

Food and Science

Levels:	Grades 9-12
Units of Credit:	0.50
CIP Code:	20.0128
Core Code:	34-01-00-00-180
Prerequisite:	Foods and Nutrition I & II
Skill Test:	None

COURSE DESCRIPTION

This course teaches scientific principles and how those principles can be applied to improve the health of individuals and families. Instruction is given concerning the physical, microbiological, and chemical principles that affect the food we eat. Student leadership (FCCLA) may be an integral part of the course.

CORE STANDARDS, OBJECTIVES, AND INDICATORS

STANDARD 1

Students will learn the meaning of food science and management for the classroom and laboratory.

Objective 1: Define the term food science and describe the main goal of food scientists.

Objective 2: Explain the interrelationship of food science and nutrition.

Objective 3: Explain classroom and laboratory procedures.

- a. Identify scientific equipment and the proper methods for use.
- b. Follow safety procedures when conducting experiments.
- c. Write reports using scientific terminology.
- d. Use the metric system of measurement.

STANDARD 2

Students will explain how food provides and produces energy.

Objective 1: Discuss the processes of heat and temperature.

- a. Discuss molecular motion and temperature.
- b. Explain heat transfer.
- c. Explain latent heat in phase changes.
- d. Compare various temperatures on rates of reaction.

Objective 2: Explain how the body uses energy and calories.

- a. Describe the relationship of energy to physical and chemical reactions.
- b. Analyze relationships between food intake and body weight.
- c. Determine energy requirements of individuals using multiple variables.
- d. Identify weight-related disorders and diseases.

STANDARD 3

Students will discuss the meaning of food physics.

Objective 1: Define the term sensory evaluation.

- a. Identify qualities that make the sensory characteristics of food.
- b. Describe the characteristics of successful sensory testing.
- c. Discuss factors affecting people's food preferences.

Objective 2: List the qualifications needed for a career in sensory evaluation.

- a. Explain what sensory evaluation panels do.
- b. Explain how sensory evaluation panels are conducted.

STANDARD 4

Students will discuss the principles of food microbiology.

Objective 1: Discuss food safety and microbe control

- a. Identify properties of microorganisms that cause food spoilage.
- b. Explain the difference between food intoxication and food infection.
- c. List organisms that cause food-borne illness.
- d. Identify microorganisms that are helpful and those that are harmful.
- e. Identify sanitary food-handling practices.
- f. Practice laboratory procedures that prevent biological contamination.
- g. Identify United States government agencies that keep the food supply safe.

Objective 2: Explain the food dehydration process.

- a. List the purposes of dehydration.
- b. Explain why food is pretreated before dehydrating.
- c. Compare sulfating, sulfuring and blanching.
- d. Describe types of blanching that can be used as pretreatment methods.
- e. Discuss the role of air temperature and movement in successful dehydration.
- f. Identify four methods of dehydration and explain their similarities and differences.
- g. Describe how dried food should be served.

Objective 3: Discuss the food canning process.

- a. Identify equipment used in home and commercial canning.
- b. Describe hot pack, cold pack, and pressure canning.
- c. Identify advantages and disadvantages of each method.
- d. Identify types of food that should be processed by each method.
- e. Compare heat transfer by conduction and by convection in canning.
- f. Discuss the similarities and differences in regular retort canning and aseptic canning.
- g. Describe the properties of *C. botulinum* that make botulism poisoning a problem in improperly canned food.

Objective 4: Discuss the food freezing process.

- a. List the steps of the food freezing process.
- b. Identify factors needed for successful freezing of food.
- c. Identify advantages and disadvantages of freezing food.

Objective 5: Discuss freeze-drying and/or air drying processes.

- a. List the steps of the freeze drying and air drying process.
- b. Explain the role of sublimation in freeze drying.
- c. Identify examples of food that can successfully be freeze-dried and explain how they should be stored.

Objective 6: Discuss the food irradiation process.

- a. List the steps of the food irradiation process.
- b. Define the units used to measure the amount of radiation used during the irradiation process.
- c. Describe the effects of irradiation on food.
- d. Discuss the effect the Delaney Anti-Cancer Clause has had on the irradiated food industry.

Objective 7: Discuss the USDA packaging guidelines.

- a. List food packaging guidelines established by the USDA.
- b. Explain the rationale and purposes of those guidelines.
- c. List properties of containers needed for commercial food packaging.
- d. Identify factors related to the successful use of controlled-atmosphere packaging.
- e. Describe information required on a food label.

STANDARD 5

Students will discuss the basis of food chemistry.

Objective 1: Discuss elements, compounds, mixtures, and formulas.

- a. Explain the scientific table of elements.
- b. Compare and contrast elements and compounds.
- c. Describe heterogeneous mixtures and homogeneous mixtures.
- d. Explain the similarities and differences between heterogeneous and homogenous mixtures.
- e. Identify common examples of pure substances and mixtures.
- f. Describe the parts of an atom.
- g. Identify chemical symbols, formulas, and equations.
- h. Explain how chemical symbols, formulas, and equations are used in food science.
- i. Explain the differences between ionic and covalent bonds and ionic and covalent compounds.
- j. Explain why specific chemical reactions occur.
- k. Explain the chemical and physical changes in food.

Objective 2: Explain solutions, colloids, sols, gels, foams, and emulsions.

- a. Identify the solvent and solute in a given solution.
- b. Discuss the effect of a solute and its concentration on the boiling and freezing points of a solution.
- c. Calculate the concentration of a solution using mass percent.
- d. Compare and contrast, unsaturated, saturated, and supersaturated solutions.
- e. Describe the properties of colloidal dispersions.
- f. Explain the three parts of an emulsion and their relationship to each other.
- g. Identify various food emulsions and tell the types of each emulsion.

Objective 3: Discuss the functions of enzymes.

- a. Describe how enzymes act as catalysts in chemical reactions.
- b. Explain the relationship between an enzyme and a substrate.
- c. Compare the functions and activities of enzymes and coenzymes.
- d. Discuss the enzymes involved in digestion.
- e. Identify factors that affect enzyme activity.
- f. Explain how enzyme reactions are involved in food preparation.

Objective 4: Discuss fermentation and food.

- a. Explain anaerobic respiration and how it is involved in metabolism and food science.
- b. List three reasons why food is fermented.
- c. Identify bacteria used to ferment food.
- d. Compare fresh-pack pickling and brine pickling.
- e. Discuss how lactic acid bacteria create sauerkraut from cabbage.
- f. Describe the process of making vinegar.

Objective 5: Discuss leavening agents and baked goods.

- a. Describe the purpose of leavening agents in baked goods.
- b. List the four major leavening agents.
- c. Explain why baking soda is used with an acid in baked goods.
- d. Identify the types of doughs and batters used in making quick breads.
- e. List the ingredients in baking powder.
- f. Discuss how air and steam act as leavening agents.
- g. Identify the purposes of the ingredients used in making yeast breads.

Objective 6: Discuss the purpose of additives.

- a. Identify agencies involved in regulating food additives.
- b. Discuss the purposes for using food additives.
- c. Describe properties of a desirable food preservative.
- d. Explain why additives used as antioxidants are added to food.
- e. Explain the difference between natural and artificial additives.
- f. Identify kinds of sweeteners used in food processing.
- g. Name nutrients that are used as food additives.
- h. Discuss advantages and disadvantages of using food additives.

STANDARD 6

Students will discuss the basics of nutrition as related to food.

Objective 1: Discuss human physiology.

- a. Illustrate and label the parts of the human digestive system.
- b. Define the terms mechanical and chemical digestive processes.
- c. Explain the difference between mechanical and chemical digestive processes.
- d. Explain absorption as part of the digestive process.

Objective 2: Discuss cellular biology.

- a. Illustrate and label the parts of a plant and an animal cell.
- b. Explain the role of osmosis as part of the digestive process.
- c. Analyze components and by-products of metabolism.
- d. Explain a food chain and its relationship to human nutrition.
- e. Identify the common and different characteristics of plant and animal cells.
- f. Describe the functions of plant and animal cells.
- g. Describe the function of the root, stem, leaf, and seed in the plant structure.
- h. Describe the denaturation process and how it relates to food preparation.
- i. Describe the dehydration process and how it related to food preparation.

Objective 3: Discuss molecular structures.

- a. Duplicate the molecular structure of carbohydrates.
- b. Duplicate the molecular structure of proteins.
- c. Duplicate the molecular structure of fats.

Objective 4: Discuss metabolism.

- a. Define anabolism and catabolism.
- b. Describe conditions needed for metabolism to occur.
- c. Explain the process of osmosis and the role it plays in metabolism.
- d. Discuss basal metabolism and the factors that affect it.
- e. Identify levels of voluntary activity and how these affect the need for kilocalories.
- f. Describe metabolic changes and the effect they have on the body during fasting.
- g. Explain why lactic acid builds up in the muscles during exercise and how this can be prevented or treated.

STANDARD 7

Students will discuss the basic nutrients and their specific properties as related to food science.

Objective 1: Identify nutrients and recommended daily allowances.

- a. Identify the recommended daily allowances (RDA) of the basic nutrients.
- b. List the five main nutrients and food sources of each.
- c. Explain the use of the five main nutrients in relation to the Food Guide Pyramid and/or the Dietary Guidelines.
- d. Discuss the importance of fiber in the diet.

Objective 2: Identify the properties of carbohydrates.

- a. Explain the chemical reaction that occurs when plants produce carbohydrates.
- b. Define monosaccharides and disaccharides and name examples of each.
- c. Describe the normal regulation of glucose levels in the blood and the conditions of low and high glucose levels.
- d. Explain sugar hydrolysis and list the products of the hydrolysis of sucrose and lactose
- e. Discuss the process of caramelization.
- f. Compare the structures of amylose and amylopectin and how these structures affect cooking properties.
- g. Define the terms gelatinization, paste, retrogradation, and syneresis as used in starch cookery.

Objective 3: Identify the properties of fats and lipids.

- a. Compare the properties of saturated and unsaturated fatty acids.
- b. Identify foods containing triglycerides and identify which foods contain saturated and unsaturated fat.
- c. Discuss the function of fat in food preparation.
- d. List ways lipid oxidation can be controlled in food.
- e. Describe the functions of fat in the body.
- f. Explain the role of fat in maintaining optimum health.
- g. Explain the role of cholesterol in maintaining optimum health.
- h. Contrast the properties of saturated and unsaturated fats.
- i. Describe the effects of temperature on fats used in food preparation.

Objective 4: Identify the properties of proteins and amino acids.

- a. Name the groups of elements that identify an amino acid.
- b. Describe the chemical structure of protein.
- c. Explain what happens during the denaturation of protein and how the process occurs.
- d. Describe ways in which protein is used in food preparation.
- e. Discuss the composition of eggs and how they should be stored.
- f. List factors that affect the stability of an egg foam.
- g. Identify the functions of protein in the body.
- h. Compare and contrast complete and incomplete protein.

Objective 5: Identify the properties of vitamins and minerals.

- a. Explain why mega doses of fat-soluble vitamins can be toxic.
- b. Discuss the functions of vitamins and minerals in the body.
- c. Describe water and fat-soluble vitamins and list the main vitamins in each category.
- d. Identify the food sources for each vitamin and mineral.
- e. Identify deficiency diseases and explain their causes.
- f. Explain the difference and list examples of major and trace minerals.
- g. Explain the interrelationships among nutrients.

Objective 6: Explain the properties of water.

- a. Identify the properties of water that make it a polar molecule.
- b. Describe hydrogen bonds and how they differ from covalent bonds.
- c. Discuss the differences between hard water and soft water.
- d. Compare the heat of fusion and the heat of vaporization.
- e. Explain the functions of water in food preparation.
- f. Identify the functions of water in the body.

STANDARD 8

Students will apply basic food science principles.

Objective 1: Discuss the role of acids and bases.

- a. Discuss what happens when water ionizes and how ionization relates to the formation of acids and bases.
- b. Identify the properties of acids and bases.
- c. Describe the pH scale and how it is used.
- d. Use indicators to measure the pH of solutions.
- e. Define atomic mass and mole and analyze relationship between them.
- f. Explain how molarity is calculated.
- g. Describe the importance of pH in digestion and blood.
- h. Discuss ways pH is related to the properties of food, its safety, and its freshness.

Objective 2: Explain the coagulation and coalescence processes associated with milk protein and cheese.

- a. List the components of milk and explain how each component is dispersed in the milk.
- b. Describe what happens when milk protein is coagulated.
- c. Discuss the processing of milk and how it is treated when it is pasteurized, homogenized, and fortified.
- d. Compare and contrast skim milk, low-fat milk, whole milk, half-and-half, and various creams.
- e. Explain the differences between evaporated milk, condensed milk, and dried milk.
- f. Identify factors that affect the ability of cream to form a foam.
- g. Explain the changes that occur when milk is heated.
- h. Describe the process of making a fermented or cultured milk product and list examples of these products.

STANDARD 9

Students will complete experiments in food science.

Objective 1: Complete steps for research project preparation.

- a. Describe ways of selecting a topic for research.
- b. Identify resources to be used to gather information for a project.
- c. Select a hypothesis and title.
- d. Propose variables.
- e. Develop a procedure.
- f. Explain the importance of having accurate supply and equipment lists.

Objective 2: Complete a research project.

- a. Complete a research project according to scientific principles.
- b. Describe the results of the project and compare it with the initial hypothesis.
- c. Evaluate the research project information for reliability and usability.

STANDARD 10

Students will identify careers related to food science.

Objective 1: Identify career opportunities related to food science.

- a. Identify career areas that are open to people with college degrees in food science and technology.
- b. List careers available to people with college degrees in Family and Consumer Sciences or a related field.
- c. Discuss the duties of a dietitian and the setting in which a dietitian might work.
- d. Explain the difference between commercial and noncommercial establishments in the food service industry.
- e. Compare and contrast entry-level with higher-level jobs in the food service industry.

Objective 2: Complete a personal career evaluation.

- a. Identify careers in food science that would meet a person's individual needs.
- b. Complete a personal aptitude analysis and analyze the results.