Describe the composition, structure and sources of vitamins and minerals and their nutritional contribution to dietary needs
- 6.1.09 Describe the functions and physical properties of vitamins, minerals and phytochemicals in the manufacturing of food products
- 6.1.10 Describe the metabolic processes and the factors that effect metabolic changes in human body (anabolism, catabolism, basal metabolism)
- 6.1.13 Describe the use of food additives in food products.

Academic Standards

English: Apply knowledge of roots, affixes and phrases to aid understanding of content area vocabulary. (Vocabulary D, 11-12)

Math: Estimate, compute and solve problems involving real numbers, including ratio, proportion and percent, and explain solutions. (Number G, 8-10)

Science: Explain the characteristics of life as indicated by cellular processes and describe the process of cell division and development. (Life Sciences B, 9-10)

Unit: Key Food Processing Operations

In this unit, learners will analyze unit operations in food processing technology that involve physical changes of raw materials.

Benchmark: 6.3 Food Production and Processing

Level 1: Develop a process-flow diagram for a food product

Level 2: Process a food item using basic preparation techniques (e.g., mixing, grinding)

Indicators

6.3.05 Describe key food processing operations (e.g., mixing, grinding, pumping, washing, etc.)

Academic Standards

English: Use multiple resources to enhance comprehension of vocabulary. (Vocabulary F, 8-10; Vocabulary E, 11-12)

Math: Apply mathematical knowledge and skills routinely in other content areas and practical situations. (Mathematical Processes B, 8-10)

Science: Explain the characteristics of life as indicated by cellular processes and describe the process of cell division and development. (Life Sciences B, 9-10)

Unit: Government Regulation in the Food Industry

Learners will summarize government statutes/regulations that contribute to safe nutritious and wholesome food supply. Furthermore, learners will integrate regulation of manufactured and sale of food and supplements into food production and processing.

Benchmark: 3.10 Business Regulation, Law and Related Issues

Level 1: Identify and describe government regulations and societal issues related to a specific business enterprise or environmental project

Level 2: Determine the impact of government regulations and societal issues on an environmental project or the performance of a business enterprise

Indicators

3.10.02 Explain the purpose and impact of government regulations

3.10.03 Identify local, state and federal regulations relative to compliance

3.10.04 Assess business liability and describe the consequences of noncompliance

3.10.06 Identify governmental agencies and non-governmental organizations that impact agricultural/environmental issues

3.10.07 Research history, politics and policies related to issues

3.10.08 Assess the impact of issues affecting the industry and recommend solutions

Academic Standards

English: Demonstrate comprehension of print and electronic text by responding to questions (e.g., literal, inferential, evaluative and synthesizing). (Reading Process B, 8-10; Reading Process B, 11-12)

Math: Construct convincing arguments based on analysis of data and interpretation of graphs. (Data Analysis F, 8-10)

Social Studies: Evaluate the consequences of geographic and environmental changes resulting from governmental policies and human modifications to the physical environment. (Geography B, 11-12)

Science: Explain the structure and function of ecosystems and relate how ecosystems change over time. (Life Sciences F, 9-10)

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 design and implement a Hazard Analysis Critical Control Point System in relation to food production and processing.

Benchmark: 6.5 Food Safety and Security

Level 1: Identify and assess food safety risks for an enterprise

Level 2: Develop a food safety and security plan addressing facility needs and contamination points

Indicators

- 6.5.01 Control and monitor the eight major food product allergens
- 6.5.02 Establish and implement procedures for preoperational inspection and cleaning (e.g., Sanitation Standard Operating Procedures [SSOPs], visual, ATP swabs, sanitation swabs, nonpathogenic tests)
- 6.5.03 Identify sources and types of food-borne illness and food-borne pathogens (e.g., salmonella, E. coli 0157:H7, listeria) and how they enter the food supply
- 6.5.04 Prevent/control food-borne illness through environmental monitoring
- 6.5.05 Develop and implement a pest control system
- 6.5.06 Conduct Good Manufacturing Practices (GMP) audit, review findings and implement corrective actions
- 6.5.07 Identify hazards and critical control points
- 6.5.08 Scientifically establish critical limits, monitor control points and apply corrective action procedures (HAACP)
- 6.5.09 Identify methods used to assess food security
- 6.5.10 Determine critical safety parameters for handling and storage (e.g., cold chain, temperature control, sanitation, cleanliness)
- 6.5.11 Conduct product hazard analysis and ingredient hazard analysis
- 6.5.12 Identify the key activities of a traceback/recall program

Academic Standards

- English: Use multiple resources to enhance comprehension of vocabulary. (Vocabulary F, 8-10; Vocabulary E, 11-12)
- Math: Construct convincing arguments based on analysis of data and interpretation of graphs. (Data Analysis F, 8-10)
- Science: Explain the structure and function of ecosystems and relate how ecosystems change over time. (Life Sciences F, 9-10)

Unit: Food Sensory Evaluation and Analysis

Learners will apply sensory evaluation methods used for food products based on flavor, odor, taste, color, and texture. This includes techniques for measuring sensory attributes, instrumental analyses of food and how sensory evaluation programs are utilized in the food industry. Furthermore, learners will identify principles and application of physical and chemical methods to the separation, characterization and quantitative analysis of food constituents.

3.11 Research and Analysis

Level 1: Conduct a study or survey, select descriptive statistics, create graphical displays and draw conclusions

Level 2: Conduct a problem-based study applying scientific methodology and using descriptive statistics to communicate and support predictions and conclusions

Indicators

- 3.11.01 Identify research problems and structure a statistical experiment, simulation or study related to the problem
- 3.11.02 Create a hypothesis and set the probability of acceptance based on review of valid literature
- 3.11.03 Establish and implement procedures for systematic collection, organization, and use of data

- 3.11.04 Select and apply sampling methods that appropriately represent the population to be studied
- 3.11.05 Create, interpret and use tabular and graphical displays and descriptive statistics to describe data
- 3.11.06 Compute measures of central tendency and dispersion to interpret results and draw conclusions
- 3.11.07 Describe the relationships among variables using correlations and draw conclusions
- 3.11.08 Draw conclusions based on observations and/or data analysis and disseminate information to interested parties

Academic Standards

- English: Formulate open-ended research questions suitable for inquiry and investigation and adjust questions as necessary while research is conducted. (Research A, 8-10; Research A, 11-12)
- Math: Use algebraic representations, such as tables, graphs, expressions, functions and inequalities, to model and solve problem situations. (Algebra D, 8-10)
- Science: Participate in and apply the processes of scientific investigation to create models and to design, conduct, evaluate and communicate the results of these investigations. (Scientific Inquiry A, 9-10)

Benchmark: 6.4 Food Product Development

Level 1: Modify an existing food product using bench-top methods and develop package design

Level 2: Create a new food prototype, using limited ingredients and processing steps, and develop package design

Indicators

- 6.4.01 Conduct sensory evaluation of food and food analogs
- 6.4.02 Identify motivations for new product production
- 6.4.03 Manipulate ingredients to reach desired product goal
- 6.4.04 Calculate nutrient value and serving sizes in a food product
- 6.4.05 Estimate the variability in nutritional content
- 6.4.06 Calculate part per million of restricted ingredients
- 6.4.07 Develop a food product label according to industry standards
- 6.4.08 Estimate shelf life and potential changes in attributes over time
- 6.4.09 Develop product and raw materials gold standard
- 6.4.10 Find new uses for low value components of the food generation process

Academic Standards

- Math: Estimate, compute and solve problems involving real numbers, including ratio, proportion and percent, and explain solutions. (Number G, 8-10)
- Science: Explain the ways in which the processes of technological design respond to the needs of society. (Science and Technology A, 9-10)

Unit: Food Microbiology

In this unit, learners will differentiate between microorganisms in relation to food safety, spoilage, and production during production, processing, handling, and distribution of food products. Furthermore, learners will analyze the development of microbes as a resource for the food industry.

Benchmark: 6.1 The Science of Food

Level 1: Differentiate the structure, function and sources of basic functional ingredients and the role they play in human nutrition

Level 2: Manipulate temperature, pH, and/or water content to determine their effect on functional ingredients

Indicators

- 6.1.03 Measure the acidity and alkalinity of food products and describe the role of pH in food processing and storage

- 6.1.11 Describe the structure of molds, bacteria, viruses, prions and yeast, how they reproduce, and the factors that affect their growth

Academic Standards

- English: Apply knowledge of roots, affixes and phrases to aid understanding of content area vocabulary. (Vocabulary D, 11-12)
- Math: Estimate, compute and solve problems involving real numbers, including ratio, proportion and percent, and explain solutions. (Number G, 8-10)
- Science: Explain the characteristics of life as indicated by cellular processes and describe the process of cell division and development. (Life Sciences B, 9-10)

Benchmark: 6.2 Quality Assurance

- Level 1: Examine food production process and locate sources or potential sources of food quality deviations
- Level 2: Inspect food production process, locate sources or potential sources of food quality deviations and prepare a corrective action plan

Indicators

- 6.2.01 Identify and describe the types of spoilage microorganisms

Academic Standards

- English: Produce functional documents that report, organize and convey information and ideas accurately, foresee readers' problems or misunderstandings and that include formatting techniques that are user friendly. (Writing Applications C, 11-12)
- Math: Construct convincing arguments based on analysis of data and interpretation of graphs. (Data Analysis F, 8-10)

Benchmark: 6.3 Food Production and Processing

- Level 1: Develop a process-flow diagram for a food product
- Level 2: Process a food item using basic preparation techniques (e.g., mixing, grinding)

Indicators

- 6.3.09 Differentiate among beneficial microorganisms (e.g., bacterial, mold and yeast) and their uses in food production.
- 6.3.12 Describe and select biological, chemical and mechanical processing procedures for manufacturing food products.

Academic Standards

- English: Use multiple resources to enhance comprehension of vocabulary. (Vocabulary F, 8-10; Vocabulary E, 11-12)
- Math: Apply mathematical knowledge and skills routinely in other content areas and practical situations. (Mathematical Processes B, 8-10)
- Science: Explain the characteristics of life as indicated by cellular processes and describe the process of cell division and development. (Life Sciences B, 9-10)

Benchmark: 6.5 Food Safety and Security

- Level 1: Identify and assess food safety risks for an enterprise
- Level 2: Develop a food safety and security plan addressing facility needs and contamination points

Indicators

- 6.5.03 Identify sources and types of food-borne illness and food-borne pathogens (e.g., salmonella, E. coli O157:H7, listeria) and how they enter the food supply

Academic Standards

- English: Use multiple resources to enhance comprehension of vocabulary. (Vocabulary F, 8-10; Vocabulary E, 11-12)

- Math: Construct convincing arguments based on analysis of data and interpretation of graphs. (Data Analysis F, 8-10)
- Science: Explain the structure and function of ecosystems and relate how ecosystems change over time. (Life Sciences F, 9-10)

Unit: Heat and Mass Transfer in Food Processing

Learners will describe and discuss rate processes; conduction, convection, radiation heat transfer, microwave heating, refrigeration, freezing, and mass transfer during drying and storage. In addition, learners will apply heat and mass transfer process to the production of food products.

Benchmark: 6.3 Food Production and Processing

Level 1: Develop a process-flow diagram for a food product

Level 2: Process a food item using basic preparation techniques (e.g., mixing, grinding)

Indicators

- 6.3.01 Describe the process used in thermal and non-thermal preservation, control variables, and apply thermal processing methods (e.g., retorting, high pressure, irradiation, pulse electric field (PEF), aseptic packaging, chilling, freezing)
- 6.3.02 Describe the process of dehydration and concentration, control the variables that affect quality of dried foods, and apply methods
- 6.3.06 Describe storage and distribution methods for non-shelf-stable products.
- 6.3.13 Process food products through mechanical processing (e.g., cut, grind, heat, homogenize, texturize, extrude, mill, mix).
- 6.3.14 Process food products through chemical processing (e.g. hydrating, hydrogenating and Tenderizing)
- 6.3.15 Identify the energy resources utilized in processing a food product.

Academic Standards

- English: Use multiple resources to enhance comprehension of vocabulary. (Vocabulary F, 8-10; Vocabulary E, 11-12)
- Math: Apply mathematical knowledge and skills routinely in other content areas and practical situations. (Mathematical Processes B, 8-10)
- Science: Explain the characteristics of life as indicated by cellular processes and describe the process of cell division and development. (Life Sciences B, 9-10)

Unit: Fermentation Processes

Learners will apply principles related to the processing and fermentation of food products with an emphasis on microbiology.

Benchmark: 6.3 Food Production and Processing

Level 1: Develop a process-flow diagram for a food product

Level 2: Process a food item using basic preparation techniques (e.g., mixing, grinding)

Indicators

- 6.3.10 Process food products through biological processing (e.g. fermenting, enzymes, microbes)
- 6.3.12 Describe and select biological, chemical and mechanical processing procedures for manufacturing food products

Academic Standards

- English: Use multiple resources to enhance comprehension of vocabulary. (Vocabulary F, 8-10; Vocabulary E, 11-12)
- Math: Apply mathematical knowledge and skills routinely in other content areas and practical situations. (Mathematical Processes B, 8-10)

Science: Explain the characteristics of life as indicated by cellular processes and describe the process of cell division and development. (Life Sciences B, 9-10)

Unit: Mechanical Processing

In this unit, learners will apply mechanical principles and practices of food processing to develop food products.

Benchmark: 6.3 Food Production and Processing

Level 1: Develop a process-flow diagram for a food product

Level 2: Process a food item using basic preparation techniques (e.g., mixing, grinding)

Indicators

6.3.05 Describe key food processing operations (e.g., mixing, grinding, pumping, washing, etc.)

6.3.07 Identify characteristics and properties of mixtures (solutions, colloidal dispersions and suspensions) and select appropriate chemical or biological separation techniques

6.3.11 Manage processes for handling solid and liquid waste resulting from the manufacturing of food products

6.3.13 Process food products through mechanical processing (e.g., cut, grind, heat, homogenize, texturize, extrude, mill, mix)

6.3.15 Identify energy resources utilized in the processing of a food product

Academic Standards

English: Use multiple resources to enhance comprehension of vocabulary. (Vocabulary F, 8-10; Vocabulary E, 11-12)

Math: Apply mathematical knowledge and skills routinely in other content areas and practical situations. (Mathematical Processes B, 8-10)

Science: Explain the characteristics of life as indicated by cellular processes and describe the process of cell division and development. (Life Sciences B, 9-10)

Unit: Dairy Products Processing

In this unit, learners will use hands-on skills in formulating and processing dairy products.

Benchmark: 6.3 Food Production and Processing

Level 1: Develop a process-flow diagram for a food product

Level 2: Process a food item using basic preparation techniques (e.g., mixing, grinding)

Indicators

6.3.05 Describe key food processing operations (e.g., mixing, grinding, pumping, washing, etc.)

6.3.06 Describe storage and distribution methods for non-shelf-stable product

6.3.07 Identify characteristics and properties of mixtures (solutions, colloidal dispersions and suspensions) and select appropriate chemical or biological separation techniques

6.3.08 Describe the initial processing of animals and animal products and the basis for product grading

6.3.09 Differentiate among beneficial microorganisms (e.g., bacterial, mold and yeast) and their use in food production

6.3.10 Process food products through biological processing (e.g. fermenting, enzymes, microbes)

6.3.11 Manage processes for handling solid and liquid waste resulting from the manufacturing of food products

6.3.12 Describe and select biological, chemical and mechanical processing procedures for manufacturing food products

6.3.13 Process food products through mechanical processing (e.g., cut, grind, heat, homogenize, texturize, extrude, mill, mix)

6.3.14 Process food products through chemical processing (e.g. hydrating, hydrogenating and tenderizing)

6.3.15 Identify energy resources utilized in the processing of a food product

Academic Standards

- English: Use multiple resources to enhance comprehension of vocabulary. (Vocabulary F, 8-10; Vocabulary E, 11-12)
- Math: Apply mathematical knowledge and skills routinely in other content areas and practical situations. (Mathematical Processes B, 8-10)
- Science: Explain the characteristics of life as indicated by cellular processes and describe the process of cell division and development. (Life Sciences B, 9-10)

Unit: Meat Science Processing

In this unit, learners will apply processing principles to develop meat products.

Benchmark: 6.3 Food Production and Processing

Level 1: Develop a process-flow diagram for a food product

Level 2: Process a food item using basic preparation techniques (e.g., mixing, grinding)

Indicators

- 6.3.05 Describe key food processing operations (e.g., mixing, grinding, pumping, washing, etc.)
- 6.3.06 Describe storage and distribution methods for non-shelf-stable product
- 6.3.07 Identify characteristics and properties of mixtures (solutions, colloidal dispersions and suspensions) and select appropriate chemical or biological separation techniques
- 6.3.08 Describe the initial processing of animals and animal products and the basis for product grading
- 6.3.09 Differentiate among beneficial microorganisms (e.g., bacterial, mold and yeast) and their use in food production
- 6.3.10 Process food products through biological processing (e.g. fermenting, enzymes, microbes)
- 6.3.11 Manage processes for handling solid and liquid waste resulting from the manufacturing of food products
- 6.3.12 Describe and select biological, chemical and mechanical processing procedures for manufacturing food products
- 6.3.13 Process food products through mechanical processing (e.g., cut, grind, heat, homogenize, texturize, extrude, mill, mix)
- 6.3.14 Process food products through chemical processing (e.g. hydrating, hydrogenating and tenderizing)
- 6.3.15 Identify energy resources utilized in the processing of a food product

Academic Standards

- English: Use multiple resources to enhance comprehension of vocabulary. (Vocabulary F, 8-10; Vocabulary E, 11-12)
- Math: Apply mathematical knowledge and skills routinely in other content areas and practical situations. (Mathematical Processes B, 8-10)
- Science: Explain the characteristics of life as indicated by cellular processes and describe the process of cell division and development. (Life Sciences B, 9-10)

Unit: Fruits and Vegetables Processing

Learners will use hands-on skills in formulating and processing fruit and vegetable products.

Benchmark: 6.3 Food Production and Processing

Level 1: Develop a process-flow diagram for a food product

Level 2: Process a food item using basic preparation techniques (e.g., mixing, grinding)

Indicators

- 6.3.05 Describe key food processing operations (e.g., mixing, grinding, pumping, washing, etc.)
- 6.3.06 Describe storage and distribution methods for non-shelf-stable product
- 6.3.07 Identify characteristics and properties of mixtures (solutions, colloidal dispersions and suspensions) and select appropriate chemical or biological separation techniques

- 6.3.09 Differentiate among beneficial microorganisms (e.g., bacterial, mold and yeast) and their use in food production
- 6.3.10 Process food products through biological processing (e.g. fermenting, enzymes, microbes)
- 6.3.11 Manage processes for handling solid and liquid waste resulting from the manufacturing of food products
- 6.3.12 Describe and select biological, chemical and mechanical processing procedures for manufacturing food products
- 6.3.13 Process food products through mechanical processing (e.g., cut, grind, heat, homogenize, texturize, extrude, mill, mix)
- 6.3.14 Process food products through chemical processing (e.g. hydrating, hydrogenating and tenderizing)
- 6.3.15 Identify energy resources utilized in the processing of a food product

Academic Standards

- English: Use multiple resources to enhance comprehension of vocabulary. (Vocabulary F, 8-10; Vocabulary E, 11-12)
- Math: Apply mathematical knowledge and skills routinely in other content areas and practical situations. (Mathematical Processes B, 8-10)
- Science: Explain the characteristics of life as indicated by cellular processes and describe the process of cell division and development. (Life Sciences B, 9-10)

Unit: Food Packaging

In this unit, learners will discuss the functions of packaging within the food processing. In addition learners will investigate and examine the properties of metal, glass, paper, and plastic material and packages. Finally, learners will engage in design, fabrication, and applications of food packaging.

Benchmark: 6.3 Food Production and Processing

Level 1: Develop a process-flow diagram for a food product

Level 2: Process a food item using basic preparation techniques (e.g., mixing, grinding)

Indicators

- 6.3.03 Describe function and types of packaging operations, equipment and materials and use in manufacturing food products (e.g. metal, glass, paper, plastic, film, laminates, edible coatings)
- 6.3.04 Compare and contrast reduced oxygen packaging (ROP) and processes and use in the manufacturing of food products (e.g. controlled atmosphere and modified atmosphere packaging, desiccants)

Academic Standards

- English: Use multiple resources to enhance comprehension of vocabulary. (Vocabulary F, 8-10; Vocabulary E, 11-12)
- Math: Apply mathematical knowledge and skills routinely in other content areas and practical situations. (Mathematical Processes B, 8-10)
- Science: Explain the characteristics of life as indicated by cellular processes and describe the process of cell division and development. (Life Sciences B, 9-10)