Science & Technology of Food
Subject Code: 011010
Course & Unit Descriptions

Course Description:
This first course in the pathway examines the research, marketing, processing and packaging techniques applied to the development of food products. Learners will examine principles of food preservation techniques and determine correlations to food sensory, shelf life and food stability. Learners will examine and develop food safety, sanitation, and quality assurance protocol. Government regulations and food legislation will be examined and the implications to food science and technology will be identified.

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.

Benchmark: 2.2 Biological Chemistry
Level 1: Differentiate organic and inorganic compounds

Indicators
2.2.01 Describe the properties of atoms and the formulation of compounds
2.2.02 Identify compounds using both common and chemical nomenclature
2.2.05 Identify components and describe the functions of nucleic acids, carbohydrates, lipids, and amino acids

Academic Standards

English:	Apply knowledge of roots, affixes and phrases to aid understanding of content area vocabulary. (Vocabulary D, 11-12)
Math:	Apply mathematical knowledge and skills routinely in other content areas and practical situations. (Mathematical Processes B, 8-10)
Science:	Explain that cells are the basic unit of structure and function of living organisms, that once life originated all cells come from pre-existing cells, and that there are a variety of cell types. (Life Sciences A, 9-10)

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

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)

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: 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.

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

Indicators

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

6.1.10 Describe the metabolic processes and the factors that effect metabolic changes in human body (anabolism, catabolism, basal metabolism)

6.1.12 Calculate nutritional content of 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: 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.

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

Indicators

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

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: Lipids

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

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

Indicators

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

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: Proteins

In this unit, learners will investigate and describe amino acids with emphasis on essential amino acids. Learners will discuss functions of proteins that include enzymes and contractile proteins.

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

Indicators

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

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: 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.

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

Indicators

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.

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: Microorganisms in Food

In this unit, learners will identify and describe the cultural and morphological characteristics of microorganisms involved in food spoilage, in foodborne disease, and good fermentation. Furthermore, learners will investigate the factors affecting microbial growth through experimentation.

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

Indicators

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

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

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

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 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.

Benchmark: 2.1 Laboratory Preparation and Maintenance
Level 1: Use aseptic techniques to protect media and test results

Indicators
2.1.01 Maintain a sterile environment (e.g., flame sterilization, heat, filtration, pressure, chemical)
2.1.02 Select and apply appropriate glassware/equipment cleaning method for intended use
2.1.03 Prepare solutions/mixtures applying the concepts of polarity, saturation and solubility
2.1.04 Use precision weighing and measuring techniques (e.g., analytical balance, micropipette)
2.1.05 Select and apply appropriate sterilization methods for solutions/mixtures
2.1.06 Use and maintain the integrity of stock reagents
2.1.07 Select and utilize appropriate storage method for solutions/mixtures, equipment and biologicals
2.1.08 Demonstrate aseptic laboratory techniques

Academic Standards

English:	Use appropriate self-monitoring strategies for comprehension. (Reading Process C, 8-10; Reading Process C, 11-12)
Math:	Estimate, compute and solve problems involving real numbers, including ratio, proportion and percent, and explain solutions. (Number G, 8-10)

Benchmark: 4.1 Safety Procedures
Level 1: Follow safety procedures in general situations with basic tools and equipment, evaluate work environment and seek assistance to rectify the problem

Indicators
4.1.01 Demonstrate knowledge of safety rules and regulations
4.1.02 Interpret safety signs and symbols
4.1.03 Model safe attitudes and behaviors (e.g., lifting, climbing)
4.1.04 Identify safety hazards and take corrective measures
4.1.05 Use safety equipment in accordance with established procedures
4.1.06 Follow established procedures for the administration of first aid and contact emergency medical personnel when necessary

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)

Benchmark: 6.5 Food Safety and Security
Level 1: Identify and assess food safety risks for an enterprise

Indicators
6.5.02 Establish and implement procedures for preoperational inspection and cleaning (e.g., Sanitation Standard Operating Procedures [SSOPs], visual, ATP swabs, sanitation swabs, nonpathenogenic tests)
6.5.07 Identify hazards and critical control points
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)

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 overtime. (Life Sciences F, 9-10)

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.

Benchmark: 6.2 Quality Assurance
Level 1: Examine food production process and locate sources or potential sources of food quality deviations

Indicators
6.2.01 Identify and describe the types of spoilage microorganisms
6.2.02 Identify and describe critical quality attributes of food product (e.g., appearance, flavor, texture)

6.2.03 Demonstrate methods of evaluating food quality (e.g., chemical, microbiological, sensory/organoleptic, physical)
6.2.04 Develop a quality check based on food quality attributes and regulation

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)

Unit: Food Processing

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

Benchmark: 6.3 Food Production and Processing
Level 1: Develop a process-flow diagram for a food product

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
6.3.03 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)
6.3.05 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: 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.

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

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

Unit: Food Product Development and Research

Learners will design and develop 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.

Benchmark: 3.1 Marketing

Level 1: Promote a product or service using basic strategies for packaging, display and publicity

Indicators

3.1.01 Select target market and consumers
3.1.02 Research products and service design(s) and determine the technical feasibility of new products
3.1.03 Conduct market research and analysis

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:	Use algebraic representations, such as tables, graphs, expressions, functions and inequalities, to model and solve problem situations. (Algebra D, 8-10)
Social:	Analyze how scarcity of productive resources affects supply, demand, inflation and economic choices. (Economics A, 11-12)

Benchmark: 3.11 Research and Analysis

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

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

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)