### 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) including world wine regions and enology (winemaking). 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  
This is a cooperative course available 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. Cooperative: open to WSU degree-seeking students.  
**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.  
**Prereq:** FS 110 or FS 220; and MATH 160 or MATH 170; and STAT 251.

**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 and CHEM 277.

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

**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 defects in dairy products and relating these defects to their probable cause; remedies. Recommended Preparation: FS 329, FS 429, and FS 433. Cooperative: open to WSU degree-seeking students. (Spring only)

FS 407 Evaluation of Dairy Products Lab  
1 credit  
Identifying defects in dairy products and intense training for Collegiate Dairy Products Evaluation Competition. Cooperative course available to WSU degree-seeking students.  
Prereq: FS 406 .

FS 409 Principles of Environmental Toxicology  
3 credits  
Cross-listed with EnvS 409. Joint-listed with FS 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. Students registering for FS 509 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 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-hr labs a wk. 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 Products  
3 credits  
Joint-listed with FS 529.  
Dairy chemistry, microbiology, sanitation, product development and processing from cow to consumer. Additional projects/assignments required for graduate credit. Cooperative: open to WSU degree-seeking students.

Prereq: BIOL 250, BIOL 300, and FS 303.

FS 430 Dairy Products Lab  
1 credit  
Joint-listed with FS 530.  
Students gain hands-on skills formulating, processing, evaluating and analyzing dairy products. Communication and critical thinking skills are also developed in this laboratory course. Additional projects/assignments required for graduate credit. Cooperative: open to WSU degree-seeking students.

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  
To enhance the learning experience of the students taking FS 432 through laboratories, problem sessions and group discussions. Field Trip Required. Cooperative: open to WSU degree-seeking students.  
Prereq or Coreq: FS 432.

FS 436 Principles of Sustainability  
3 credits  
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. (Fall only)  
Prereq: Junior or higher standing.

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 275/276 or CHEM 278; and Senior Standing.

FS 464 Food Toxicology
3 credits
Joint-listed with FS 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 biomannufactured 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: Permission of department.

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

FS 500 Master's Res & 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
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. Students registering for FS 509 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.

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. Open to Food Science Graduate Students Only.

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. Open to Food Science Graduate Students Only.

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. (Spring only) Cooperative: open to WSU degree-seeking students.
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 Products
3 credits
Joint-listed with FS 429.
Dairy chemistry, microbiology, sanitation, product development and processing from cow to consumer. Additional projects/assignments required for graduate credit. Cooperative: open to WSU degree-seeking students.
Prereq: BIOL 250, BIOL 300, and FS 303.

FS 530 Dairy Products Lab
1 credit
Joint-listed with FS 430.
Students gain hands-on skills formulating, processing, evaluating and analyzing dairy products. Communication and critical thinking skills are also developed in this laboratory course. Additional projects/assignments required for graduate credit. Cooperative: open to WSU degree-seeking students.

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 ENVS 536. Joint-listed with FS 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. (Fall only)
Prereq: Junior or higher standing.
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
Joint-listed with FS 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.