

# Food Science and Safety Detailed Course Outline

## Unit 1: Introduction to Food Science

### Lesson 1.1 Exploring Food Science

1. Consumers perceive food quality using their five senses.
  - Evaluate foods using sensory evaluation. (Activity 1.1.1)
2. Organization and record-keeping are important to success in food science.
  - Prepare an *Agriscience Notebook* to record and store information. (Activity 1.1.2)
  - Start a *Laboratory Notebook* to record observations and protocols. (Activity 1.1.2)
3. Science advancements have changed food processing and preservation techniques.
  - Research the date and significance of a food science discovery, scientist, organization, or event. (Project 1.1.3)
  - Organize key events in food science history into a timeline. (Project 1.1.3)
4. The food industry requires accurate measurements.
  - Measure foods using imperial measurements and compare accuracy to the metric system. (Activity 1.1.4)

### Lesson 1.2 Food Handlers

1. Food safety begins with identifying biological, chemical, and physical hazards.
  - Identify biological, chemical, and physical hazards in a kitchen. (Activity 1.2.1)
  - Diagram and describe the location of emergency equipment and safety hazards. (Activity 1.2.2)
  - Publish and present a sign for display that outlines proper protocols for a personal hygiene topic. (Project 1.2.3)
  - Demonstrate knife safety skills while cutting fruits and vegetables for salsa. (Activity 1.2.4)
2. Food scientists maintain safe lab facilities.
  - Diagram and describe the location of emergency equipment and safety hazards. (Activity 1.2.2)
3. Personal hygiene is a critical GMP.
  - Publish and present a sign for display that outlines proper protocols for a personal hygiene topic. (Project 1.2.3)
4. Knife safety is critical to maintaining a safe kitchen.
  - Demonstrate knife safety skills while cutting fruits and vegetables for salsa. (Activity 1.2.4)
5. Food is constantly reacting to its environment.
  - Inoculate lettuce samples to observe cross-contamination of *E. coli*. (Activity 1.2.5)
  - Inoculate foods exposed to the food danger zone to observe yeast and mold activity. (Activity 1.2.5)
6. The food industry uses written procedures to control and monitor food product safety.
  - Compose Standard Operating Procedures (SOPs) and Sanitation Standard Operating Procedures (SSOPs) for milling wheat into flour. (Project 1.2.6)

## Unit 2: Food Chemistry

### Lesson 2.1 Scientific Processes

1. Foods contain six essential nutrients.
  - Research the function of nutrients in foods and human health. (Activity 2.1.1)
2. Food scientists use qualitative indicators and controls to identify food nutrients.
  - Use indicators to determine the presence of food nutrients. (Activity 2.1.1)
3. Food scientists use quantitative data to analyze nutrients in foods.
  - Use a polarimeter to identify beverage sweeteners. (Activity 2.1.2)
4. The food industry uses standard scientific research methods.
  - Use the scientific method to investigate the presence of nutrients in unknown food sources. (Project 2.1.3)

### Lesson 2.2 Food Nutrients

1. A food's amylose and amylopectin starch content will affect its structure.
  - Inspect amylose and amylopectin in starches under a microscope. (Activity 2.2.1)
  - Observe the viscosity, retrogradation, syneresis, texture, stability, and opacity of starches. (Activity 2.2.2)
2. Lipids affect a food's flavor, texture, and mouthfeel.
  - Compare how saturated and unsaturated fat content affects sensory characteristics. (Activity 2.2.3)
3. Food contains free and bound water.
  - Model how water binds to food starches. (Activity 2.2.4)
4. Water influences the structure, flavor, and texture of food.
  - Dehydrate meats to determine the percentage of water in each food product. (Activity 2.2.5)
5. Proteins have chemical properties used to emulsify foods.
  - Emulsify a food using egg protein. (Activity 2.2.6)
6. Gluten is a network of proteins found in wheat, oats, and barley.
  - Compare protein elasticity in different flours and its effect on sensory characteristics. (Activity 2.2.7)

### Lesson 2.3 Factors of Change

1. Physical changes affect the form of a substance without altering its chemical composition.
  - Demonstrate common physical changes in food. (Project 2.3.1)
2. Food scientists select ingredients for their functional properties.
  - Research functional properties of ingredients in a cake recipe. (Activity 2.3.2)
3. Food scientists substitute ingredients in food products to meet consumer and economic demands.
  - Substitute ingredients in a recipe and evaluate physical changes. (Activity 2.3.3)
4. Enzymes are proteins acting as biological catalysts to accelerate reaction rates.
  - Evaluate the effects of storing food products. (Activity 2.3.4 and Activity 2.3.6)
  - Quantify nutrition loss from enzymatic browning. (Activity 2.3.4)

5. Chemical reactions change the composition of foods.
  - Demonstrate Maillard's browning reactions in French fries. (Activity 2.3.5)
  - Model chemical changes in Maillard's browning reactions. (Activity 2.3.6)

### **Lesson 2.4 pH of Foods**

1. Ingredient pH influences the characteristics of foods.
  - Determine the pH of common pantry ingredients and the functions of those ingredients in foods. (Activity 2.4.1)
  - Conduct a reference test of low acid orange juice and regular orange juice. (Activity 2.4.2)
2. Food scientists routinely calibrate laboratory equipment.
  - Calibrate a sensor using two known values. (Activity 2.4.1)
3. Food scientists use acid-base reactions to leaven foods.
  - Measure the amount of CO<sub>2</sub> gas produced in a chemical reaction with varying pH levels. (Activity 2.4.2)
4. Foods change over time due to chemical reactions and physical changes.
  - Prepare a soda bread and observe how the ingredients chemically and physically react. (Activity 2.4.3)

## **Unit 3: The Safety of Our Food**

### **Lesson 3.1 Safe Practices**

1. Food inspectors examine food facilities for compliance with Current Good Manufacturing Practices.
  - Inspect photographs of food science situations to identify what CGMPs compliance and violations. (Activity 3.1.1)
2. Food manufacturers validate and verify allergen monitoring practices.
  - Verify cleaning procedures using allergen monitoring tests. (Activity 3.1.2)
3. Good Agricultural Practices reduce the risk of biological contamination in food.
  - Analyze a strawberry operation and create a food safety plan. (Project 3.1.3)

### **Lesson 3.2 HACCP**

1. HACCP consists of seven principles to limit or eliminate food contaminants.
  - Design a poster and presentation detailing a HACCP principle. (Project 3.2.1)
  - Match HACCP principles to portions of a HACCP plan. (Activity 3.2.2)
2. A process flow diagram is a critical preliminary step in a HACCP plan.
  - Summarize the processing of turkey and cheese sandwiches in a process flow diagram. (Activity 3.2.3)
3. HACCP teams analyze processing steps for biological, chemical, and physical hazards.
  - Develop control methods for biological, chemical, and physical safety hazards. (Activity 3.2.4)
4. HACCP teams assign critical limits and monitoring procedures to critical control points.
  - Assign critical control points and critical limits for significant safety hazards. (Activity 3.2.5)
  - Design monitoring methods for critical limits in a HACCP plan. (Activity 3.2.5)

### Lesson 3.3 Pathogen Pathways

1. Microbiological organisms have both positive and negative effects on foods.
  - Research and examine bacteria, mold, and yeast. (Activity 3.3.1)
2. Food processors use environmental controls and chemicals to manipulate microbial growth.
  - Design and conduct a research project examining the microbial growth of yeast. (Project 3.3.2)
3. Pathogens can cause illness or death when present in food.
  - Research foodborne pathogens and identify prevention methods to control pathogens. (Project 3.3.3)
  - Create a comic strip depicting an assigned pathogen. (Project 3.3.3)
4. The CDC collects data to investigate multi-state outbreaks of foodborne illnesses.
  - Collaborate with peers to determine possible pathogens that caused sickness in a role-play activity. (Activity 3.3.4)

## Unit 4: Processing and Preservation

### Lesson 4.1 Processing

1. Food processing changes the chemical properties of food.
  - Evaluate changes to the chemical properties of processed strawberries. (Activity 4.1.1)
2. Food processing changes the physical characteristics of food.
  - Identify changes to the physical characteristics of a raw commodity during food processing. (Activity 4.1.2)
3. Food scientists categorize processing into broad categories called unit operations.
  - Process foods and identify unit operations. (Activity 4.1.3)
4. Agricultural commodities are processed and separated into components for further processing or consumption.
  - Process a chicken into multiple food products. (Problem 4.1.4)

### Lesson 4.2 Preservation

1. The water activity ( $a_w$ ) in a food product indicates a food's vulnerability to spoilage.
  - Study the effects of water on microbes by removing water from fruit. (Activity 4.2.1)
2. Cold processing slows the chemical reactions leading to food spoilage.
  - Observe the deterioration rate of food products at room temperature, refrigeration, and freezing. (Activity 4.2.2)
3. Pasteurization slows microbial growth and inactivates enzymatic reactions that lead to spoilage.
  - Compare microbial growth of non-heat-treated and heat-treated buttermilk. (Activity 4.2.3)
4. Food processors use acidic preservatives to inactivate enzymes.
  - Change pH levels of apples to inactivate enzymatic reactions and extend shelf life. (Activity 4.2.4)
5. Food preservation extends the shelf life of food while changing its quality and usability.
  - Evaluate differences between minimally and highly processed food products. (Activity 4.2.5)

## Lesson 4.3 Quality and Safety

1. Federal and state agencies govern the manufacture and sale of food.
  - Research regulatory agencies and the laws that they regulate. (Activity 4.3.1)
  - Determine which agency is responsible for regulating specific food products. (Activity 4.3.1)
2. Agricultural commodities have commodity standards and quality grades.
  - Grade maple syrup by following quality grading standards. (Activity 4.3.2)
3. Artificial intelligence systems can be trained to predict commodity grades.
  - Build an artificial intelligence model to predict U.S. quality grades of egg breakouts. (Activity 4.3.3)
4. Certain food products must meet legal standards of identity.
  - Evaluate milk samples to determine if the product has been adulterated. (Project 4.3.4)

## Unit 5: Food Chemistry

### Lesson 5.1 Nutrition and Labeling

1. The FDA regulates food label information and claims.
  - Locate required claims, required information, consumer warnings on food labels. (Activity 5.1.1)
2. Foods are analyzed and labeled based on their nutritional content.
  - Calculate the caloric content of foods based upon nutritional content. (Activity 5.1.2)
  - Identify the nutrient contents of each ingredient for a food product and prepare a nutrition panel (Activity 5.1.2)
3. Recommended dietary allowances provide guidelines for the proper intake of nutrients.
  - Develop a menu containing the necessary nutrients for a healthy diet. (Problem 5.1.3)
  - Recommend alternative foods for individuals with dietary restrictions. (Problem 5.1.3)

### Lesson 5.2 Security and Defense

1. Safe and nutritious food, necessary to maintain health, is not equally accessible to everyone.
  - Analyze local food insecurity statistics. (Activity 5.2.1)
  - Develop solutions to possible situations of food insecurity in their community. (Activity 5.2.1)
2. The food industry builds food defense plans to protect against intentional adulteration.
  - Evaluate vulnerabilities toward intentional adulteration of a packing plant. (Project 5.2.2)
  - Develop a food defense plan. (Project 5.2.2)

## Unit 6: Consumers

### Lesson 6.1 Consumer Preferences

1. Consumers choose food based on lifestyle factors, including price, acceptance, availability, convenience, culture, and nutrition.
  - Evaluate a menu and consider choices based on nutrition, price, acceptance, convenience, and culture. (Activity 6.1.1)
2. The food industry designs sensory evaluations to reduce biases irrelevant to the test objective.
  - Participate in sensory evaluation modeling factors to identify biases. (Activity 6.1.2)
  - Discuss how non-relevant factors can manipulate the perception of panelists. (Activity 6.1.2)

3. Food scientists use a range of sensory evaluation techniques to determine consumer preferences.
  - Construct and conduct a sensory evaluation and analyze the outcome. (Project 6.1.3)

### **Lesson 6.2 To Protect and Sell**

1. Food companies use the Four Ps of marketing, price, product, place, and promotion.
  - Compare different advertisements and determine how the marketer addresses the Four Ps. (Activity 6.2.1)
2. Food packaging protects food and attracts consumers.
  - Design a food package to protect a peanut butter and jelly sandwich and attract consumers. (Project 6.2.2)
  - Evaluate a food package using a crush, drop, and water test. (Activity 6.2.3)
3. Food retailers position products based on shopping behaviors.
  - Evaluate a food retailer and evaluate product placement. (Activity 6.2.4)

## **Unit 7: Food Product Development**

### **Lesson 7.1 Innovative Foods**

1. Food product development is the process of transforming an idea into a tangible food product.
  - Start the food product development process by choosing a food to innovate. (Activity 7.1.1)
2. Food scientists protect intellectual products, including processes and formulations, with patents.
  - Collect and summarize research about similar products with patented solutions. (Activity 7.1.2)
3. A feasibility analysis includes ingredients, processing, facilities, equipment, and expenses.
  - Conduct a feasibility analysis for a new food product. (Project 7.1.3)
4. Food scientists use test markets to trial new foods before commercial sales.
  - Test market a food product. (Project 7.1.4)
  - Prepare a food product for commercialization. (Project 7.1.4)
5. Food scientists validate new food products against the original concept.
  - Justify that a developed product meets consumer needs. (Project 7.1.5)
  - Develop a display to highlight new food products. (Project 7.1.5)