

Microbial Food Science and Safety

Subject Code: 011025

Course & Unit Descriptions

Course Description:

Learners are introduced to the chemistry, bioengineering and microbiology involved in producing food products. Processes contributing to the appearance, taste, texture, and smell of food products will be explored. Learners will examine functional foods, value-added foods, organic foods and food additives. Contamination points from biological hazards and food allergens will be identified and preventive measures developed. Food laws, regulations and regulatory and commercial grading standards will be examined.

Unit: Microbial Ecology of Foods

Learners will identify cultural and morphological characteristics of classifying microorganisms involved in food spoilage, foodborne disease and good fermentation. In addition, learners will analyze parameters that affect microbial growth.

Benchmark: 2.2 Biological Chemistry

Level 1: Differentiate organic and inorganic compounds.

Level 2: Perform quantitative and qualitative biochemical assays (e.g., proteins, lipids, carbohydrates, nucleic acids and enzymes).

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
- 2.2.03 Apply the concepts of stoichiometry and the laws of thermodynamics to chemical reactions
- 2.2.04 Identify structure of cells and the function of their components

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: 2.5 Molecular Biology Technology

Level 1: Precipitate DNA from a solution, and interpret the results.

Level 2: Fingerprint DNA, and interpret the results.

Indicators

- 2.5.01 Isolate nucleic acids
- 2.5.02 Perform and interpret the results of restriction enzyme digests
- 2.5.03 Perform and interpret the results of Polymerase chain reaction
- 2.5.04 Perform and interpret the results of Southern or Northern Blot Analysis
- 2.5.05 Perform and interpret the results of nucleic acid sequencing and compare using a sequence database (e.g., Genbank)

Academic Standards

Science: Summarize the historical development of scientific theories and ideas within the study of life sciences. (Life Sciences G, 11-12)

Benchmark: 6.1 The Science of Food

Level 1: Differentiate the structures, functions 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 effects on functional ingredients.

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)

Unit: Bacteria

In this unit, learners will identify common types of bacteria found in food. Additionally, learners will categorize bacteria according to common characteristics and physiological reactions. Finally, learners will compare extrinsic and intrinsic factors affecting growth of bacteria in our food supply.

Benchmark: 2.6 Cell Biology and Culturing Techniques

Level 1: Conduct microscopic identification and propagation of cells.

Level 2: Culture and preserve pure cell lines.

Indicators

2.6.01 Compare and contrast prokaryotic and eukaryotic cells

2.6.02 Isolate, propagate, harvest and characterize bacteria, fungi, yeast and viruses

2.6.04 Isolate, maintain and store (e.g., cryogenic, refrigeration) pure cultures

2.6.05 Determine suitable media for propagation

Academic Standards

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

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: 2.7 Microbiology

Level 1: Aseptically collect and prepare a sample (e.g., dry, wet, low water content).

Level 2: Conduct a shelf-life study to determine physical change and biological growth.

Indicators

2.7.05 Test for pathogens using ELISA

2.7.08 Identify and test for bacteria and tuberculi (e.g., mycobacterium, campylobacterium, Brucella, streptococcus, Salmonella, E. coli, Staphylococcus, Vibrio)

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)

Benchmark: 6.1 The Science of Food

- Level 1: Differentiate the structures, functions 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 effects on functional ingredients.

Indicators

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

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- 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)

Units: Molds

Learners will identify common types of molds found in the food industry. Additionally, learners will categorize molds according to common characteristics and physiological reactions. Finally, learners will analyze the use of molds in the food product development.

Benchmark: 2.6 Cell Biology and Culturing Techniques

- Level 1: Conduct microscopic identification and propagation of cells.
- Level 2: Culture and preserve pure cell lines.

Indicators

- 2.6.01 Compare and contrast prokaryotic and eukaryotic cells
- 2.6.02 Isolate, propagate, harvest and characterize bacteria, fungi, yeast and viruses
- 2.6.04 Isolate, maintain and store (e.g., cryogenic, refrigeration) pure cultures
- 2.6.05 Determine suitable media for propagation

Academic Standards

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

- Level 1: Aseptically collect and prepare a sample (e.g., dry, wet, low water content).
- Level 2: Conduct a shelf-life study to determine physical change and biological growth.

Indicators

- 2.7.04 Incubate and identify colonies microscopically and/or macroscopically (e.g., colonial morphology, Gram stain, biochemicals)
- 2.7.05 Test for pathogens using ELISA

- 2.7.08 Identify and test for bacteria and tuberculi (e.g., mycobacterium, campylobacterium, Brucella, streptococcus, Salmonella, E. coli, Staphylococcus, Vibrio)

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Benchmark: 6.1 The Science of Food

- Level 1: Differentiate the structures, functions and sources of basic functional ingredients and the role they play in human nutrition.
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Indicators

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- 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: Mycotoxins

In this unit, learners will identify mycotoxins utilized in the food industry. Additionally, learners will categorize Mycotoxins according to common characteristics and physiological reactions.

Benchmark: 2.6 Cell Biology and Culturing Techniques

- Level 1: Conduct microscopic identification and propagation of cells.
- Level 2: Culture and preserve pure cell lines.

Indicators

- 2.6.01 Compare and contrast prokaryotic and eukaryotic cells
- 2.6.02 Isolate, propagate, harvest and characterize bacteria, fungi, yeast and viruses
- 2.6.04 Isolate, maintain and store (e.g., cryogenic, refrigeration) pure cultures
- 2.6.05 Determine suitable media for propagation

Academic Standards

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

- Level 1: Aseptically collect and prepare a sample (e.g., dry, wet, low water content).
- Level 2: Conduct a shelf-life study to determine physical change and biological growth.

Indicators

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Indicators

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

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- 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)

Units: Yeasts

Learners will analyze the utilization of yeasts in the food industry. Additionally, learners will categorize yeasts according to common characteristics and physiological reactions.

Benchmark: 2.6 Cell Biology and Culturing Techniques

- Level 1: Conduct microscopic identification and propagation of cells.
- Level 2: Culture and preserve pure cell lines.

Indicators

- 2.6.01 Compare and contrast prokaryotic and eukaryotic cells
- 2.6.02 Isolate, propagate, harvest and characterize bacteria, fungi, yeast and viruses
- 2.6.04 Isolate, maintain and store (e.g., cryogenic, refrigeration) pure cultures
- 2.6.05 Determine suitable media for propagation

Academic Standards

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

- Level 1: Aseptically collect and prepare a sample (e.g., dry, wet, low water content).
- Level 2: Conduct a shelf-life study to determine physical change and biological growth.

Indicators

- 2.7.04 Incubate and identify colonies microscopically and/or macroscopically (e.g., colonial

- morphology, Gram stain, biochemicals)
- 2.7.05 Test for pathogens using ELISA
- 2.7.08 Identify and test for bacteria and tuberculi (e.g., mycobacterium, campylobacterium, Brucella, streptococcus, Salmonella, E. coli, Staphylococcus, Vibrio)

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

Benchmark: 6.1 The Science of Food

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

Indicators

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- 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: Foodborne Illness

Learners will describe the effects of food-borne pathogens have on food products and humans. Furthermore, learners will examine and investigate the importance of microbiological tests in food product preparation. Finally, learners will conduct and interpret microbiological tests for food-borne pathogens and implement corrective procedures.

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 0157:H7, listeria) and how they enter the food supply
- 6.5.04 Prevent/control food-borne illness through environmental monitoring

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: Utilization of Microorganisms in Food Production

In this unit, learners will differentiate between microorganisms in relation to food product development. Moreover, 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 structures, functions 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 effects 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
- 6.1.04 Describe water's function in food processing, distinguish between moisture content and water activity, and demonstrate how water activity affects food functionality and storage.
- 6.1.07 Describe the role of enzymes as catalysts and the factors that effect enzyme activity
- 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: 6.3 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 use in food production
- 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
- 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: Fermented Foods

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

Benchmark: 6.1 The Science of Food

Level 1: Differentiate the structures, functions 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 effects 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
- 6.1.04 Describe water's function in food processing, distinguish between moisture content and water activity, and demonstrate how water activity affects food functionality and storage.
- 6.1.11 Describe the structure of molds, bacteria, viruses, prions and yeast, how they reproduce, and the factors that affect their growth
- 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)

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.)
- 6.3.10 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
- 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: Preservation

Learners will examine and investigate techniques used in food preservation to secure the wholesomeness of the food supply

Unit: 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
- 6.3.03 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)

Unit: Quality Assurance

Learners will identify types of spoilage microorganisms 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 the food production process, and locate sources or potential sources of food quality deviations.
- Level 2: Inspect the 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
- 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
- 6.2.05 Establish finished product quality attributes
- 6.2.06 Develop product specifications
- 6.2.07 Evaluate, inspect and select raw food products for manufacturing based on raw ingredient specifications

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 Safety

Learners will recognize the sources and causes of contamination and develop the protocols to implement bio-security procedures.

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)