§130.230. Food Science (One Credit).

(a) General requirements. This course is recommended for students in Grades 11-12. Prerequisites: three units of science. Recommended prerequisite: Principles of Hospitality and Tourism.
To receive credit in science, students must meet the 40% laboratory and fieldwork requirement identified in §74.3(b)(2)(C) of this title (relating to Description of a Required Secondary Curriculum).

(b) Introduction.

(1) Food Science. In Food Science students conduct laboratory and field investigations, use scientific methods during investigations, and make informed decisions using critical thinking and scientific problem solving. Food Science is the study of the nature of foods, the causes of deterioration, the principles underlying food processing, and the improvement of foods for the consuming public.

(2) Nature of science. Science, as defined by the National Academy of Sciences, is the "use of evidence to construct testable explanations and predictions of natural phenomena, as well as the knowledge generated through this process." This vast body of changing and increasing knowledge is described by physical, mathematical, and conceptual models. Students should know that some questions are outside the realm of science because they deal with phenomena that are not scientifically testable.

(3) Scientific inquiry. Food scientific inquiry is the planned and deliberate investigation of the natural world. Scientific methods of investigation are experimental, descriptive, or comparative. The method chosen should be appropriate to the question being asked.

(4) Science and social ethics. Scientific decision making is a way of answering questions about the natural world. Students should be able to distinguish between scientific decision-making methods (scientific methods) and ethical and social decisions that involve science (the application of scientific information).

(5) Science, systems, and models. A system is a collection of cycles, structures, and processes that interact. All systems have basic properties that can be described in space, time, energy, and matter. Change and constancy occur in systems as patterns and can be observed, measured, and modeled. These patterns help to make predictions that can be scientifically tested. Students should analyze a system in terms of its components and how these components relate to each other, to the whole, and to the external environment

(6) Students are encouraged to participate in extended learning experiences such as career and technical student organizations and other leadership or extracurricular organizations.

(c) Knowledge and skills.

(1) The student, for at least 40% of instructional time, conducts laboratory and field investigations using safe, environmentally appropriate, and ethical practices. The student is expected to:

(A) demonstrate safe practices during laboratory and field investigations; and

(B) demonstrate an understanding of the use and conservation of resources and the proper disposal or recycling of materials.

(2) The student uses scientific methods and equipment during laboratory and field investigations. The student is expected to:

(A) know the definition of science and understand that it has limitations, as specified in subsection (b)(2) of this section;

(B) know that hypotheses are tentative and testable statements that must be capable of being supported or not supported by observational evidence. Hypotheses of durable explanatory power which have been tested over a wide variety of conditions are incorporated into theories;

(C) know scientific theories are based on natural and physical phenomena and are capable of being tested by multiple independent researchers. Unlike hypotheses, scientific theories are well-established and highly-reliable explanations, but they may be subject to change as new areas of science and new technologies are developed;

(D) distinguish between scientific hypotheses and scientific theories;

(E) plan and implement descriptive, comparative, and experimental investigations, including asking questions, formulating testable hypotheses, and selecting equipment and technology;

(F) collect and organize qualitative and quantitative data and make measurements with accuracy and precision using tools and equipment;

(G) analyze, evaluate, make inferences, and predict trends from data; and

(H) communicate valid conclusions supported by the data through methods such as lab reports, labeled drawings, graphic organizers, journals, summaries, oral reports, and technology-based reports.

(3) The student uses critical thinking, scientific reasoning, and problem solving to make informed decisions within and outside the classroom. The student is expected to:

(A) in all fields of science, analyze, evaluate, and critique scientific explanations by using empirical evidence, logical reasoning, and experimental and observational testing, including examining all sides of scientific evidence of those scientific explanations, so as to encourage critical thinking by the student;

(B) communicate and apply scientific information extracted from various sources such as current events, news reports, published journal articles, and marketing materials;

(C) draw inferences based on data related to promotional materials for products and services;

(D) evaluate the impact of scientific research on society and the environment;

(E) evaluate models according to their limitations in representing biological objects or events; and

(F) research and describe the history of science and contributions of scientists.

(4) The student analyzes the role of acids and bases in the food sciences. The student is expected to:

(A) identify the properties of acids and bases;
(B) describe the pH scale and how it is used;
(C) use various indicators to measure the pH of solutions;
(D) describe the importance of pH in digestion and blood; and
(E) discuss ways pH is related to the properties of food, its safety, and its freshness.

(5) The student applies the principles of food safety and microbiology. The student is expected to:

(A) investigate the properties of microorganisms that cause food spoilage;
(B) explain the difference between food intoxication and food infection;
(C) examine the conditions under which the important pathogens are commonly destroyed, inactivated, or rendered harmless in foods;
(D) discuss the difference between microorganisms that are helpful and those that are harmful; and
(E) analyze sanitary food-handling practices.

(6) The student studies the chemical properties of food. The student is expected to:

(A) discuss elements, compounds, mixtures, and formulas;
(B) explain the Periodic Table of the Elements;
(C) compare elements and compounds;
(D) describe heterogeneous and homogeneous mixtures;
(E) explain the similarities and differences between heterogeneous and homogenous mixtures;
(F) identify chemical examples of pure substances and mixtures;
(G) identify chemical symbols, formulas, and equations and explain how they are used in food science;
(H) analyze the occurrence of specific chemical reactions; and
(I) analyze chemical and physical changes in food.

(7) The student analyzes solutions, colloids, solids, gels, foams, and emulsions. The student is expected to:

(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; and
(G) identify various food emulsions and the types of each emulsion.

(8) The student understands the functions of enzymes. The student is expected to:

(A) describe how enzymes act as catalysts in chemical reactions;
(B) explain the relationship between an enzyme and a substrate;
(C) discuss the enzymes involved in digestion;
(D) identify factors that affect enzyme activity; and
(E) explain how enzyme reactions are involved in food preparation.

(9) The student understands the role of fermentation in food sciences. The student is expected to:

(A) explain anaerobic respiration and how it is involved in metabolism and food science;
(B) list reasons food is fermented;
(C) describe how bacteria is used to ferment food, including how lactic acid bacteria creates sauerkraut from cabbage;
(D) compare fresh-pack pickling and brine pickling; and
(E) describe the process of making vinegar.

(10) The student discusses how leavening agents are used in baking. The student is expected to:

(A) describe the purpose of leavening agents in baked goods;
(B) identify and describe major leavening agents;
(C) explain why baking soda is used with an acid in baked goods;
(D) describe the types of dough and batters used in making quick breads;
(E) analyze the ingredients in baking powder;
(F) discuss how air and steam act as leavening agents; and
(G) identify the purposes of the ingredients used in making yeast breads.

(11) The student understands the purposes of additives in food. The student is expected to:

(A) discuss the use of food additives;
(B) describe properties of a desirable food preservative;
(C) explain why additives used as antioxidants are added to food;
(D) explain the difference between natural and artificial additives;
(E) identify kinds of sweeteners used in food processing;
(F) name nutrients that are used as food additives;
(G) discuss the advantages and disadvantages of using food additives; and
(H) identify agencies involved in regulating food additives.

(12) The student understands the physiology of digestion. The student is expected to:

(A) define mechanical and chemical digestive processes;
(B) explain the difference between mechanical and chemical digestive processes; and
(C) explain absorption as part of the digestive process.

(13) The student understands metabolism. The student is expected to:

(A) analyze components and byproducts of metabolism;

(B) define anabolism and catabolism;

(C) describe conditions needed for metabolism to occur;

(D) explain the process of osmosis and the role it plays in metabolism;

(E) discuss basal metabolism and the factors that affect it;

(F) identify levels of voluntary activity and how these affect the need for kilocalories;

(G) describe metabolic changes and the effect they have on the body during fasting; and

(H) explain why lactic acid builds up in the muscles during exercise and how this can be prevented or treated.

(14) The student explains how food provides energy. The student is expected to:

(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;

(E) analyze how the body uses energy and calories;

(F) describe the relationship of energy to physical and chemical reactions;

(G) analyze relationships between food intake and body weight;

(H) determine energy requirements of individuals using multiple variables such as activity level;

(I) discuss energy imbalances in relationship to weight-related disorders and diseases; and

(J) explain the transfer of energy through a food chain and its relationship to human nutrition.

(15) The student describes the basic nutrients and their specific properties as related to food science. The student is expected to:

(A) identify the recommended daily allowances 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; and

(D) discuss the importance of fiber in the diet.

(16) The student identifies properties of carbohydrates. The student is expected to:

A) explain the chemical reaction that occurs when plants produce carbohydrates;

(B) define monosaccharides and disaccharides and name examples of each;

(C) describe the regulation of glucose in the blood and the conditions resulting from 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; and
(G) describe gelatinization, paste, retrogradation, and syneresis.

(17) The student describes the properties of fats and lipids. The student is expected to:
(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) describe 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; and
(I) describe the effects of temperature on fats in food preparation.

(18) The student describes the properties of proteins and amino acids. The student is expected to:
(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 their storage requirements;
(F) list factors that affect the stability of an egg foam;
(G) identify the functions of protein in the body; and
(H) compare and contrast complete and incomplete proteins.

(19) The student understands the coagulation and coalescence processes associated with milk protein and cheese. The student is expected to:
(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; and
(H) describe the process of making a fermented or cultured milk product and list examples of these products.

(20) The student analyzes the properties of vitamins and minerals. The student is expected to:
(A) discuss the functions of vitamins and minerals in the body;
(B) describe water- and fat-soluble vitamins and list the main vitamins in each category;
(C) explain why megadoses of fat-soluble vitamins can be toxic;
(D) analyze the food sources for each vitamin and mineral;
(E) analyze deficiency diseases and explain their causes;
(F) explain the difference and list examples of major and trace minerals; and
(G) explain the interrelationships among nutrients.

(21) The student explains the properties of water. The student is expected to:
(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 and soft water;
(D) compare the heat of fusion and the heat of vaporization;
(E) explain the functions of water in food preparation; and
(F) identify the functions of water in the body.

(22) The student analyzes the food irradiation process. The student is expected to:
(A) list the steps in the food irradiation process;
(B) define the units used to measure the amount of radiation used during the irradiation process; and
(C) describe the effects of irradiation on food.

(23) The student discusses United States Department of Agriculture (USDA) packaging guidelines. The student is expected to:
(A) research food packaging guidelines established by the USDA;
(B) explain the rationale and purposes of those guidelines;
(C) describe properties of containers needed for commercial food packaging;
(D) identify factors related to the successful use of controlled-atmosphere packaging; and
(E) describe information required on a food label.

(24) The student analyzes the food dehydration process. The student is expected to:

(A) describe the principles and purposes of dehydration;
(B) describe methods of dehydration and explain their similarities and differences;
(C) explain why food is pretreated before dehydrating;
(D) compare sulfating, sulfuring, and blanching;
types of blanching that can be used as pretreatment methods; and
(F) discuss the role of air temperature and movement in successful dehydration.

(25) The student analyzes the food canning process. The student is expected to:

(A) identify safety practices and equipment used in home and commercial canning;
(B) describe hot-pack, cold-pack, and pressure canning;
(C) identify advantages and disadvantages of each canning method;
(D) identify types of food that should be processed by each canning method; and
(E) compare heat transfer by conduction and by convection in canning.

(26) The student analyzes the food freezing process. The student is expected to:

(A) list the steps of the food freezing process;
(B) identify factors needed for successful freezing of food; and
(C) identify advantages and disadvantages of freezing food.

(27) The student understands the importance of developing lifelong skills. The student is expected to:

(A) demonstrate the use of oral and written communication skills such as writing technical reports, letters, and memos; communicating technical information to a nontechnical audience; and making formal and informal presentations;
(B) define a problem, identify potential causes and possible solutions, and make thoughtful recommendations;
(C) apply critical-thinking skills to new situations;
(D) demonstrate the highest standards of professional integrity and ethical values;
(E) work and interact with individuals from diverse cultures;
(F) explain the skills necessary for lifelong learning;
(G) work effectively with others;
(H) provide leadership in a variety of situations;
(I) deal with individual or group conflicts;
(J) research scientific and nonscientific information;
(K) competently use library resources;
(L) manage time effectively;
(M) facilitate group projects;
(N) handle multiple tasks and pressures; and
(O) prepare for a state or national food manager's sanitation certification or alternative credential within the field of food science technology.