FOOD SCIENCE (FS)

FS 110 Introduction to Food Science
3 credits
Chemistry, microbiology, and processing of food and food products; concepts of food preservation, packaging and marketing of foods; food additives and regulations; world food problems. Field trip may be required. Cooperative: open to WSU degree-seeking students.

FS 113 Introduction to Vines and Wines
3 credits
The importance of viticulture (grape growing) and enology (winemaking); wine quality. Cooperative: open to WSU degree-seeking students.

FS 201 Science on Your Plate
3 credits
Cross-listed with CORS 232. Applications of science, scientific literacy, and critical thinking as related to the development and manufacture of modern food products and their use in modern civilizations. Cooperative: open to WSU degree-seeking students.

FS 204 (s) Special Topics
Credit arranged
Cooperative: open to WSU degree-seeking students.

FS 220 Food Safety and Quality
3 credits
Regulation, safety, and wholesomeness of food products; microbiological, chemical, and physical risks associated with food; hazard analysis as related to food safety, processing and quality; sanitation and pest management principles; methods for analyzing the sensory qualities of food products; problem management associated with food quality assurance. Cooperative: open to WSU degree-seeking students.

FS 299 (s) Directed Study
Credit arranged
FS 301 Food Mycology
3 credits
Survey of the fungi important in food production, storage, and spoilage. Includes two hours of lecture and three hours of lab per week. Cooperative: open to WSU degree-seeking students.
Coreq or Prereq: BIOL 250 or BIOL 255

FS 302 Food Processing Lab
1 credit
Application of specialized techniques, concepts and practices of food processing. Field trip required. Cooperative: open to WSU degree-seeking students.
Coreq: FS 303

FS 303 Food Processing
3 credits
Specialized techniques, concepts and practices of food processing. Cooperative: open to WSU degree-seeking students.
Prereq: AVS 172 or FS 110; and FS 220; and MATH 160 or MATH 170; and STAT 251
Coreq: FS 302.

FS 304 Cereal Chemistry and Processing
3 credits
This course has been designed to provide students with a breadth of knowledge in the field of cereal grain science. This course will cover cereal and legume structure, chemistry, and function as it relates to processing and utilization. Cooperative: open to WSU degree-seeking students.
Prereq: CHEM 275 or CHEM 277.

FS 329 Dairy Foods Composition and Quality
4 credits
Prereq: AVS 172 or FS 110; and Chem 275 and Chem 276

FS 350 Instrumental and Sensory Analysis of Food
5 credits
Introduction to the theory, principles, and applications of sensory evaluation techniques and instrumental techniques for the evaluation of the chemical and physical properties of foods. Students will learn basic psychological and physiological processes underlying sensory analysis, sensory testing methodologies, and the perception of appearance, aroma, taste, and texture of foods, basic food analysis methods and the relationship between instrumental and sensory methods of analysis. 3 credit lecture, 2 credit laboratory Cooperative: open to WSU degree-seeking students.
Prereq: FS 110 or FS 201, FS 302 & FS 303, CHEM 277 and CHEM 278, STAT 251

FS 363 Animal Products for Human Consumption
4 credits
Cross-listed with AVS 363
The meat, dairy, and egg industries, including product produced, processed, safety (HACCP), nutrition, distribution, quality, quantity, palatability, health, cooking, home storage, and consumer concerns. Special clothing and equipment required. Three lecture credits and one 3-hour lab per week. Recommended Preparation: BIOL 115. Cooperative: open to WSU degree-seeking students.

FS 398 (s) Internship
Credit arranged
Supervised professional internship in the food industry; requires formal written plan of activities approved by academic advisor and department head. Final written report and presentation required. Cooperative: open to WSU degree-seeking students.
Prereq: Permission of department

FS 400 (s) Seminar
Credit arranged

FS 401 Industrial Fermentations
3 credits
Science and technology associated with industrial-scale food fermentations. Cooperative: open to WSU degree-seeking students.
Prereq: BIOL 250 and BIOL 300
FS 402 Ciders and Other Fermented Foods
3 credits
Chemistry, microbiology, and technology associated with the production of cider, beer, and other food fermentations. Two half-day field trips required. Cooperative: open to WSU degree-seeking students.
Prereq: FS 304; FS 465

FS 403 (s) Workshop
Credit arranged
Workshops focusing on Food Science. Cooperative: open to WSU degree-seeking students.

FS 404 (s) Special Topics
Credit arranged
Special topics related to Food Science. Cooperative: open to WSU degree-seeking students.

FS 405 (s) Professional Development
Credit arranged

FS 406 Evaluation of Dairy Products
2 credits
Identifying attributes of different dairy products caused by production, processing, and storage issues; determining probable cause of those attributes and how to reduce their occurrence. Recommended Preparation: FS 329, FS 429, and FS 430. Cooperative: open to WSU degree-seeking students.

FS 407 Evaluation of Dairy Products Lab
1 credit
Identifying defects in dairy products and intense training for Collegiate Dairy Products Evaluation Competition. One 3-hour lab per week. Cooperative course available to WSU degree-seeking students. Graded Pass/Fail.
Coreq: FS 406

FS 409 Principles of Environmental Toxicology
3 credits
Cross-listed with ENVS 409 and SOIL 409, Joint-listed with ENVS 509, FS 509, and SOIL 509
Fundamental toxicological concepts including dose-response relationships, absorption of toxicants, distribution and storage of toxicants, biotransformation and elimination of toxicants, target organ toxicity and teratogenesis, mutagenesis, and carcinogenesis; chemodynamics of environmental contaminants including transport, fate, and receptors; chemicals of environmental interest and how they are tested and regulated; risk assessment fundamentals. Graduate students are required to prepare an additional in-depth report. Recommended Preparation: BIOL 102 or BIOL 115, CHEM 111, CHEM 112, CHEM 275, and STAT 251. Cooperative: open to WSU degree-seeking students.

FS 410 Food Science (FS)

FS 416 Food Microbiology
3 credits
Purpose for enumeration, detection, and identification of microorganisms in food products; physical, chemical, and environmental factors influencing growth and survival of foodborne microorganisms; pathogenic and spoilage microorganisms in food and their control. Cooperative: open to WSU degree-seeking students.
Prereq: BIOL 250 and BIOL 255

FS 417 Food Microbiology Laboratory
2 credits
Methods for enumeration, detection, and identification of spoilage and pathogenic microorganisms in foods. Two 3-hour labs per week. Cooperative: open to WSU degree-seeking students.
Prereq or Coreq: FS 416

FS 418 Oral Seminar in Food Science
1 credit
Development of skills and communication tools and techniques for oral presentations of current food science research. Cooperative: open to WSU degree-seeking students.
Prereq: FS 110 or FS 220; and junior standing; and major in Food Science

FS 422 Sensory Evaluation of Food and Wine
3 credits
Joint-listed with FS 522.
Theory, principles and application of sensory evaluation techniques to evaluate appearance, aroma, flavor and texture of foods and wine. Additional projects/assignments required for graduate credit. Cooperative: open to WSU degree-seeking students.
Prereq: FS 110 or FS 113; and STAT 251

FS 423 Sensory Evaluation of Food and Wine Laboratory
1 credit
This course will provide a practical application of FS 422, including the theory, principles and applications of sensory evaluation techniques for the evaluation of appearance, aroma, flavor and texture of foods and wine. Recommended for ages 21 or older. Cooperative: open to WSU degree-seeking students.
Coreq: FS 422

FS 429 Dairy Processing
3 credits
Joint-listed with FS 529.
Basic dairy chemistry, microbiology, and processing from cow to consumer; dairy quality, safety, and sanitation; milk components, fluid milk, concentrated milk, cream, butter, ice cream, fermented milk, cheese, and dairy powders. Additional projects/assignments required for graduate credit. Recommended Preparation: FS 110, FS 113. Cooperative: open to WSU degree-seeking students.
Prereq: BIOL 300 or BIOL 308, PHYS 111
Coreq: FS 430

FS 430 Dairy Processing Lab
1 credit
Joint-listed with FS 530.
Hands-on training in processing of various dairy products (e.g., fluid milk, butter, ice cream, cheese, and yogurt); milk pick-up and raw milk quality; cleaning and sanitation of dairy plants. Additional projects/assignments required for graduate credit. Cooperative: open to WSU degree-seeking students.
Prereq or Coreq: FS 429 or FS 529

FS 432 Food Engineering
3 credits
Fundamentals of food engineering for improving the efficiency of food processing operations and the quality of processed food. Principles of heat transfer, steam, air-vapor mixtures, refrigeration and fluid flow as applied to food processing and storage. Recommended preparation: PHYS 111. Cooperative: open to WSU degree-seeking students.
Prereq: FS 302 and FS 303
Coreq: FS 433

FS 433 Food Engineering Lab
1 credit
Enhances the learning experience of the students taking FS 432 through laboratories, problem sessions and group discussions. Cooperative: open to WSU degree-seeking students.
Prereq or Coreq: FS 432
FS 436 Principles of Sustainability
3 credits
Cross-listed with SOIL 436, Joint-listed with FS 536 and SOIL 536
Presented as online doculectures, covering topics such as: Origins of Sustainability, Standards of Sustainability, Culture of Waste, Built Environment, Industrial Sustainability, Energy Sustainability, Water Resources, Measuring Sustainability, Sustainable Impact Assessment, and Our Sustainable Future. Readings and homework are assigned with each topic. Learning assessment will be from homework, exams and written papers. Additional work is required for graduate credit.
Cooperative: open to WSU degree-seeking students.
Prereq: Junior standing or higher

FS 460 Food Chemistry
3 credits
Fundamentals of food chemistry; composition of foods and the changes that occur during processing. Cooperative: open to WSU degree-seeking students.
Prereq: CHEM 275 and CHEM 276; or CHEM 277 and CHEM 278, and BIOL 300 or BIOL 380

FS 461 Food Chemistry Lab
1 credit
Experiments related to properties, reactions, and interactions of chemical components of foods. Cooperative: open to WSU degree-seeking students.
Coreq: FS 460

FS 462 Food Analysis
3 credits
Introductory food analysis; methods common to many food commodities. Recommended Preparation: FS 460 and FS 461. This is a cooperative course available to WSU degree-seeking students.
Prereq: FS 302 and FS 303; and CHEM 275/CHEM 276 or CHEM 277/ CHEM 278; and Senior Standing

FS 464 Food Toxicology
3 credits
Cross-listed with SOIL 464, Joint-listed with FS 564 and SOIL 564
General principles of toxicologic evaluation of chemicals, which intentionally or unintentionally enter the food chain. Toxicology of food additives, colors, preservatives, drugs, pesticides and natural toxins in foods and risk characterization. Additional projects/assignments required for graduate credit. Cooperative: open to WSU degree-seeking students.
Prereq: BIOL 300 or BIOL 380

FS 465 Wine Microbiology and Processing
3 credits
Joint-listed with FS 565.
Technical principles related to the processing and fermentation of wines with an emphasis on microbiology. Additional projects/assignments required for graduate credit. Cooperative: open to WSU degree-seeking students.
Prereq: BIOL 250 and BIOL 300

FS 466 Wine Microbiology and Processing Lab
1 credit
Hands-on winemaking; application of chemical microbiological methods for wine analysis. Field trip required. Cooperative: open to WSU degree-seeking students.
Prereq or Coreq: FS 465

FS 470 Advanced Food Technology
3 credits
Joint-listed with FS 570.
Physical principles of food preservation and recent advances in food technology including process control and control systems. Recommended Preparation: FS 432 and FS 460. Additional projects/assignments required for graduate credit. Cooperative: open to WSU degree-seeking students.
Prereq: FS 302 or FS 303

FS 475 Quality Management Tools for Food Products
3 credits
Describe fundamental concepts for quality management and improvement of biomanufactured goods. Apply principles of statistical process control in a variety of situations and systems. Cooperative: open to WSU degree-seeking students.
Coreq: FS 302 and FS 303; STAT 251 or permission from instructor.

FS 489 Food Product Development
3 credits
Gen Ed: Senior Experience
Course serves as a capstone experience for food science seniors, and will require the application of food chemistry, food processing/engineering, and microbiology course knowledge in formulating a new food product. Cooperative: open to WSU degree-seeking students.
Prereq: FS 302, FS 303, FS 416, and FS 460; and Senior standing

FS 498 (s) Internship
Credit arranged
Supervised professional internship in the food industry; requires formal written plan of activities approved by academic advisor and department head. Final written report and presentation required. Cooperative: open to WSU degree-seeking students.
Prereq: Department Permission

FS 499 (s) Directed Study
Credit arranged
Cooperative: open to WSU degree-seeking students.

FS 500 Master's Research & Thesis
Credit arranged

FS 501 (s) Seminar
Credit arranged

FS 502 (s) Directed Study
Credit arranged

FS 503 (s) Workshop
Credit arranged
Workshops focusing on Food Science. Cooperative: open to WSU degree-seeking students.

FS 504 (s) Special Topics
Credit arranged
Topics in Food Science. Cooperative: open to WSU degree-seeking students.
**FS 509 Principles of Environmental Toxicology**  
3 credits  
Cross-listed with ENVS 509 and SOIL 509, Joint-listed with ENVS 409, FS 409, and SOIL 409  
Fundamental toxicological concepts including dose-response relationships, absorption of toxicants, distribution and storage of toxicants, biotransformation and elimination of toxicants, target organ toxicity and teratogenesis, mutagenesis, and carcinogenesis; chemodynamics of environmental contaminants including transport, fate, and receptors; chemicals of environmental interest and how they are tested and regulated; risk assessment fundamentals. Graduate students are required to prepare an additional in-depth report. Recommended Preparation: BIOL 102 or BIOL 115, CHEM 111, CHEM 112, CHEM 275, and STAT 251. Cooperative: open to WSU degree-seeking students.

**FS 510 Functional Foods and Health**  
3 credits  
Functional foods are foods that provide health benefits beyond basic nutrition. This course will deal with the actions of bioactive compounds in functional foods and nutraceuticals as they relate to disease prevention and health promotion. In addition, this course will cover (1) the chemistry and mechanism of action of the various bioactive compounds, and (2) the safety, efficacy, stability and regulatory aspects of functional foods and nutraceuticals. The course is intended for graduate students in food science, nutrition, or related biological science fields. Cooperative: open to WSU degree-seeking students.

**FS 511 Foods Lipids**  
3 credits  
To gain an understanding of the functionality fats in our foods and the beneficial and detrimental health related aspects of fats in our diets. Emphasis will be placed on relationships among fat and oil chemistry and the physiological results of eating foods containing specific triacylglycerols, fatty acids, and other lipids. Recent research and popular literature will supplement the discussions. Cooperative: open to WSU degree-seeking students.

**FS 512 Protein Structure and Function**  
2 credits  
Chemistry/biochemistry of proteins/enzymes applied to food research and industry; protein functionality/enzyme technology application to food industry. Cooperative: open to WSU degree-seeking students.

**FS 513 Food Carbohydrates**  
3 credits  
This course will provide insight into structure-function relationships of polysaccharides within food systems as a function of their respective molecular structures and physical characteristics. Cooperative: open to WSU degree-seeking students.

**FS 514 Starch Chemistry**  
3 credits  
The course will provide insight into structure-function relationship of starch through case study-teaching in a student-centered classroom. Cooperative: open to WSU degree-seeking students.  
**Prereq:** CHEM 275/CHEM 276 or CHEM 277/CHEM 278, BIOL 380 or BIOL 300, or permission from instructor.

**FS 516 Food Laws**  
2 credits  
Become familiar with government statutes and regulations that contribute to a safe, nutritious, and wholesome food supply. Understand more about the law and the US legal system relevant to the regulation of the manufacture and sale of food and supplements, including jurisdictional issues, administrative law, and tort, contract, corporate, environmental, labor and criminal law issues. Senior or Graduate student standing recommended. Cooperative: open to WSU degree-seeking students.

**FS 517 Scientific Writing**  
2 credits, max 4  
Planning, writing, reporting, reviewing and evaluating current food-related research. Cooperative: open to WSU degree-seeking students. Preference will be given to graduate students in their second year or higher of study.

**FS 518 Oral Seminar**  
1 credit  
Development of skills and communication tools and techniques for oral presentations of current food science research. Additional projects/assignments required for graduate credit. Cooperative: open to WSU degree-seeking students. Preference will be given to graduate students in their second year or higher of study.

**FS 520 Instrumental Analysis**  
2 credits  
Theory and techniques involved in the use of various instruments in modern biological laboratories; topics include chromatography, spectrometry, sterilization, sample preparation, radioisotope techniques, electrophoresis, centrifugation, and fermentation. Cooperative: open to WSU degree-seeking students. Spring only.  
**Prereq:** Permission

**FS 521 Food Rheology**  
3 credits  
Rheology is the study of flow, deformation and friction. This course, will cover the fundamentals of rheology, including stress, strain, flow behaviors, pipe flow, viscoelasticity, and tribology. In the lab component, we will learn how to correctly set up and run tests. Both the lecture and the lab will focus on sound application of rheological principles for interpretation of rheological data. Cooperative: open to WSU degree-seeking students.

**FS 522 Sensory Evaluation of Food and Wine**  
3 credits  
Joint-listed with FS 422. Theory, principles and application of sensory evaluation techniques to evaluate appearance, aroma, flavor and texture of foods and wine. Additional projects/assignments required for graduate credit. Cooperative: open to WSU degree-seeking students.  
**Prereq:** FS 110 or FS 113; and STAT 251

**FS 525 Engineering Principles for Foods**  
3 credits  
Engineering principles of mass and energy balances, fluid flow, heat transfer, mass transfer, psychrometrics, refrigeration, and drying are applied to processing of food products. The engineering problem-solving method is emphasized in determining solutions to application problems. Cooperative: open to WSU degree-seeking students.  
**Prereq:** FS 303, PHYS 111, and MATH 160 or MATH 170
FS 529 Dairy Processing
3 credits
Joint-listed with FS 429
Basic dairy chemistry, microbiology, and processing from cow to consumer; dairy quality, safety, and sanitation; milk components, fluid milk, concentrated milk, cream, butter, ice cream, fermented milk, cheese, and dairy powders. Additional projects/assignments required for graduate credit. Recommended Preparation: FS 110, FS 113. Cooperative: open to WSU degree-seeking students.
Prereq: BIOL 300 or BIOL 308, PHYS 111
Coreq: FS 430

FS 530 Dairy Processing Lab
1 credit
Joint-listed with FS 430.
Hands-on training in processing of various dairy products (e.g., fluid milk, butter, ice cream, cheese, and yogurt); milk pick-up and raw milk quality; cleaning and sanitation of dairy plants. Additional projects/assignments required for graduate credit. Cooperative: open to WSU degree-seeking students.
Prereq or Coreq: FS 429 or FS 529

FS 532 Advanced Food Microbiology
3 credits
Discuss current topics in foodborne pathogen including novel detection, method, virulence, and pathogenesis, and their interaction with environment and host. Recommended Preparation: BIOL 115, BIOL 250, and FS 416. Cooperative: open to WSU degree-seeking students.

FS 536 Principles of Sustainability
3 credits
Cross-listed with SOIL 536, Joint-listed with FS 436 and SOIL 436
Presented as online doculectures, covering topics such as: Origins of Sustainability, Standards of Sustainability, Culture of Waste, Built Environment, Industrial Sustainability, Energy Sustainability, Water Resources, Measuring Sustainability, Sustainable Impact Assessment, and Our Sustainable Future. Readings and homework are assigned with each topic. Learning assessment will be from homework, exams and written papers. Additional work is required for graduate credit. Cooperative: open to WSU degree-seeking students.
Prereq: Junior standing or higher

FS 538 Introduction to Physical Properties of Food
2 credits
Thermophysical behavior of foods and biopolymers, including water transport/activity, rheological, thermal, dielectric and barrier properties. Newtonian and non-Newtonian flow; Viscous, viscoelastic, and Hookean behavior. Relationship between rheology of food biopolymers and structure, composition, temperature, and plasticizer content. Recommended preparation one undergraduate course in calculus. Cooperative: open to WSU degree-seeking students.
Prereq: FS 432, FS 460, MATH 310, or Permission

FS 564 Food Toxicology
3 credits
Cross-listed with SOIL 564, Joint-listed with FS 464 and SOIL 464
General principles of toxicologic evaluation of chemicals, which intentionally or unintentionally enter the food chain. Toxicology of food additives, colors, preservatives, drugs, pesticides and natural toxins in foods and risk characterization. Additional projects/assignments required for graduate credit. Cooperative: open to WSU degree-seeking students.
Prereq: BIOL 300 or BIOL 380

FS 565 Wine Microbiology and Processing
3 credits
Joint-listed with FS 465.
Technical principles related to the processing and fermentation of wines with an emphasis on microbiology. Additional projects/assignments required for graduate credit. Cooperative: open to WSU degree-seeking students.
Prereq: BIOL 250 and BIOL 300

FS 570 Advanced Food Technology
3 credits
Joint-listed with FS 470.
Physical principles of food preservation and recent advances in food technology including process control and control systems. Recommended Preparation: FS 432 and FS 460. Additional projects/assignments required for graduate credit. Cooperative: open to WSU degree-seeking students.
Prereq: FS 302 or FS 303

FS 575 Food Quality Management
3 credits
Discuss the principles and practices of commonly used quality management systems used to maintain and improve the quality of their products and services. Use statistical tools to monitor and assess quality. Cooperative: open to WSU degree-seeking students.
Prereq: STAT 251, FS 302 and FS 303

FS 583 Advances in Cereal Chemistry and Technology
3 credits
This course provides in-depth information on wheat chemistry and technology as well as chemistry and uses of other cereal grains and legumes. Emphasis will be given to composition and functionality of wheat as related to processing and product quality, along with reviews of recent advances in cereal chemistry and technology. Cooperative: open to WSU degree-seeking students.

FS 588 Food Science Teaching Practicum
1-3 credits
Supervised teaching in a university setting. Cooperative: open to WSU degree seeking students.
Prereq: Admission to graduate program and Permission

FS 598 (s) Internship
Credit arranged

FS 599 Non-thesis Master's Research
Credit arranged

FS 600 Doctoral Research & Thesis
Credit arranged