871. Ecology of Fishes
Summer of even-numbered years. 4 credits. Approval of department. Given at the W. K. Kellogg Biological Station. Interdepartmental work administered by the Department of Zoology. Exploration of ecological problems with particular emphasis on growth, food and habitat selection, population biology and niche relations. Field and experimental investigations of fish communities.

872. Fish Communities and Aquatic Ecosystems
Winter of even-numbered years. 3(3-0) Approval of department. Processes by which fish influence the structure and function of aquatic ecosystems.

874. Advanced Biological Limnology
Fall of odd-numbered years. 3(4-0) F W 477, or approval of department. Historical and current contributions to concepts of community structure, energy flow and materials cycling in aquatic ecosytems. Special consideration given to selected heterogeneous equilibria.

875. Chemical Limnology
Winter. 4(2-3) F W 476, F W 477 or approval of department. Application of analytical chemistry concepts and technologies to fundamental chemical mechanisms in natural and polluted water systems. Special consideration given to selected heterogeneous equilibria.

876. Applied Limnology
Spring. 3(3-0) F W 874 or F W 875 or approval of department. Aquatic ecology: quantitative relationship between physical, chemical and biological parameters in polluted and unpolluted lakes and streams.

877. Fish Population Dynamics
Winter of odd-numbered years. 3(3-0) Approval of department. Quantitative analysis of fish populations; rates of change and their underlying causes.

878. Dynamics of Aquatic Contaminants
Spring of even-numbered years. 6(2-4) F W 476, F W 477 or approval of department. Movement of contaminants through aquatic ecosystems. Chemical and physical processes controlling decomposition and disposition of contaminants. Relationship of chemical form to bioavailability and toxicity. Statistical and deterministic predictive simulation models.

897. Ecosystem Ecology
Fall of even-numbered years. 4(4-0) ZCL 398 or BOT 450. Interdepartmental with and administered by the Department of Zoology. Concepts of ecosystem structure, energy flow, and nutrient cycling in representative terrestrial and aquatic ecosystems.

899. Master's Thesis Research
Fall. Winter, Spring, Summer. Variable credits. Approval of department.

999. Doctoral Dissertation Research
Fall. Winter, Spring, Summer. Variable credits. Approval of department.

FOOD SCIENCE AND HUMAN NUTRITION
College of Agriculture and Natural Resources College of Human Ecology

Food Science FSC

101. Food and Society (N)
Fall, Winter, Spring. 3(3-0) Interdepartmental with Human Nutrition and Foods. Analysis of the history and current environmental aspects of food in determining the quality of human life. Introduction into the principles of food preservation and safety.

205. Food Laws and Regulations
Spring. 3(3-0) Interdepartmental with Human Nutrition and Foods. Food laws and regulations that govern food processing and food service systems; procedures involved in adopting and enforcing food laws and regulations.

211. Introduction to Food Science
Winter, Spring. 3(3-0) CEM 141B. Fundamentals of food composition, food processing, preservation and food commodities.

256. Meats, Poultry and Fishery Products I
Fall. 3(2-2) Interdepartmental with the Department of Animal Science. Principles of evaluation and nutritive value. Identification of grades and cuts of beef, pork, lamb and poultry products.

300. Dairy Products
Spring. 3(3-0) CEM 143 or approval of department. Chemical and physical properties of milk and milk products. Survey of dairy products and the technologies involved in their manufacture.

310. Food Safety and Microbiology
Fall. 3(3-0) CEM 143 or concurrently or approval of department. Not open to students with credit in FSG 440. Interdepartmental with the Department of Microbiology and Public Health. Effects of food handling, preparation and service on food safety. Microorganisms in foods, sanitation, food borne disease and food service regulations.

325. Food Plant Sanitation (FSC 332.) Winter. 3(3-0) FSC 211, MPH 200, CEM 141B. Sanitary aspects of food processing operations, water quality, equipment design, bacteriological agents, pest control, personal hygiene, biological hazards, and regulatory agencies. Field trips required.

328L. Laboratory in Food Plant Sanitation
Winter. 1(0-3) FSC 328 or concurrently. Sanitary aspects of food processing operations water quality, and related hygienic aspects. Field trips required.

329. Unit Operation and Food Processing I
Fall. 4(3-2) PHY 237, MTH 169. Interdepartmental with and administered by Agricultural Technology and Systems Management. Engineering concepts related to the unit operations found in the food industry. Fluid mechanics, heat transfer and rate processes including psychrometrics and refrigeration.

330. Food Processing Operations (FSC 331.) Winter. 3(3-0) PHY 237, FSC 211, or approval of department. Unit operations for food preservation by low temperature, heat, dehydration, evaporation and separation processes.

330L. Laboratory in Food Processing Operations
Winter. 1(0-2) FSC 330 or concurrently. Demonstrations, workshops, and pilot-scale processing illustrating selected unit operations in food manufacture.

333. Food Chemistry
Spring. 3(3-0) FSC 211 and CEM 241 or approval of department. Chemical changes in foods that affect the texture, color, flavor, odor, stability, and nutritive quality during processing and storage.

333L. Laboratory in Food Chemistry
Spring. 1(0-3) FSC 211, CEM 241 and FSC 323 or concurrently. Chemical changes in food that affect quality and stability.

400. Milk Processing Technology
Fall. 4(3-3) CEM 241 or approval of department. The fluid milk industry. Composition, quality, sanitation, nutritive value, processing, packaging and distribution of milk and milk products.

401. Industrial Food Fermentations
Fall. 3(3-0) FSC 440 and organic chemistry or approval of department. Physical, microbiological and chemical procedures in utilizing microbial cultures in controlled fermentations of foods and food constituents.

402. Chemistry and Technology of Lipids
Winter. 3(3-0) One term organic chemistry. Chemical and physical properties of edible fats and oils. Refining and processing of lipids into margarine, butter, shortening and salad oils. Chemical methods for analysis of lipids.

405. Technology of Manufactured Dairy Products
Winter. 4(3-3) CEM 406 or approval of department. Manufacturing technology of fermented dairy foods, frozen dairy desserts, and imitation dairy products.

421. Food Plant Management
Spring. 3(3-0) Seniors or approval of department. Business and technical management concepts associated with food plants. Efficiency factors, regulatory obligations, and administrative aspects.

430. Thermal Processes for Foods
Winter. 3(3-2) AET 328, FSC 328 or concurrently. Process design concepts with emphasis on heating and cooling of foods in containers. Parameters used to describe thermal resistance of product components. Process time calculations for thermal processes.
440. Food Microbiology
Spring, 3(0-0) MPH 200 or MPH 301 or approval of department. Interdepartmental with the Department of Microbiology and Public Health.
Major groups of microorganisms of importance to the food industry are studied with emphasis on ecological, physiological, and public health aspects.

441. Food Microbiology Laboratory
Spring, 2(0-4) FSC 440 or concurrently or approval of department. Interdepartmental with the Department of Microbiology and Public Health.
Laboratory practice with major groups of microorganisms of importance to the food industry. Concurrent enrollment in FSC 440 recommended.

445. Meat, Poultry and Fish Processing
Spring, 4(2-8) FSC 333 or approval of department.
Muscle food and egg processing technology, product formulation and quality control. Manufacturing of cured meat, sausage and processed products.

455. Food Analysis I
Fall, Spring, Summer of even-numbered years. 4(8-4) CEM 162, CEM 241 or approval of department.
Modern methods of analysis for fat, protein, moisture and other macroconstituents of food. Application of spectrophotometry in determination of microconstituents: use of dye-binding, colorimetric and titrimetric techniques in food analysis.

456. Food Analysis II
Winter, 4(2-6) CEM 162 and CEM 241 or approval of department.
Use of colorimetry and spectrophotometry, chromatographic methods and other techniques for the analysis of food constituents and additives.

457. Quality Control in the Food Industry
Winter of even-numbered years. 3(0-0) STT 201 or approval of department.
Organization of and tools used for quality control: control charts, acceptance and auditing inspections, critical control points, reliability, safety, recall and liability.

460. Fruit and Vegetable Processing
Fall, 4(3-3) FSC 330 or approval of department.
Product composition, harvesting, quality indexes, post-harvest changes, thermal process systems and freezing techniques.

470. Cereal Products Technology
Spring, 3(0-0) FSC 330 or approval of department.
Classification and composition of food grains, milling processes, quality parameters, baking technology, breakfast cereals, and extrusion technology.

480. Special Problems in Food Science
Fall, Winter, Spring, Summer. 1 to 3 credits. May reenroll for a maximum of 6 credits.
Advanced undergraduates may select research work in food chemistry, food microbiology, food engineering, food plant management, processing dairy products, meat, poultry and fishery products, fruits and vegetables, cereals or beverages.

490. Seminar
Fall, 1(0-0) Approval of department.
Preparation and presentation of reports on a specialized aspect of food science.

830. Advanced Thermal Processes for Foods
Spring, 4(3-3) FSC 430, or approval of department.
Integration of kinetic parameters for food product components and heat and mass transfer relationships into prediction models for food product quality.

831. Rheology and Texture of Food
Winter, 3(2-2) Approval of department.
Definition, measurement, analysis of and relationship between the rheological and textural parameters which describe food. Relationship between basic rheology and food texture.

832. Microbiology of Food Processing
Winter of odd-numbered years. 2(0-2) FSC 440 or approval of department.
Relationship of environment to occurrence, growth and survival of microorganisms in foods, control of food spoilage and food poisoning microorganisms in food processing. Role of spores in process selection.

834. Flavor Quality Control
Fall of odd-numbered years. 4(3-3) Approval of department.
Sensory methods used for food evaluation and panel analyses. Flavor chemistry analytical methods. Sampling plans, control charts and acceptance sampling for statistical quality control.

835. Carbohydrates in Foods
Fall of odd-numbered years. 3(0-0) FSC 333.
The chemistry and food technology of mono-, oligo-, and poly-saccharides.

850. Selected Topics in Food Science
Fall, Winter, Spring, Summer. 2 to 4 credits. May reenroll for a maximum of 12 credits. Approval of department.
Advanced studies; food utilization, texture, additives, toxicants, food proteins, ingredient safety, nutrient stability, new processing techniques, flavors, quality control, storage stability, state and federal food regulations.

852. Advanced Lipids
Winter of even-numbered years. 3(0-0) FSC 402 or approval of department.
A course relating composition, structure, and physical and chemical properties of lipids to processing requirements of fats and oils to their function in food systems.

934. Research Techniques with Proteins
Fall, 3(2-3) BCH 401 or BCH 451.
Physical and chemical techniques applicable to protein characterization (including—electrophoretic techniques, thi-layer chromatography, gelfiltration, ultracentrifugation and amino acid analysis).

951. Muscle Biochemistry
Spring of odd-numbered years. 3(3-0) BCH 452.
The structure and function of living muscle. Emphasis is placed upon the chemical and energy changes of muscle in contraction. Changes occurring after death during rigor development are also discussed.

952. Advanced Lipids
Winter of even-numbered years. 3(3-0) BCH 402 or approval of department.
A course relating composition, structure, and physical and chemical properties of lipids to processing requirements of fats and oils to their function in food systems.

999. Doctoral Dissertation Research
Fall, Winter, Spring, Summer. Variable credit. Approval of department.

Human Nutrition and Foods

HNF

100. Principles of Food Preparation
Fall, Winter, Spring, 4(2-4)
Composition and properties of food related to quality characteristics; methods of preparation, evaluation of quality and use of selected foods.

101. Food and Society (N)
Fall, Winter, Spring, 3(0-0) Interdepartmental with and administered by Food Science.
Analysis of the scientific, social and environmental aspects of food in determining the quality of human life. Introduction into the principles of food preservation and safety.

102. Nutrition for Humans (N)
Fall, Winter, Spring, 3(3-0) Fundamentals of nutrition with reference to diverse ways people provide for and attach meaning to food.

200. Physical and Chemical Properties of Foods
Fall, Winter, 4(2-4) CEM 1418 or concurrently.
Interrelationships between basic physical and chemical principles and food preparation; composition, methods of preparation, evaluation, quality standards and comparative analysis.
Descriptive — Food Science and Human Nutrition

205. Food Laws and Regulations
Spring, 3(3-0) Interdepartmental with and administered by Food Science.
Food laws and regulations that govern food processing and food service systems, procedures involved in adopting and enforcing food laws and regulations.

221. Food and the Consumer
Fall, Spring, 3(3-0) Sophomores or approval of department.
Factors affecting the food supply, consumer protection, food buying and management of human and material resources in feeding the family.

222. Food and the Consumer Laboratory
Winter, 2(0-4) HNF 221 or concurrently.
Decision making in Foods and Nutrition with emphasis on food choices in the marketplace. Management of human and nonhuman resources in food consumerism activities.

290. Professional Literature I
Fall, Spring, 3(3-0) HNF 102 or HNF 200 or FSC 310 or concurrently, sophomores majors.
Evaluation and communication of scientific information. Food and nutrition resources and misinformation, application of statistics, nutritional epidemiology, nutrient composition and computer diet analysis.

300. Experimental Foods
Winter, Spring, 4(2-0) HNF 200, CEM 143; FSC 310 or concurrently.
Experimental approach to the study of foods, relating chemical and physical properties to reactions and processes occurring in food in response to various treatments.

310. Sensory Assessment of Foods
Winter, 2(1-2) HNF 290, HNF 300 or concurrently.
Sensory perception, chemistry of food flavors, and methods used in organoleptic evaluation of foods.

Winter, 3(3-0) HNF 102, FCS 262A; three terms of natural science or approval of department.
Functions and importance of nutrients to physical growth, development and health of the child. Eating behavior of children. Feeding in child care centers.

375. Community Nutrition
Fall, 3(3-0) HNF 102 or approval of department.
Identification of nutritional needs of population groups and available resources in communities.

379. Basic Nutritional Counseling
Fall, Winter, 3(2-3) HNF 102, HCP 450 or approval of department.
Competencies required of professional dietitians. Skills in communicating, interviewing, problem solving and planning for nutritional care using simulated situations.

400H. Honors Work
Fall, Winter, Spring, Summer, 1 to 16 credits. May reenroll for a maximum of 24 credits. Seniors, approval of department.

403. Fats and Carbohydrates in Food Systems
Fall, 4(3-3) HNF 300 or approval of department.
Chemical and physical reactions in fat and carbohydrate food systems, including sols, gels, emulsions, etc. Food evaluation techniques will be introduced.

404. Role of Proteins in Food Systems
Winter, 4(3-3) HNF 300 or approval of department.
Physical and chemical reactions with protein foods, meats, eggs, cheese, seeds. Emphasis on time-temperature data in relation to quality.

406. Cultural Aspects of Food
Spring, Summer, 3(3-0) Juniors.
A cross cultural investigation of food and its consumption. Factors such as history, religion, food sources and socio-economic status are considered.

406L. Laboratory — Cultural Aspects of Food
Spring, 1(0-3) HNF 100 or HNF 200 or approval of department; HNF 406 concurrently.
Art and science of cookery in relation to historical, cultural, personal, regional, racial and religious customs.

407. Interactions of Culture and Nutrition
Spring, 3(3-0) Juniors; HNF 102 or HNF 171 or approval of instructor, Interdepartmental with the Department of Anthropology.
World and U.S. food behavior focusing on conflicts between behavior and nutritional needs at various stages of life cycle. Anthropological, psychological and social influences affecting food behavior are analyzed.

411. Principles of Human Nutrition
Spring, 4(4-0) ECH 200.
Identification, function and food sources of nutrients required by humans. Metabolism as affected by deficiency or excess of specific nutrients.

415. Consumer Trends in the Food Industry
(HNF 315.) Spring, 3(3-0) Juniors in the College of Human Ecology or approval of department.
Current and projected trends concerning American consumers in the food industry. Consumer behavior and market segmentation concepts influencing the food market place and food product development.

440. Foodservice Management: Material Resources
Fall, 4(4-0) HNF 290, CPS 100 or CPS 115 or concurrently, FSC 310 or approval of instructor.
Principles, processes and control strategies in non-commercial foodservice operations. Menu planning, procurement, on-premise storage and issue, production, consumer distribution, safety, and sanitation.

440P. Foodservice Management Practicum
Winter, Spring, 3(2-4) HNF 440 or approval of department.
Receiving, storage, preparation and service of food along with safety, sanitation, design and layout of equipment in a noncommercial food-service operation. Meal tickets required.

441. Foodservice Management: Financial Resources
Winter, 4(3-2) HNF 440.
Costs of human and material resources in a non-commercial foodservice operation utilizing manual and electronic data processing strategies.

442. Foodservice Management: Problem Analysis and Decision Making
Spring, 3(2-3) HNF 440P or concurrently, HNF 441.
Problem-solving techniques. Cause and effect factors, situational components, and development of alternative solutions to problems in non-commercial foodservice.

461. Energy Nutrients and Proteins for Human Nutrition
Fall, 4(4-0) BCH 200; PSL 432 or PSL 241.
Metabolism of protein, fats and carbohydrates as applied to the nutritional requirements and food supplies of people.

462. Vitamins and Minerals for Human Nutrition
Winter, 4(4-0) HNF 461.
Metabolism of vitamins and minerals as applied to the nutritional requirements and food supplies of people.

463. Nutrition and Human Development
Winter, 4(4-0) HNF 492 or approval of department.
The role of nutrition in physiological systems and biochemical processes related to the perspective of human growth and development.

470. Clinical Nutrition
Spring, 3(3-0) HNF 462; PHM 350 or approval of department.
Changes in physiological and/or biochemical functions or processes due to illness and uses of modified diets as an essential part of treatment.

470P. Clinical Nutrition Practicum
Spring, 1(0-3) HNF 470 concurrently.
Assessment of nutritional status. Modification of the hospital general menu for implementation of diets prescribed for treatment of disease.

473. Interpretation of Clinical Laboratory Tests in Dietetics
Spring, 4(3-2) HNF 470 or concurrently.
Principles, procedures and interpretation of clinical laboratory methods with particular emphasis on their interpretation relative to nutritional status and therapeutic nutrition.

477. Issues in Dietetic Practice
Spring, 3(3-0) HNF 379, HNF 462, HNF 441, Seniors or approval of department.
Identification of issues in clinical and community nutrition, foodservice management and health care delivery systems with emphasis on needed strategies for change in future practice.

490A. Professional Literature II: Foods
Fall, 2(2-0) HNF 290, HNF 300 or HNF 402 or approval of department.
Selected topics in foods research. Emphasis on experimental data and basic scientific principles related to food quality, nutritive stability and food safety.
490. Professional Literature II: Nutrition
Winter. 2(2-0) HNF 290, HNF 462 or approval of department. Emphasis on experimental data and scientific principles related to basic nutrition research. Focus on current developments in nutrient requirements, metabolism and interactions.

490C. Professional Literature II: Clinical Nutrition
Spring. 2(2-0) HNF 290, HNF 470 or concurrently or approval of department. Selected topics in clinical nutrition research. Emphasis on the use of data and scientific principles related to nutritional care of patients/clients including pathophysiologic correlations, nutritional assessment, diet planning, nutrition counseling.

490D. Professional Literature II: Foodservice Management
Winter. 2(2-0) HNF 290, HNF 441 or approval of department. Examination of trends, problems and research in food service systems operation. Focus on current issues and developments relating to materials handling, labor needs, operational accountability and public responsibility.

490E. Professional Literature II: Foods and Nutrition Information
Spring. 2(2-0) HNF 290, HNF 411 or HNF 492 or approval of department. Selected topics in foods and nutrition information. Emphasis on research related to method and effectiveness of nutrition education.

495. Independent Study
Fall, Winter, Spring, Summer. 1 to 3 credits. May reenroll for a maximum of 9 credits. Senior approval of department. Individual study of selected topics in food, nutrition and food service management under staff guidance.

498. Field Study
Fall, Winter, Spring. 3 to 12 credits. May reenroll for a maximum of 12 credits. Approval of department. Planned program of research, observation, study or work in selected organizations under staff guidance.

805. Seminar in Foods and Nutrition
Fall, Winter, Spring. 1(1-0) HNF 403 or HNF 463.

813C. Supervised Individual Study in Foodservice Management
Fall, Winter, Spring. 2 to 4 credits. May reenroll for a maximum of 10 credits. Approval of department.

814. Nutrition and Obesity
Winter. 2(2-0) HNF 462. One undergraduate course in nutrition, biochemistry or physiology. Assessment, energy metabolism, and risk factors associated with obesity. Significance of nutrition and other factors for weight control and reduction.

842. Nutritional Counseling
Fall of odd-numbered years. 2(2-0) HNF 401 or approval of department. Provision of nutritional counseling for clients. Assessment, planning, implementation and evaluation of nutritional counseling.

899. Master’s Thesis Research
Fall, Winter, Spring, Summer. Variable credit. Approval of department.

912. Pathology of Nutritional and Metabolic Diseases
(HNF 521, LSM 521.) Spring of odd-numbered years. 4(3-2) ANT 420, ANS 525, BCH 452, HNF 462 recommended. Interdepartment with and administered by the Department of Large Animal Clinical Sciences. Development, physiopathology and morphologic pathology of nutritional and metabolic diseases including carbohydrate, protein, fat, vitamin, mineral deficiencies, their experimental induction and their medical or economic significance.

935. Comparative Nutrition — Lipids and Carbohydrates
Winter. 2(2-0) HNF 452 and a previous course on principles of nutrition. Interdepartmental with the Department of Animal Science. Regulatory aspects of carbohydrate and lipid metabolism as influenced by nutrition in mammals. Emphasis on normal and abnormal physiological states such as obesity, ketosis and diabetes.

936. Comparative Nutrition — Protein Metabolism and Developmental Biology
Winter. 2(2-0) HNF 452 and a previous course on principles of nutrition. Interdepartmental with and administered by the Department of Animal Science. Protein quality assessment, protein status, protein calorie malnutrition, amino acid metabolism, protein turnover, absorption, hormonal control of protein metabolism, developmental aspects of protein metabolism and growth.