820. Advanced Topics
Fall, Winter, Spring. Summer. 1 to 6 credits. May re-enroll for a maximum of 15 credits. Approval of department. Study of selected advanced topics in detail and depth.

821. Advanced Stream Ecology
Summer. 3 credits. ENT 421 or approval of instructor. Given at W. K. Kellogg Biological Station. Interdepartmental with the Entomology Department. Stream ecosystem energy budget models with emphasis on individual projects involving both laboratory and field experiments. Particular use will be made of artificial streams and locally abundant species of aquatic insects.

830. Environmental Requirements of Fish
Winter. 3(3-0) Approval of department.
Adaptations and responses of fish to environmental changes; research methods for evaluating environmental limitations and effects of pollutants on fish growth, reproduction and survival. Applications for developing water quality criteria.

871. Ecology of Fishes
Summer. 3 credits. Approval of instructor or 473 or ZOI 389. Given at the W. K. Kellogg Biological Station. Interdepartmental with and administered by the Department of Zoology. Exploration of ecological problems in fish biology with particular emphasis on growth, food and habitat selection, population biology, niche analysis and patterns in community structure. Field and experimental investigations of fish communities.

874. Advanced Biological Limnology
Fall. 3(4-0) 477, or approval of department.
Historical and current contributions to concepts of community structure, energy flow and materials cycling in aquatic eco-systems.

875. Chemical Limnology
Winter. 4(2-3) 476, 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.

899. Research
Fall, Winter, Spring, Summer. Variable credit. Approval of department.

940. Quantitative Wildlife Ecology
Spring. 3(3-0) Approval of department.
Fundamentals of population demographics. Rates of increase, dynamic and static life tables, logistic theory, the Leslie matrix model, age specific and time specific parameters. Current hypotheses on mechanisms promoting population stability.

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

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

Food Science

101. Food and Society
Fall, Winter. 3(3-0) Interdepartmental with Human Nutrition and Foods. Analysis of the scientific, social and environmental aspects of food in determining the quality of man's life. Introduction into the principles of food preservation and safety.

211. Introduction to Food Science
Spring. 3(3-0)
Modern food processing, world food problems, and the basic characteristics of processed foods.

215. World Food Issues
Spring. 3(3-0) Interdepartmental with and administered by the Department of Geography.
Food resources as related to world distributions of population, soil, water, fuel and minerals. Special attention to urbanization, irrigation, and future food needs and global constraints.

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

300. Dairy Products
Spring. 3(2-3)
Composition, use, classification and market grades, methods of storage and factors affecting keeping quality of dairy products.

331. Physical Principles of Food Processing
Fall, Winter. 4(3-2) 211; MTH 109; PHY 239 or approval of department.
Food preservation by heat, low temperature, dehydation and radiation.

332. Biological Principles of Food Processing
Winter. 4(3-3) MPH 200 or approval of department.
Biological problems related to food processing including waste disposal, sanitizing and bactericidal compounds, pesticides and residues, plant and animal growth regulators, radioactive elements, preservatives and toxicology of additives.

333. Chemical Principles of Food Processing
Spring. 4(3-3) 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.

400. Milk Processing Technology
Fall. 4(3-3) CEM 132 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) 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(2-2) 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.

404. Dehydrated Foods
Spring. 3(2-3) 331; 333 concurrently or approval of department.
Concentration and dehydration of foods by roller, vacuum, and freeze drying and foam, puff and tunnel drying. Stability and nutritional aspects of dehydrated foods.

405. Chemistry and Technology of Dairy Products Manufacturing
Winter. 3(2-3) May re-enroll for a maximum of 6 credits if a different topic is taken. 400 or approval of department.
Physical, chemical and microbiological factors in the processing of dairy products. Ice cream, sherbets, ice milks and special frozen desserts are studied in odd-numbered years; cheese, and related dairy products in even-numbered years.

421. Food Plant Management
Spring. 3(2-3) Seniors or approval of department.
Efficiency concepts, merchandizing, personnel utilization and organization.

440. Food Microbiology
(MPH 371) Spring. 5(3-4) MPH 200 or 401 or approval of department. Interdepartmental with the Microbiology and Public Health Department.
Major groups of microorganisms of importance to the food industry are studied with emphasis on ecological, physiological, and public health aspects.

445. Meat, Poultry and Fishery Products III
Spring. 5(3-6) 333 or approval of department.
Processing, formulation, and quality control.

449. Fruit, Vegetable and Cereal Products I
Fall. 4(3-3) 331 or approval of department.
Quality factors involved in canning, sugar and salt preservation, and milling.

449. Fruit, Vegetable and Cereal Products II
Winter. 4(3-3) 331 or approval of department.
Quality factors involved in cooling, freezing and other preservation procedures.

455. Food Analysis I
Fall. 4(2-6) CEM 132 and 163 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, complexometric and titrimetric techniques in food analysis.
458. Food Analysis II
Winter. 4(2-8) CEM 162 and 241
or approval of department.

Use of colorimetry and spectrophotometry, chromato­
graphic 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(3-0)
STT 201 or approval of department.

Organization of quality control within the food
industry by case study. Use of control charts,
sampling plans, flavor panel analyses.

450. Special Problems in Food
Science
Fall, Winter, Spring, Summer. 1 to 3
credits. May re-enroll for a maximum of
9 credits.

Advanced undergraduates may select research
work in food chemistry, food microbiology, food
engineering, food plant management, processing
dairy products, meat, poultry and fishery prod­
ucts, fruits and vegetables, cereals or beverages.

490. Seminar
Fall. 1(1-0) Approval of department.

Preparation and presentation of papers on
a specialized aspect of food science.

828. Food Processing Concepts,
Systems and Selected New
Processes
Winter. 3(3-0) 331; 332 or 440,
or approval of department.

Concepts of and requirements for processing
systems and continuous processes. Use of com­
puters in food processing; microwave heating
of foods; radiation preservation of foods and
related processing methods.

830. Thermal Processing of Food
Products
Fall. 3(3-3) 331; 332 or 440,
or approval of department.

Heating and cooling characteristics of foods in
containers, thermal resistance of microorganisms,
and derivation of process times and tempera­
tures for pasteurization and sterilization.

832. Microbiology of Food Processing
Fall. 3(2-3) 440 or approval of de­
partment.

Control of food spoilage and food poisoning mi­
croorganisms in food processing and the role of
bacterial spores in process selection.

833. Advanced Food Plant
Management
Fall of odd-numbered years. 3(3-0)
421 or approval of department.

Advanced concepts and strategy of policies and
practices in the management of food plants.

834. Flavor Quality Control
Spring of odd-numbered years. 4(3-3)
Approval of department.

Sensory methods used for food evaluation and
panel analyses. Flavor chemistry and analyti­
cal methods. Sampling plans, control charts,
and acceptance sampling for statistical quality
control.

835. Carbohydrates in Foods
Fall of odd-numbered year. 3(3-0)
332.

The chemistry and food technology of mono­
, disaccharides and poly-saccharides.

850. Selected Topics in Food Science
Winter of odd-numbered years. 3(3-0)
Approval of department.

Current developments in food utilization and
wholesomeness including food additives, resi­
duants, toxicants, and state and federal regula­
tions pertaining to food processing and quality
assurance.

860. Special Problems in Food
Science
Fall, Winter, Spring, Summer. 1 to 4
credits. May re-enroll for a maximum of
12 credits. Approval of department.

Investigation of food science areas of special interest
to individual graduate students.

899. Research
Fall, Winter, Spring, Summer. Variable
credit. Approval of department.

926. Historical and Chemical
Techniques
Winter. 3(1-6) Approval of depart­
ment.

Research techniques in thin-layer and gas
chromatography, differential thermal analysis,
isoelectric focusing, histology, histoch­
chemistry, biological testing, polargraphy and pH
measurement.

933. Instrumental Methods of Analysis
Fall, Winter, Spring. 3(2-2) 455 or 456 or
approval of department.

Spectroscopy (ultraviolet, visible, infrared, flame,
atomic absorption, fluorescence), manometry,
ion exchange, counterecurrent distribution, radio­
isotope tracers.

934. Research Techniques with
Proteins
Fall. 3(2-3) BCH 401 or 451.

Physical and chemical techniques applicable to
protein characterization (including -electropho­
esis, thin-layer chromatography, gel
filtration, ultra centrifugation and amino acid
analysis).

951. Muscle Chemistry
Spring of odd-numbered years. 3(2-3)
BCH 451 or approval of department.

The structure and function of living muscle.
Emphasis is placed on the chemical and energy
changes of muscle in contraction. Changes occurring
after death during rigor deve­
lopment are also discussed.

952. Advanced Lipids
Winter of even-numbered years. 3(3-0)
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.

953. Enzyme Reactions
Spring of even-numbered years. 4(3-3)
BCH 451, or approval of department.

Comprehensive discussion of parameters which
affect enzyme activity. Properties of enzymes
important in food processing.

954. Chemistry of Plant Products
Fall of even-numbered years. 3(3-0)
333, BCH 451, or approval of instructor.

Chemistry and biochemistry of plant pigments,
tannins, toxins and proteins.

990. Food Science Seminar
Fall, Winter, Spring. 1(1-0) May re­
enroll for a maximum of 3 credits toward M.S.
and 6 credits toward the Ph.D. Approval of
department.

Preparation and presentation of reports on a
specialized aspect of research findings in food
science.

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

Human Nutrition
and Foods*

100. Elementary 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
Fall. Winter. 3(3-0) Interdepart­
mental with and administered by Food Science.

Analysis of the scientific, social and environ­
mental aspects of food in determining the qual­
ity of man's food. Introduction into the prin­
ciples of food preservation and safety.

102. Nutrition for Man
Fall, Winter. 3(3-0)

Fundamentals of nutrition with reference to
diverse ways man provides for and attaches
meaning to his food.

221. Food and the Consumer
Fall, Winter, Spring. 2(3-0) Sopho­
more or approval of department.

Factors affecting the food supply, consumer pro­
tection, food buying and management of
human and material resources in feeding the
family.

222. Laboratory for Food
Management
Fall, Winter, Spring. 2(0-4) 221
concurrently.

Planning, organizing, preparing and serving
meals with consideration of human and materi­
al resources as well as nutrient needs.

320. Food Service Systems
Fall, Winter. 5(3-4) 221. Juniors.

Management of food service systems with vary­
ing organizational patterns and objectives. Em­
phasis on human and material resources and
their interactions in quality food produc­
tion and service.

340. Experimental Foods
Fall. 4(2-4) CEM 152; MPH 290
or concurrently.

Physical and chemical changes occurring in foods
during storage, preservation and prepara­
tion in terms of palatability, microbial safety
and nutritive value. Emphasis on carbohydrates
and fats.

341. Experimental Foods
Winter. 4(2-4) 340.

Continuation of 340. Emphasis on proteins.

350. Fundamental Principles of
Nutrition
Winter, Spring. 4(3-3) FSL 331 or
BCH 320 or concurrently.

Identification, functions, metabolism and food
sources of specific nutrients required by men
for normal growth and development.

400H. Honors Work
Fall, Winter, Spring, Summer. Vari­
able credit. May re-enroll for a maximum of
16 credits. Seniors, approval of department.

*Name changed July 1, 1970. Formerly Foods
and Nutrition and Institution Administration.
469. Physical and Physiological Growth of Children
Winter. BCH 462. 4(4-0) 102.
Three terms of natural science. Interdepartmental with and administered by the Family and Child Sciences Department.
Physical and physiological growth patterns. Experimental evidence for nutritional requirements. Applications to feeding practices, and physical activity of children.

470. Clinical Nutrition
Spring. 4(4-0) 468.
Changes in physiological and/or biochemical functions or processes due to illness and use of modified diets as an essential part of treatment.

475. Community Nutrition
Spring. 4(3-2) 462 or approval of department.
Identification of nutritional needs of population groups and available resources in communities.

813C. Special Studies in Food Service Management
(F N 813A) Fall, Winter, Spring. Summer. Variable credit. Approval of department.
Special studies in facility management, manpower coordination and tools and methods of operational control.

816. Applied Human Nutrition
Spring. 3(3-0) 492.

825. Techniques in Nutrition Research
Winter. 3 credits. BCH 452. Interdepartmental with the Animal Husbandry Department.
Use of specialized instruments and techniques. Laboratory safety. Management of laboratory animals. Development of abilities in areas of particular interest to individual students.

899. Research
Fall, Winter, Spring, Summer. Variable credit. Approval of department.

926. Comparative Nutrition—Lipids and Carbohydrates
Winter. 4 credits. BCH 452. Interdepartmental with the Animal Husbandry Department.
Regulatory aspects of carbohydrate and lipid metabolism as influenced by nutrition in animals. Emphasis on normal and abnormal physiological states such as obesity, ketosis and diabetes.

927. Comparative Nutrition—Protein Metabolism and Developmental Biology
Winter of even-numbered years. 4(4-0) BCH 452. PSL 602 or concurrently. Interdepartmental with Animal Husbandry Department.
Protein quality assessment, protein status, protein calorie malnutrition, amino acid metabolism, protein turnover, digestion and absorption, hormonal control of protein metabolism, developmental aspects of protein metabolism and growth.

928. Comparative Nutrition—Minerals
Spring of even-numbered years. 3 credits. BCH 452. PSL 602. Interdepartmental with and administered by the Animal Husbandry Department.
Forms and location in body, metabolic roles, deficiency and toxicity signs, interrelationships, requirements and biological availability of sources.

929. Comparative Nutrition—Vitamins
Spring. 3(3-0) 492 and a previous course on principles of nutrition. Interdepartmental with and administered by the Animal Husbandry Department.
Chemical and physical properties, standards of activity, occurrence, metabolic roles, antagonists, deficiency and toxicity signs, requirements and factors affecting requirements.

999. Research
(F N 999) Fall, Winter, Spring, Summer. Variable credit. Approval of department.