**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 to 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: 1.3. 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.

*An “X” indicates that the pathway applies to the outcome.*

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| **Pathways** |  | Agribusiness and Production Systems |  | Animal Science and Management | X | Bioscience | | |  | Horticulture |
|  | Natural Resource Management |  | Power Technology | | |  |  | | |
| **Green Practices** |  | Green-specific |  | Context-dependent | | |  | Does not apply | | |

**Strand 3. Biotechnology**

Learners apply the skills and knowledge of interpreting laboratory requests, using protective clothing and hazardous material containment, specimen collection procedures, a variety of laboratory testing and techniques, and maintenance of laboratory equipment and supplies.

**Outcome: 3.2. Foundations of Chemistry**

Perform a systematic and methodical application of general and organic chemistry principles to examine structures, their functions, their binding to other molecules and the methodologies for their purity and characterization.

**Competencies**

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

3.2.3. Differentiate between organic and inorganic compounds.

3.2.4. Use common and chemical nomenclature for organic and inorganic materials.

3.2.5. Write names and formulas for common compounds.

3.2.7. Describe chemical bonding and bond types, including ionic and covalent and the relationships that they have with the physical state of materials.

3.2.10. Identify materials that can be used as a catalyst.

**Outcome: 3.3. Microbiology Testing and Technology**

Describe the morphologies and processes of the reproduction of microorganisms.

**Competencies**

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

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

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

**Outcome: 3.5. Laboratory Standard Operational Procedures**

Perform methods and techniques using protocols to conduct an experiment.

**Competencies**

3.5.1. Use an aseptic technique to collect, prepare and test samples.

3.5.5. 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).

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

3.5.8. Titrate liquids.

3.5.9. Transfer gases, liquids and solids from storage containers to equipment used in the laboratory.

**Outcome: 3.6. Culturing**

Perform experimental techniques used in microbial biology to study cell growth, manipulation and evaluation.

**Competencies**

3.6.12. Describe physical factors that affect microbial growth and identify a normal bacteria population growth curve.

**Outcome: 3.8. Research and Experiments**

Conduct a problem-based study, applying scientific methodology and using descriptive statistics to communicate and support predictions and conclusions.

**Competencies**

3.8.1. Identify research problems and structure a statistical experiment, simulation or study related to the problem.

3.8.2. Design a research plan, including the significance of the problem, purpose, variables, hypotheses, objectives, methods of study and a list of materials.

3.8.3. Distinguish between dependent, independent and control variables in an experiment.

3.8.4. Establish and implement procedures for systematic collection, organization and use of data.

3.8.5. Select and apply sampling methods that appropriately represent the population to be studied.

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

3.8.12. Prepare and present findings using scientific reports.

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| **Pathways** |  | Agribusiness and Production Systems |  | Animal Science and Management | X | Bioscience | | |  | Horticulture |
|  | Natural Resource Management |  | Power Technology | | |  |  | | |
| **Green Practices** |  | Green-specific |  | Context-dependent | | |  | Does not apply | | |

**Strand 7. Food Science**

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

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

Differentiate the structures, functions and sources of basic functional ingredients and the roles they play in the development and manufacturing of food products for human nutrition.

**Competencies**

7.1.1. Classify the matter in foods by elements, compounds, mixtures, chemical bonds, organic and

inorganic properties and physical and chemical changes.

7.1.2. Distinguish the sources and forms of energy, the relationship between heat and temperature, how heat is transferred and the factors that affect the rates of reaction in food processing.

7.1.3. Measure the acidity, alkalinity and molarity of food products and describe the role of pH in food processing and storage.

7.1.4. Assess water’s function in food processing, distinguish between moisture content and water activity and differentiate how water activity affects food functionality and storage.

7.1.5. Describe the composition, structure and sources of sugars, complex carbohydrates, lipids, vitamins, minerals and proteins (i.e., functional ingredients) and their nutritional contributions to dietary needs.

7.1.6. 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.

7.1.7. Describe the roles of enzymes as catalysts and the factors that affect enzyme activity.

7.1.8. Differentiate the metabolic processes and the factors that affect metabolic changes in the human body (i.e., anabolism, catabolism, basal metabolism).

7.1.9. Describe the structure of molds, bacteria, viruses, prions and yeast; how they reproduce; the factors that affect their growth and their roles in food production.

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

**Outcome: 7.2. Quality Assurance**

Inspect the food production process, locate potential sources of food quality and safety deviations in facilities and prepare a corrective action plan.

**Competencies**

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

7.2.2. Describe the internal and external quality attributes that a food product should possess.

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

Process a food product for distribution and consumption.

**Competencies**

7.4.1. Describe the process used in thermal and non-thermal preservation, control the variables and apply processing methods (e.g., retorting, high pressure, ultra-high temperature [UHT], high temperature short time [HTST], chilling, freezing).

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

7.4.3. Describe the functions and types of packaging operations, equipment and materials and use them to manufacture food products (e.g., metal, glass, paper, plastic, film, laminates, edible coatings).

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

7.4.6. Identify the characteristics and properties of mixtures (e.g., solutions, colloidal dispersions and

suspensions) and select and apply appropriate chemical or biological separation techniques.

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

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

**Outcome: 7.5. Food Product Development**

Apply principles of nutrition and human behavior to create a new food prototype that meets a specific dietary need or demand for consumption, design packaging and seek label approval.

**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. Calculate 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**

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

**Competencies**

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

7.6.3. Identify the sources and types of food-borne illness and pathogens and prevent their entrance into the food supply.

7.6.5. Conduct a good manufacturing practice (GMP) audit, review the findings and implement corrective actions.

7.6.6. Identify and monitor hazards and critical control points and apply hazard analysis and critical control point (HAACP) corrective action procedures.

7.6.7. Determine critical safety parameters using government regulations for handling and storage.

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

7.6.9. Identify the government agencies involved in the production and regulation of food products.

**Outcome: 7.7. Biosecurity**

Connect the sources and causes of contamination and develop the protocols to implement bio-security procedures.

**Competencies**

7.7.1. Investigate sources and origins of agents that can contaminate processed and unprocessed food products.

7.7.2. Identify activities and biological agents that contribute to the risk of acquiring or preventing a specific disease.

7.7.3. Identify sources of biological and chemical tampering points.

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|  | Natural Resource Management |  | Power Technology | | |  |  | | |
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