

*The College of Agricultural Sciences performs four vital services—instruction, research, extension, and international agriculture—that are closely tied to the human and natural resources of the state of Oregon and that support the economic, environmental, and community welfare of the state, the Pacific Northwest, the nation, and the world.*

**T**he College of Agricultural Sciences offers educational programs to serve the needs of individuals interested in pursuing careers in agribusiness; agriculture; animal, plant and food systems; environmental economics and policy; fisheries and wildlife; food science; range and natural resource management; veterinary medicine; and more. The faculty realizes the importance of individual aims and abilities and, through course work, internships, advising, and extracurricular activities, tries to help each student discover and develop social, aesthetic, and ethical values as well as professional competence.

Undergraduate students may pursue the following bachelor of science degree programs through the College of Agricultural Sciences:

- Agricultural Business Management
  - Animal Sciences
  - Bioresources Research
  - Crop and Soil Science
  - Environmental Economics, Policy, and Management
  - Fisheries and Wildlife
  - Food Science and Technology
  - General Agriculture
  - Horticulture
  - Natural Resources
  - Rangeland Ecology and Management
- Graduate students may pursue the following degree programs:
- Agricultural and Resource Economics (MAG, MS, PhD)
  - Agricultural Education (MAG, MS)
  - Animal Science (MAG, MS, PhD)
  - Biological and Ecological Engineering (MEng, MS, PhD)
  - Crop Science (MAG, MS, PhD)
  - Economics (MA, MS, PhD)
  - Fisheries Science (MAG, MS, PhD)
  - Food Science and Technology (MAG, MS, PhD)
  - Genetics (MA, MAG, MS, PhD)
  - Horticulture (MAG, MS, PhD)
  - Interdisciplinary Studies (MAIS)
  - Poultry Science (MAG, MS, PhD)
  - Public Policy (MPP)
  - Rangeland Ecology and Management (MAG, MS, PhD)
  - Soil Science (MAG, MS, PhD)
  - Toxicology (MAG, MS, PhD)
  - Water Resources Engineering (MS, PhD)
  - Water Resources Policy and Management (MS)
  - Water Resources Science (MS, PhD)
  - Wildlife Science (MAG, MS, PhD)

#### **DUAL DEGREES IN INTERNATIONAL STUDIES OR EDUCATION**

Undergraduates with majors in the College of Agricultural Sciences can earn a second degree in international studies or education. See the International Programs or College of Education sections of this catalog for more information.

#### **HIGH SCHOOL PREPARATION**

Advances in the technology and sciences of agriculture and natural resources make the study of biological, physical, and social sciences and communications vital. High school agricultural science and technology (AST) courses also help prepare students for some fields of study. The following preparation in high school is strongly recommended for students who plan to enter a College of Agricultural Sciences degree program: English, 4 units; mathematics, 3 units; physics, chemistry, and biology, 1 unit each; social studies, 3 units; and foreign language, 2 units.

#### **INDIVIDUAL ADVISING**

Each student is considered an important individual. His or her study program is developed in personal consultation with a faculty advisor in the department of his or her major interest. As early as possible, each student is encouraged to select a subject area and become associated with instructors and other students with similar interests. Initial or early advising is based upon the student's high school record and placement test scores. When high school preparation is found to be inadequate, the student is encouraged to enroll in courses providing the education, training, and experience necessary to help assure success at the university level, even though such work may require the student to take one or more additional terms to complete a prescribed four-year curriculum. Students planning to transfer from a community college or another four-year institution are encouraged to contact an advisor to discuss their plan of study as far in advance of transferring as possible.

#### **INTERNSHIPS**

College of Agricultural Science departments and programs offer academic credit for learning achieved during supervised work experience. Internships are available in all facets of agriculture and natural resources through individual departmental offerings. Applications for internships must be approved prior to placement. Details are available from departmental advisors.

#### **SCHOLARSHIPS**

The College of Agricultural Sciences and its departments offer a variety of scholarships to deserving students. Several are reserved for incoming high school or transfer students. Additional information and application forms for college-level scholarships are available online at <http://agsci.oregonstate.edu/students/schol.html> or from the Academic Programs Office, 137 Strand Agriculture Hall, 737-2211. For information about departmental scholarships, contact each department directly. For more information about university-level scholarships, contact the Office of Financial Aid and Scholarships, 737-2241.

137 Strand  
Agriculture Hall  
Oregon State  
University  
Corvallis, OR  
97331-2202  
541-737-2211  
E-mail: [casstudy@oregonstate.edu](mailto:casstudy@oregonstate.edu)  
Website: <http://agsci.oregonstate.edu/>

#### **ADMINISTRATION**

##### **Thayne R. Dutson**

Dean  
737-2331  
[thayne.dutson@oregonstate.edu](mailto:thayne.dutson@oregonstate.edu)

##### **Stella M. Coakley**

Associate Dean  
737-5264  
[stella.coakley@oregonstate.edu](mailto:stella.coakley@oregonstate.edu)

##### **William G. Boggess**

Executive Associate  
Dean  
737-1395  
[bill.boggess@oregonstate.edu](mailto:bill.boggess@oregonstate.edu)

##### **Larry Curtis**

Associate Dean  
737-1764  
[larry.curtis@oregonstate.edu](mailto:larry.curtis@oregonstate.edu)

##### **Cary J. Green**

Assistant Dean and  
Head Advisor  
737-5746  
[cary.green@oregonstate.edu](mailto:cary.green@oregonstate.edu)

**MINOR PROGRAMS**

Minors are offered through most departments of the College of Agricultural Sciences. Students interested in pursuing a minor must first contact the key advisor in the area of interest and meet the following requirements:

1. The minor must consist of a minimum of 27 designated credits of related course work, including 12 in upper-division courses.
2. Courses required for the student's major may not count toward a minor.
3. An individual course may not count toward more than one minor.

**GRADUATION REQUIREMENTS**

To be eligible for a Bachelor of Science (BS) degree, a student must complete a minimum of 180 credits including:

1. University baccalaureate core requirements
2. Courses in agricultural sciences: 36 credits including 24 credits at the upper-division level.

## AGRICULTURAL AND RESOURCE ECONOMICS

**Gregory M. Perry,**

*Interim Department Head*  
213 Ballard Extension Hall  
Oregon State University  
Corvallis, OR 97331-3601  
541-737-2942

E-mail: arec@oregonstate.edu

Website: <http://arec.oregonstate.edu/>

**FACULTY**

**Professors** Buccola, Fare, Hanna, Jaeger, Lev, McMullen, Munisamy, Perry, Seavert, Sylvia, Weber, Wu  
**Associate Professors** Burt, Diebel, Durham, Eleveld, Plantinga, Riggs, Tanaka  
**Assistant Professors** Egelkraut, Fisher, Gow, Langpap, Reimer  
**Adjunct Faculty** Adams, Albers, Bernell, Johnson, Montgomery, Rosenberger

**Undergraduate Majors**

**Environmental Economics, Policy, and Management (BS)**  
**Agricultural Business Management (BS)**

**Minors**

**Agricultural Business Management**  
**Natural Resource and Environmental Law and Policy**  
**Resource Economics**

**Graduate Majors**

**Agricultural and Resource Economics (MS, PhD)**

**Graduate Areas of Concentration**

*Agricultural Economics (MS only)*  
*Industrial Organization (PhD only)*

*International Trade**Resource and Environmental Economics***Economics (MA, MS, PhD)**

(See Graduate School)

**Graduate Minor****Agricultural and Resource Economics**

The Department of Agricultural and Resource Economics offers two Bachelor of Science degrees: one in environmental economics, policy, and management and one in agricultural business management. These degrees open doors to exciting careers in the traditional areas of commercial agriculture, agricultural business management, and agricultural policy, and in the newer career areas of natural resource and environmental management, marine resources, international trade and development, rural growth and change, and environmental and resource law.

The Environmental Economics, Policy, and Management (EPPM) degree prepares students for public and private positions in natural and environmental resource analysis and management. EPPM students receive strong training in economic theory, resource economics, environmental economics, and quantitative decision-making techniques. Students learn how to apply economic theory and techniques to "real world" resource and environmental problems. They also are trained to understand and appreciate the noneconomic aspects of resource and environmental problems, including social, ecological, physical, political, and legal considerations.

The Agricultural Business Management (ABM) degree prepares students for unique challenges and opportunities in agricultural business careers. The degree combines economic and business principles and their application to farms and ranches, companies processing and marketing farm products, and companies supplying goods and services to farmers and other businesses. The curriculum combines skills in marketing, business management, accounting, and economic analysis with a minor appropriate to a student's professional goals and interests.

The BS in Agricultural Business Management and BS in Environmental Economics, Policy, and Management are offered through the OSU Corvallis campus as well as the OSU Agriculture Program at Eastern Oregon University in LaGrande.

**CAREER OPPORTUNITIES**

Graduates may pursue a number of attractive career opportunities. Agricultural business management majors may move directly into professional jobs with agribusiness firms, financial and insurance institutions, or manage their own

agribusinesses. EPPM students can serve effectively as members of interdisciplinary teams involved in resource and environmental management, planning, and policy analysis. Government job opportunities include management, planning, and analysis positions with federal, state, and local government agencies. Private company opportunities include similar positions with utility companies, banks, consulting firms, and resource management companies. The EPPM degree also provides an excellent foundation for graduate work in economics, as well as law, public policy, and urban planning.

**MINORS**

Each minor in the Agricultural and Resource Economics (AREC) Department is created to provide students within and outside the discipline the opportunity to study a secondary area. Each minor requires 27 credits of course work in addition to the student's major. At least 12 of the 27 credits must be upper division. No credits counted toward the minor can be courses also counted toward the student's major.

Agricultural Business Management (ABM) majors **may not** elect to complete an Agricultural Business Management minor; and Environmental Economics, Policy and Management (EPPM) majors **may not** elect to complete a Resource Economics or Natural Resource and Environmental Law and Policy minor.

**AGRICULTURAL BUSINESS MANAGEMENT (BS, CRED, HBS)**

The BS in Agricultural Business Management degree curriculum blends course work in agricultural economics, business, agricultural sciences, computer science, arts, and humanities so that graduates can respond to the unique challenges and opportunities in agribusiness vocations.

All ABM students must select a minor (minimum of 27 credits) appropriate to their professional goals and interests. An internship or project is required to integrate course work with business-oriented experiences.

**\*Please note** students must receive a "C-" or above in the courses listed below. If a student receives below a "C-" they must retake the course.

AREC 211. Management in Agriculture (4)  
AREC 221. Marketing in Agriculture (3)  
AREC 250. \*Introduction to Environmental Economics and Policy (3)  
or ECON 201. \*Intro to Microeconomics (4)  
AREC 300. Applied Economic Analysis (3)  
BA 211. Financial Accounting (4)  
BA 213. Managerial Accounting (4)  
ECON 202. \*Introduction to Macroeconomics (4)  
MTH 111. \*College Algebra (4)

MTH 241. \*Calculus for Management and Social Science (4)  
 ST 351. Intro to Statistical Methods (4)  
 WR 121. \*English Composition (3)  
 WR 323. \*English Composition (3)  
 or WR 327. \*Technical Writing (3)

### BS Degree Requirements (180)

#### Baccalaureate Core (48)

#### Agricultural and Resource Economics Core Courses

AREC 121. Discovering Agribusiness and Agricultural Economics (2)  
 AREC 211. Management in Agriculture (4)  
 AREC 221. Marketing in Agriculture (3)  
 AREC 250. \*Introduction to Environmental Economics and Policy (3)  
 and AREC 299. Special Topics (1)  
 or ECON 201. \*Introduction to Microeconomics (4)  
 AREC 300. Applied Economic Analysis (3)  
 AREC 370. Agricultural Markets and Trade (3)  
 or AREC 465. M/Agricultural Financial Reporting and Analysis (2)  
 and AREC 467. M/Capital Budgeting (1)  
 AREC 406. Projects (6)  
 or AREC 410. Internship (6)  
 AREC 461. \*Agricultural and Food Policy Issues (4)  
 AREC 499. ABM Capstone I (3)

#### Quantitative Courses—Choose two courses from the following list:

AREC 447. Agricultural Price and Market Analysis (4)  
 ECON 424. Introduction to Econometrics (4)  
 ST 352. Intro to Statistical Methods (4)

#### Upper-Division Business Courses—Choose two from the following list:

BA 347. International Business (4)  
 BA 351. Managing Organizations (4)  
 BA 390. Marketing (4)  
 BA 441. Financial Institutions (4)  
 BA 463. Family Business Management (4)  
 BA 492–BA 499. Upper-division business marketing course (4)

#### Choose a minimum of 12 credits from upper-division AREC or ECON courses or others as approved by advisor.

#### Business Administration

BA 211. Financial Accounting (4)  
 BA 213. Managerial Accounting (4)  
 BA 233. Legal Environment of Business (2)  
 BA 360. Introduction to Financial Management (4)

#### Computers and Technology—

##### Choose one course from below:

AG 111. Computer Applications in Agriculture (3)  
 CS 101. Computers: Applications and Implications (4)

#### Social Sciences

ECON 202. \*Introduction to Macroeconomics (4)

#### Communications

WR 323. \*English Composition (3)  
 or WR 327. \*Technical Writing (3)

#### Mathematics

MTH 111. \*College Algebra (4)  
 MTH 241. \*Calculus for Management and Social Science (4)

#### Statistics

ST 351. Intro to Statistical Methods (4)

#### Required Minor (27)

Appropriate to student's professional goals and interests.

### ENVIRONMENTAL ECONOMICS, POLICY AND MANAGEMENT (BS, CRED, HBS)

The BS in Environmental Economics, Policy and Management degree curriculum is designed to develop skills in agricultural economics, resource economics, economic development, marine economics, international agricultural trade, and related fields. Along with the baccalaureate core of required courses in the sciences and humanities, students may select a broad range of electives with the help of a faculty advisor. This program provides flexibility to meet a wide variety of educational and career goals.

\*Please note students must receive a "C–" or above in the courses listed below. If a student receives below a "C–" they must retake the course.

AREC 211. Management in Agriculture (4)  
 AREC 221. Marketing in Agriculture (3)  
 AREC 250. \*Introduction to Environmental Economics and Policy (3)  
 or ECON 201. \*Introduction to Microeconomics (4)  
 AREC 300. Applied Economic Analysis (3)  
 BA 211. Financial Accounting (4)  
 BA 213. Managerial Accounting (4)  
 ECON 202. \*Intro to Macroeconomics (4)  
 MTH 111. \*College Algebra (4)  
 MTH 241. \*Calculus for Management and Social Science (4)  
 ST 351. Intro to Statistical Methods (4)  
 WR 121. \*English Composition (3)  
 WR 323. \*English Composition (3)  
 or WR 327. \*Technical Writing (3)

### BS Degree Requirements (180)

#### Baccalaureate Core (48)

#### Agricultural and Resource Economics

AREC 121. Discovering Agribusiness and Agricultural Economics (2)  
 AREC 250. \*Intro to Environmental Economics and Policy (3)  
 and AREC 299. Special Topics (1)  
 or ECON 201. \*Intro to Microeconomics (4)  
 AREC 253. \*Evolution of U.S. Environmental and Natural Resources Law (4)  
 AREC 300. Applied Economic Analysis (3)  
 AREC 351. \*Natural Resource Economics and Policy (3)  
 AREC 352. \*Environmental Economics and Policy (3)  
 AREC 434. \*Environmental and Resource Economics (3)

#### Select one course from below:

AREC 432. Environmental Law (4)  
 FOR 462. Natural Resource Policy and Law (3)  
 FOR 463/FOR 563. Environmental Policy and Law Interactions (3)

#### Select one course from below:

AREC 454. Rural Development Economics and Policy (3)  
 AREC 461. \*Agricultural and Food Policy Issues (4)  
 ECON 435. The Public Economy (4)  
 ECON 439. Public Policy Analysis (4)  
 FOR 432. Economics of Recreation Resources (4)

#### Select one course from below:

PS 474. Natural Resource Policy and Bureaucratic Politics (4)  
 PS 475. Environmental Politics and Policy (4)

#### Select two courses from below:

BI 370. Ecology (3)  
 CSS 305. Principles of Soil Science (4) and CSS 306. Problem Solving: Soil Science Applications (1)  
 CSS 335. \*Intro to Water Science and Policy (3)  
 FOR 111. Intro to Forestry (3)  
 FW 251. Principles of Fish and Wildlife Conservation (3)  
 OC 331. Intro to Oceanography (3)  
 RNG 241. Rangeland Ecology and Management (3)

#### Social Sciences

ECON 202. \*Intro to Macroeconomics (4)  
 ECON 315. Intermediate Macroeconomic Theory I (4)  
 PS 201. \*Intro to U.S. Government and Politics (4)

#### Computers and Technology

AG 111. Computer Applications in Agriculture (3)  
 or CS 101. Computers: Applications and Implications (4)  
 GEO 365. Introduction to Geographic Information Systems (4)

#### Communications

WR 323. \*English Composition (3)  
 or WR 327. \*Technical Writing (3)

#### Mathematics

MTH 111. \*College Algebra (4)  
 MTH 241. \*Calculus for Management and Social Science (4)

#### Statistics

ST 351. Intro to Statistical Methods (4)  
 ST 352. Intro to Statistical Methods (4)  
 or ECON 424. Intro to Econometrics (4)

### 16 additional upper-division credits or completion of an approved minor

### AGRICULTURAL BUSINESS MANAGEMENT MINOR

The Agricultural Business Management minor (27) is available to students outside the AREC Department. Business Administration majors planning to minor in Agricultural Business Management must see **both** a business and an AREC advisor to discuss certain course restrictions in the minor. Business majors must choose alternate AREC courses to replace the credits that are also in the BA major.

Each minor in the Agricultural and Resource Economics (AREC) Department

is created to provide students within and outside the discipline the opportunity to study a secondary area. Each minor requires 27 credits of course work in addition to the student's major. At least 12 of the 27 credits must be upper division. No credits counted toward the minor can be courses also counted toward the student's major.

Agricultural Business Management (ABM) majors **may not** elect to complete an Agricultural Business Management. And Environmental Economics, Policy and Management (EPPM) majors **may not** elect to complete a Resource Economics or Natural Resource and Environmental Law and Policy minor.

#### Requirements

AREC 211. Management in Agriculture (4)  
AREC 221. Marketing in Agriculture (3)  
AREC 300. Applied Economics Analysis (3)

#### Complete a minimum of 10 credits from the following:

AREC 370. Agricultural Markets and Trade (3)  
AREC 372. Agricultural Cooperatives (2)  
AREC 382. Farm and Ranch Appraisal (4)  
AREC 447. Agricultural Price and Market Analysis (4)  
AREC 461. ^Agricultural and Food Policy Issues (4)  
AREC 465. M/Agricultural Financial Reporting and Analysis (2)  
AREC 467. M/Capital Budgeting in Agriculture (1)  
AREC 468. M/Crop Enterprise Budgeting (1)  
AREC 469. M/Livestock Enterprise Budgeting (1)  
AREC 470. M/Farm Budgeting and Planning (1)  
AREC 475. M/Negotiation in Business and Resource Management (1)  
AREC 476. M/Agricultural Personnel Management (2)  
BA 360. Introduction to Financial Management (4)  
BA 463. Family Business Management (4)

**Choose additional courses from the list above or approved AREC or BA elective courses to reach 27 credits.**

**Total=27**

#### NATURAL RESOURCE AND ENVIRONMENTAL LAW AND POLICY MINOR

The Natural Resource and Environmental Law and Policy minor is an interdisciplinary minor available to students outside the AREC Department.

Each minor in the Agricultural and Resource Economics (AREC) Department is created to provide students within and outside the discipline the opportunity to study a secondary area. Each minor requires 27 credits of course work in addition to the student's major. At least 12 of the 27 credits must be upper division. No credits counted toward the minor can be courses also counted toward the student's major.

Agricultural Business Management (ABM) majors **may not** elect to complete an Agricultural Business Management. And Environmental Economics, Policy and Management (EPPM) majors **may not** elect to complete a Resource Economics or Natural Resource and Environmental Law and Policy minor.

#### Requirements

AREC 253. \*Evolution of U.S. Environmental and Natural Resources Law (4)  
AREC 353. Public Land Statutes and Policy (4)  
AREC 453. Public Land and Resource Law (4)  
FOR 462. Natural Resource Policy and Law (3)  
FOR 463. Environmental Policy and Law Interactions (3)

#### Select one course in Resource and Environmental Policy:

AREC 454. Rural Development Economics and Policy (3)  
•AREC 461. \*^Agricultural and Food Policy Issues (4)  
FOR 460. ^Forest Policy (4)  
PS 474. Natural Resource Policy and Bureaucratic Politics (4)  
PS 475. Environmental Politics and Policy (4)  
PS 476. \*Science and Politics (4)

#### Electives

(Including courses not otherwise taken above to bring credits to 27 or more):  
COMM 440. Theories of Conflict and Conflict Management (3)  
ECON 439. Public Policy Analysis (4)  
FOR 365. \*Issues in Natural Resource Conservation (3)  
NR 455. Natural Resource Decision Making (3)  
PHL 320. Legal Reasoning (4)  
PHL 365. \*Law in Philosophical Perspective (4)  
PHL 440. Environmental Ethics (4)  
PS 321, PS 322, PS 323. American Constitutional Law (4,4,4)  
PS 324. American Courts, Politics, and Justice (4)  
PS 414. ^Interest Groups (4)  
PS 424. Administrative Law (4)  
SOC 448. Law and Society (3)

**Total=27**

#### Footnote:

• Dot in front of course designator indicates class is available both on-campus and through OSU Extended Campus-Distance Education.

#### RESOURCE ECONOMICS MINOR

The Resource Economics minor is available to students outside the AREC Department.

Each minor in the Agricultural and Resource Economics (AREC) Department is created to provide students within and outside the discipline the opportunity to study a secondary area. Each minor requires 27 credits of course work in addition to the student's major. At least 12 of the 27 credits must be upper division. No credits counted toward the minor can be courses also counted toward the student's major.

Agricultural Business Management (ABM) majors **may not** elect to complete an Agricultural Business Management. And Environmental Economics, Policy and Management (EPPM) majors **may not** elect to complete a Resource Economics or Natural Resource and Environmental Law and Policy minor.

#### Requirements

AREC 311. Intermediate Microeconomic Theory I (4)  
ECON 201. \*Intro to Microeconomics (4)  
**Select 3-4 of the following courses:**  
AREC 351. \*Natural Resource Economics and Policy (3)  
AREC 352. \*Environmental Economics and Policy (3)  
AREC 353. Public Land Statutes and Policy (4)  
AREC 461. \*^Agricultural and Food Policy Issues (4)

#### Electives

#### Select additional credits from the following list to make a total of 27 credits:

AREC 250. \*Intro to Environmental Economics and Policy (3)  
AREC 253. \*Evolution of U.S. Environmental and Natural Resource Law (4)  
AREC 434. ^Environmental and Resource Economics (3)  
AREC 454. Rural Development Economics and Policy (3)  
ECON 202. \*Intro to Macroeconomics (4)  
ECON 315. Intermediate Macroeconomic Theory I (4)  
ECON 435. The Public Economy (4)  
ECON 439. Public Policy Analysis (4)  
FOR 430. Forest Resource Economics I (4)  
FOR 431. Forest Resource Economics II (4)  
FOR 432. Economics of Recreation Resources (4)  
NR 455. Natural Resource Decision Making (3)  
PS 474. Natural Resource Policy and Bureaucratic Politics (4)  
or PS 475. Environmental Politics and Policy (4)  
or PS 476. \*Science and Politics (4)

**Total=27**

#### AGRICULTURAL AND RESOURCE ECONOMICS (MAG, MS, PhD)

**Graduate Areas of Concentration**  
*Agricultural economics (MS only), industrial organization (PhD only), international trade, resource and environmental economics*

The department offers graduate work leading to the MS and PhD degrees in agricultural and resource economics and offers courses supporting the MAg and MAIS graduate degree programs. The department also offers the MA, MS, and PhD degrees in economics. Through these programs, the department strives to develop applied economists who are well trained in economic theory and quantitative methods with specialized research

experience in the fields of international trade, agricultural economics (MS only), industrial organization (PhD only), and resource and environmental economics. Opportunities for policy analysis exist in each of these fields of study.

Many students who receive the MS degree continue their studies toward the PhD degree. Others enter a wide range of occupations, such as positions with the Cooperative Extension Service, U.S. Department of Agriculture, international organizations (such as F.A.S. and U.S. Agency for International Development), consulting firms, and state government. PhD recipients take professorial (teaching/research/extension) positions in universities around the world. Others are employed in federal and state agencies.

More detailed information on the MS and PhD degree programs may be obtained by contacting the department's graduate program coordinator. Further information on the MAg and MAIS degree programs may be obtained from the academic program offices of the Colleges of Agricultural Sciences and Liberal Arts, respectively.

### AGRICULTURAL AND RESOURCE ECONOMICS GRADUATE MINOR

For more details, see the departmental advisor.

### COURSES

#### AREC 121. DISCOVERING AGRIBUSINESS AND AGRICULTURAL ECONOMICS (2).

Explore issues, opportunities, and challenges in the dynamic and diverse employment field of agricultural economics. Case studies and field trips. Emphasizes problem solving skills needed in today's agribusiness industry. **PREREQS:** Freshman or sophomore standing; new major or minor.

**AREC 211. MANAGEMENT IN AGRICULTURE (4).** Economic and business principles applied to the management of agribusiness firms, including farms and ranches; goal-setting and management information; planning and decision-making tools; acquiring, organizing, and managing land, labor, and capital resources. **PREREQS:** ECON 201.

**AREC 221. MARKETING IN AGRICULTURE (3).** Organization and functions of domestic and international markets; market channels for various agricultural commodities; role of agribusiness, cooperatives, and government in marketing decisions. **PREREQS:** ECON 201.

**AREC 250. \*INTRODUCTION TO ENVIRONMENTAL ECONOMICS AND POLICY (3).** Examines how economic forces and social institutions cause environmental degradation and help build management solutions. Explains key economic concepts for valuing environmental resources and evaluating the trade-offs of alternative management approaches from private markets to regulation. Applies the concepts and theories to topical environmental issues such as water pollution and conserving biodiversity. (Bacc Core Course)

**AREC 253. \*EVOLUTION OF U.S. ENVIRONMENTAL AND NATURAL RESOURCES LAW (4).** Historical development, current structure, and organization of Anglo/Norman-American constitutional, statutory, and case law including related agency regulatory or administrative law. Relationships among legal

processes, economic principles, social institutions, and natural resources issues are emphasized. Students also are exposed to the basic elements of legal research. (Bacc Core Course)

**AREC 299. SPECIAL TOPICS (1-4).** Targeted courses that focus on specific topics in agricultural and resource economics. Topics may vary from term to term and from year to year. May be repeated for credit when topics differ.

**AREC 300. APPLIED ECONOMIC ANALYSIS (3).** An intermediate level primer of microeconomic principles focusing on consumption and production theory and its application in the agriculture industry. The course serves as a bridge between principles of economics and intermediate economic theory courses. Both abstract and mathematical formulations of economic principles are emphasized. **PREREQS:** (ECON 201 or ECON 201H) and MTH 241

**AREC 311. INTERMEDIATE MICROECONOMIC THEORY I (4).** An examination of the theories of consumer behavior and demand, production cost, the firm, supply, and competitive and monopoly market structures. CROSSLISTED as ECON 311. **PREREQS:** ECON 201, ECON 202, and MTH 241 or MTH 251.

**AREC 312. INTERMEDIATE MICROECONOMIC THEORY II (4).** Examination of the theories of imperfect competition, input markets, general equilibrium and welfare economics. CROSSLISTED as ECON 312. **PREREQS:** AREC 311

**AREC 351. \*NATURAL RESOURCE ECONOMICS AND POLICY (3).** Application of principles of economics to identify the causes, consequences, and ways of dealing with natural resource problems, including problems associated with fisheries, forests, water resources, and land. Conceptual topics and policy applications. Emphasis is on developing students' skill in applying an economic way of thinking about natural resource management. (Bacc Core Course) **PREREQS:** ECON 201 or ECON 201H, MTH 111.

**AREC 352. \*ENVIRONMENTAL ECONOMICS AND POLICY (3).** Analysis of the interrelationships between economic activity, government policies, and the environment; benefits and costs of economic growth; economics of environmental quality and the social costs of pollution. Three to five case studies selected by the instructor introduce students to the way economists analyze environmental policies. CROSSLISTED as ECON 352. (Bacc Core Course) **PREREQS:** ECON 201.

**AREC 353. PUBLIC LAND STATUTES AND POLICY (4).** Policies guiding the homesteading and economic development of the western states; laws and policies guiding the regulation and use of water, grazing, timber, and mineral resources. The significance of the Prior Appropriations Doctrine beyond its familiar role in water law and policy is emphasized. Not offered every year. **PREREQS:** ECON 201.

**AREC 370. AGRICULTURAL MARKETS AND TRADE (3).** Economics of agricultural markets; price determining forces; price discovery methods; international trade; agricultural trade policies. **PREREQS:** AREC 221 and (AREC 300 or AREC 311)

**AREC 371. M/TOPICS IN GLOBALIZATION (1).** Surveys current economics issues associated with globalization.

**AREC 372. AGRICULTURAL COOPERATIVES (2).** A primer on agricultural cooperatives including such topics as principles of membership and business control, management perspectives, and relationships and linkages between cooperatives. Field trip. Graded P/N.

**AREC 382. FARM AND RANCH APPRAISAL (4).** An introduction to appraisal of rural real estate, including methods of valuing property, different types of appraisals, and preparation and interpretation of an appraisal report. Not offered

every year. **PREREQS:** ECON 201.

**AREC 388. AGRICULTURAL LAW (4).** Application of legal principles to business decision making in farming, ranching, and the agricultural support industry. Consideration of the obligations arising out of contract, tort, property, water, public land, and natural resource law. Not offered every year.

**AREC 401. RESEARCH AND SCHOLARSHIP (1-16).** **PREREQS:** Departmental approval required.

**AREC 402. INDEPENDENT STUDY (1-16).** **PREREQS:** Departmental approval required.

**AREC 403. THESIS (1-16).** **PREREQS:** Senior standing, departmental approval required.

**AREC 405. READING AND CONFERENCE (1-16).** **PREREQS:** Departmental approval required.

**AREC 406. PROJECTS (1-16).** **PREREQS:** Departmental approval required.

**AREC 407. SEMINAR (1-16).**

**AREC 407H. SEMINAR (1-16).** **PREREQS:** Honors College approval required.

**AREC 408. WORKSHOP (1-16).**

**AREC 410. INTERNSHIP (1-6).** Practical on-the-job training in agricultural business, marketing, commercial agricultural production, or related private or public organizations. Graded P/N. **PREREQS:** Junior or senior standing. Submission and approval of pre-internship work plans. Internship program coordinator approval required.

**AREC 432. ENVIRONMENTAL LAW (4).** Legal relationships arising out of rights to air, water, and land. The impact of federal and state regulation on pollution control and on the production, use, and disposal of hazardous materials. **PREREQS:** Junior standing.

**AREC 434. ^ENVIRONMENTAL AND RESOURCE ECONOMICS (3).** Examines economic perspectives on the allocation of natural resources and the management of environmental quality, emphasis on the use of economic concepts in the design and evaluation of public policies. (Writing Intensive Course) **PREREQS:** (AREC 311 or ECON 311) and (AREC 312 or ECON 312)

**AREC 438. EXPLORING WORLD AGRICULTURE (2).** Survey of crop and livestock production in a designated section of the world, including history, culture, and political situation. Course is designed to prepare students for a tour of study area. Not offered every year. CROSSLISTED as ANS 438, CSS 438, HORT 438. Graded P/N.

**AREC 441. AGRICULTURAL FINANCIAL MANAGEMENT (4).** Principles of financial management in production agriculture and agribusiness; financial statements, budgets, and capital investment analysis; business organization forms; legal aspects of borrowing; sources and terms of agricultural credit; taxation. **PREREQS:** AREC 211; AREC 300 or AREC 311; BA 340. EOU campus only.

**AREC 442. AGRICULTURAL BUSINESS MANAGEMENT (4).** Application of economic principles to agricultural businesses; use of regression and linear programming as management tools; risk management; marketing; forecasting; production management; competitive strategies. **PREREQS:** AREC 441. EOU campus only.

**AREC 447. AGRICULTURAL PRICE AND MARKET ANALYSIS (4).** Price determination for agricultural commodities and factors; quantitative analysis of prices, factors and markets; agricultural market structures, performance, and roles of institutions. Lec/lab. **PREREQS:** AREC 300 or AREC 311/ECON 311, AREC 370 and ST 351.

**AREC 453. PUBLIC LAND AND RESOURCE LAW (4).** Constitutional, administrative, and historical foundations of federal natural resources law and related public policy. Applicable case law emphasizing water, range, mineral, wildlife, and recreation resources. Not offered every year. **PREREQS:** AREC 353.

**AREC 454. RURAL DEVELOPMENT ECONOMICS AND POLICY (3).** Theories of economic change in developed and less-developed economies; natural resource sectors and the development of rural regions, with emphasis on growth, diversification, and instability; resource mobility and the spatial aspects of development; poverty and inequality; rural development policy. Not offered every year. **PREREQS:** AREC 300 or AREC 311

**AREC 461. \*AGRICULTURAL AND FOOD POLICY ISSUES (4).** Principles of agricultural and food policy formulation; agricultural adjustment processes; agricultural price and income policies in relation to land use, water, and rural development policies; interrelationships among U.S. and foreign agriculture and trade policies. (Bacc Core Course) (Writing Intensive Course) **PREREQS:** AREC 250 or ECON 201, AREC 300 or AREC 311/ECON 311.

**AREC 465. M/AGRICULTURAL FINANCIAL REPORTING AND ANALYSIS (3).** Covers balance sheet, income statement, statement of cash flows, and statement of owner equity, using standards outlined by the Farm Financial Records Task Force. Also the use of ratios to evaluate financial performance. **PREREQS:** AREC 211, AREC 300, BA 215, BA 340.

**AREC 467. M/CAPITAL BUDGETING IN AGRICULTURE (1).** Overview of capital budgeting techniques as applied to agribusiness decisions. Specific topics include methods of controlling land, leasing versus buying nonland capital assets. **PREREQS:** AREC 211, AREC 300, BA 340.

**AREC 468. M/CROP ENTERPRISE BUDGETING (1).** Develop and calculate the per acre costs and returns of producing a crop enterprise. Includes the costs of owning and operating farm machinery. Distinguish between accountants' and economists' definitions of production costs. **PREREQS:** AREC 211

**AREC 469. M/LIVESTOCK ENTERPRISE BUDGETING (1).** Develop and calculate the costs and returns of producing a livestock enterprise. Includes the costs of raising breeding animals, as well as owning and operating machinery and livestock facilities. Distinguish between accountants' and economists' definition of production costs. **PREREQS:** AREC 211

**AREC 470. M/FARM BUDGETING AND PLANNING (1).** The process of planning a farm. Developing long-run whole farm budgets, cash flow planning/budgeting, monitoring and control, and year end analysis. **PREREQS:** AREC 211, BA 215.

**AREC 471. M/ENTREPRENEURIAL SKILLS IN AGRIBUSINESS MANAGEMENT (1).** Examines fundamental entrepreneurial responsibilities and decisions applicable to the operation of agricultural and natural resource based firms. Topics include decision making, business models, entrepreneurship, strategic planning, enterprise selection, and business plans. Not offered every year. **PREREQS:** Senior standing.

**AREC 472. M/COMPETITIVE STRATEGIES (1).** Examines attributes of the agribusiness industry as they influence the competitiveness of firms and the strategies they adopt to compete successfully. Topics include industry organization, models of market competition, competitive strategies, and tools for analyzing competitiveness. Not offered every year. **PREREQS:** AREC 221 or AREC 370.

**AREC 473. M/RISK MANAGEMENT IN AGRIBUSINESS (1).** Examines risk management as it is applied to decision making

in the agribusiness industries. Topics include the meaning and measurement of risk, risk management tools, and risk management strategies. Not offered every year. **PREREQS:** AREC 211 or AREC 221 and ST 351.

**AREC 475. M/NEGOTIATION IN BUSINESS AND RESOURCE MANAGEMENT (1).** Understanding the theory and processes of negotiation as it is practiced in a variety of settings. The course covers distributive and integrative bargaining, dealing with the complexities of multi-party and multi-issue negotiations, and ethical issues that arise in negotiations. **PREREQS:** Junior or senior standing.

**AREC 476. M/AGRICULTURAL PERSONNEL MANAGEMENT (2).** A primer on agricultural personnel management including such topics as economic principles related to agricultural labor/management relations, the hiring process, performance appraisal, wage/benefit compensation, promotion/termination, personnel management from the employer perspective, and personnel management from the employee perspective.

**AREC 499. SPECIAL TOPICS (1-3).** Various topics in agricultural and resource economics of special and current interest not covered in other courses. May be repeated for credit.

**AREC 499H. SPECIAL TOPICS (1-3).** Various topics in agricultural and resource economics of special and current interest not covered in other courses. May be repeated for credit. **PREREQS:** Honors College approval required.

**AREC 501. RESEARCH AND SCHOLARSHIP (1-16).**

**AREC 503. THESIS (1-16).**

**AREC 505. READING AND CONFERENCE (1-16).**

**AREC 507. SEMINAR (1-16).**

**AREC 508. WORKSHOP (1-16).**

**AREC 512. MICROECONOMIC THEORY I (4).** Economic theories of consumer behavior and demand, production, cost, the firm, supply, and competitive and monopoly market structures. CROSSLISTED as ECON 512. **PREREQS:** AREC 312/ECON 312 or equivalent.

**AREC 513. MICROECONOMIC THEORY II (4).** Economic theories of imperfect competition, input markets, general equilibrium and welfare economics. CROSSLISTED as ECON 513. **PREREQS:** AREC 512 or ECON 512

**AREC 523. STATISTICS FOR ECONOMETRICS (4).** Examines mathematical and statistical topics essential for graduate-level econometric analysis, including matrix algebra, probability and distribution theory (emphasizing joint and conditional distributions), statistical inference, and econometric optimization algorithms. CROSSLISTED as ECON 523. **PREREQS:** MTH 253; ST 351; and ST 352 or ECON 424/ECON 524.

**AREC 525. ECONOMETRIC METHODS (4).** The use of multiple regression under generalized assumptions, specification problems, introduction to simultaneous equation estimation, the classical linear model using matrices. Emphasis on the analysis of data and communication of findings. CROSSLISTED as ECON 525. **PREREQS:** AREC 523 or ECON 523, ECON 424/ECON 524, AREC 512/ECON 512.

**AREC 526. APPLIED ECONOMETRICS (4).** Model building, hypothesis testing, and appropriate estimation procedures including generalized least squares, seemingly unrelated regressions, simultaneous equations, maximum likelihood, and limited dependent variables. Emphasis on applications and interpretation of results. CROSSLISTED as ECON 526. **PREREQS:** AREC 525 or ECON 525

**AREC 532. ENVIRONMENTAL LAW (4).** Legal relationships arising out of rights to air, water, and

rights to air, water, and land. The impact of federal and state regulation on pollution control and on the production, use, and disposal of hazardous materials. **PREREQS:** Graduate standing.

**AREC 534. ENVIRONMENTAL AND RESOURCE ECONOMICS (3).** Examines economic perspectives on the use and management of natural resources (e.g., fish, wildlife) and environmental quality (e.g., water, air). **PREREQS:** AREC 311.

**AREC 543. APPLIED TRADE ANALYSIS (4).** Introduction to empirical international trade analysis. Topics covered are empirical work on the Ricardian and factor endowment models and models of imperfect competition. Additional topics include trade policy, productivity analysis, and economic integration. Applications will be drawn from a wide range of industries. **PREREQS:** (AREC 512\* or ECON 512\*) and (AREC 525\* or ECON 525\*) or ECON 540.

**AREC 550. ENVIRONMENTAL ECONOMICS (3).** Historical development of environmental management and environmental economics; economics of environmental pollution, including the concept of economic efficiency, the optimal level of pollution, and alternative pollution control approaches; measuring environmental values and damages, including the contingent valuation methods, revealed preference models, and the transfer of such values; the time, discount rates, uncertainty and sustainable development. Not offered every year. **PREREQS:** AREC 512\* or ECON 512\*

**AREC 551. NATURAL RESOURCE ECONOMICS (3).** Brief introduction to welfare economics with emphasis on defining economic efficiency, intertemporal efficiency, and other criteria for economic policy; property rights and natural resource use; sources of inefficient allocation of natural resources; benefit-cost analysis with full and limited information; exhaustible resources; renewable resources; conservation and preservation. Not offered every year. **PREREQS:** AREC 512\* or ECON 512\*

**AREC 553. PUBLIC LAND AND RESOURCE LAW (4).** Constitutional, administrative, and historical foundations of federal natural resources law and related public policy. Applicable case law emphasizing water, range, mineral, wildlife, and recreation resources. Not offered every year. **PREREQS:** AREC 353.

**AREC 554. RURAL DEVELOPMENT ECONOMICS AND POLICY (3).** Theories of economic change in developed and less-developed economies; natural resource sectors and the development of rural regions, with emphasis on growth, diversification, and instability; resource mobility and the spatial aspects of development; poverty and inequality; rural development policy. Not offered every year. **PREREQS:** AREC 300 or AREC 311.

**AREC 565. M/AGRICULTURAL FINANCIAL REPORTING AND ANALYSIS (2).** Covers balance sheet, income statement, statement of cash flows, and statement of owner equity, using standards outlined by the Farm Financial Records Task Force. Also the use of ratios to evaluate financial performance. **PREREQS:** AREC 211, AREC 300, BA 215, BA 340.

**AREC 567. M/CAPITAL BUDGETING IN AGRICULTURE (1).** Overview of capital budgeting techniques as applied to agribusiness decisions. Specific topics include methods of controlling land, leasing versus buying nonland capital assets. **PREREQS:** AREC 211, AREC 300, BA 340.

**AREC 599. SPECIAL TOPICS (1-16).** Various topics in agricultural and resource economics of special and current interest not covered in other courses. May be repeated for credit when topics change.

**AREC 601. RESEARCH AND SCHOLARSHIP (1-16).**

**AREC 603. THESIS (1-16).**

**AREC 605. READING AND CONFERENCE (1-16).**

**AREC 607. SEMINAR (1-16).**

**AREC 608. WORKSHOP (1-16).**

**AREC 611. MATH FOR ECONOMICS (4).**

Mathematical concepts necessary for pursuing microeconomic theory at the PhD level: general topology (sets, functions, and cardinality), convex analysis (separation, saddle point, and Kuhn-Tucker theorems), and optimal control theory. **CROSSLISTED** as ECON 611. **PREREQS:** MTH 254.

**AREC 612. ADV MICRO THEORY: PRODUCTION, CONSUMPTION AND MARKETS (4).**

A rigorous development of the theory of production, consumption, and markets, with emphasis on duality. **CROSSLISTED** as ECON 612. **PREREQS:** (AREC 513 or ECON 513) and (AREC 611 or ECON 611), MTH 254.

**AREC 613. ADV MICROECONOMIC THEORY: GAMES, WELFARE, AND INFORMATION (4).**

A rigorous development of the theory of games, general equilibrium, welfare, and information. **CROSSLISTED** as ECON 613. **PREREQS:** AREC 612/ECON 612.

**AREC 643. INTERNATIONAL TRADE II (4).**

Introduction to empirical applications of modern trade theory. The main topic is empirical work on international trade models that incorporate increasing returns and imperfect competition. Additional topics include economic integration, geography and trade, trade conflicts, and trade and the environment. **PREREQS:** (AREC 526 or ECON 526) and (AREC 513 or ECON 513) and ECON 540, AREC 612 or ECON 612.

**AREC 651. ADVANCED NATURAL RESOURCE ECONOMICS (3).**

Dynamic allocation of scarce exhaustible and renewable natural resources, social versus private decisions; market and non-market considerations; technological change; regulation; dynamics and uncertainty. Not offered every year. **PREREQS:** AREC 513, AREC 526.

**AREC 652. ADVANCED ENVIRONMENTAL ECONOMICS (3).**

Interrelationships of natural resource use and the environment; applied welfare and benefit-cost analysis; externalities and pollution abatement; non-market valuation of resources; property rights; legal and social constraints; policy approaches. Not offered every year. **PREREQS:** (AREC 513 or ECON 513) and (AREC 526 or ECON 526)

**AREC 653X. SPATIAL ECONOMICS OF NATURAL RESOURCES (3).**

Introduces the tools of spatial economics - both modeling structure and spatial econometrics-and demonstrates how those tools have been applied to various natural resources. **CROSSLISTED** as FOR 599. **PREREQS:** AREC 550 and AREC 551

**AREC 699. SPECIAL TOPICS (1-16).**

Various topics in agricultural and resource economics of special and current interest not covered in other courses. May be repeated for credit.

## AGRICULTURAL EDUCATION AND GENERAL AGRICULTURE

**Greg Thompson, Department Head**

112 Strand Agriculture Hall  
Oregon State University  
Corvallis, OR 97331-2204  
541-737-2661

E-mail: greg.thompson@oregonstate.edu

Website: <http://oregonstate.edu/dept/ag-ed/>

### FACULTY

**Professor** Cole (Emeritus), Thompson  
**Instructors** Anderson, Gardner,  
Jansen, Wilkinson

### Undergraduate Major

**General Agriculture (BS)**

### Minors

**Agricultural Sciences**

**International Agricultural Development**

### Graduate Major

**Agricultural Education (MS, MAg)**

#### *Graduate Areas of Concentration*

*Teacher Preparation, Leadership, and  
Communication in Agriculture*

### Graduate Minor

**Agricultural Education**

**International Agricultural Development**

The Department of Agricultural Education and General Agriculture combines two programs: General Agriculture and Agricultural Education.

The General Agriculture Program is an undergraduate studies program that provides maximum flexibility in designing and structuring a course of study to meet the students' individual needs. General agriculture should be seriously considered by students desiring programs of study not currently available in any other agricultural subject matter department (such as those involving a minor in communications, recreation, or environmental studies in agriculture); students wishing to pursue two or more areas of specialization (such as students who are returning to farms or ranches and who need substantial background, for example, in animal science, crops, and agricultural business management); students preparing for leadership positions in agriculture that require excellent communication and leadership skills as well as breadth of agricultural background (such as agriculture teachers, lobbyists, commodity liaison persons or extension staff); or students who have not selected a departmental major in the College of Agricultural Sciences but who know they are interested in an agricultural career.

The goal of the General Agriculture Program is to help students identify the agricultural career in which they are most interested and build a course of study that will qualify each student for his or her chosen profession. Advising is of paramount importance in this process and major emphasis is placed on career advising.

The Agricultural Education Program offers course work serving teachers and leaders in agriculture. The MS, MAg, EdM, and MAIS degrees may be pursued with an emphasis in leadership, communication, pedagogy, extension and/or technical agriculture. Candidates work with an advisor to develop programs that meet their specific needs as indicated by their occupational objectives.

Two minors are available in the Department of Agricultural Education and General Agriculture.

The International Agricultural Development minor is available for both undergraduate and graduate students who are interested in agricultural development abroad. The minor requires foreign language proficiency, as well as appropriate agricultural and sociological course work.

The Agricultural Science minor is available for undergraduate students who have majored in an area that requires the addition of breadth in agriculture to their major program. The minor provides the appropriate technical agriculture background for students interested in agricultural management, communication, environmental studies, etc.

### CAREER OPPORTUNITIES IN AGRICULTURAL SCIENCES

Career opportunities for general agriculture majors are unlimited because of the unlimiting nature of the program structure. Students can return to home farms or ranches, move into agricultural middle management, become extension staff, move into political lobby positions, work in marketing or international agriculture, become high school teachers of agriculture, teach agriculture in community colleges, or do whatever they have planned to accomplish from their program of study. Salaries vary depending on the position a student may strive to achieve.

### UNDERGRADUATE STUDIES CURRICULUM

High school and college transfer students who are admitted to Oregon State University as an undergraduate are eligible to participate in the General Agriculture Program. General agriculture majors, in consultation with their departmental academic advisor, may plan elective course work to emphasize personal interests, abilities and career objectives. A leadership and communication area of empha-

sis is available and is especially designed for those students who will need breadth in their technical agriculture background and excellence in communication and leadership skills. The intent of this area of emphasis within the General Agriculture Program is to prepare agriculture's future leaders in extension, government, and business. A teacher preparation area of emphasis is available and allows for Initial Teacher Licensure within the baccalaureate degree.

## GENERAL AGRICULTURE (BS, CRED, HBS)

### BS Baccalaureate Core (48)

#### Agricultural Core

AG 111. Computer Applications in Agriculture (3)  
AG 199. Special Studies (1-16)  
AG 421. ^Leadership Development (3)  
AREC 211. Management in Agriculture (4)  
Agricultural electives (a minimum of 36 credits of technical agriculture, 24 credits of which must be upper division is required) (36)

#### Business

BA 215. Fundamentals of Accounting (4)  
BA 230. Business Law I (4)  
or AREC 253. \*Evolution of U.S. Environmental and Natural Resources Law (4)

#### Communication

Communications elective (3)

#### Humanities, Arts and Social Sciences

ECON 201. \*Intro to Microeconomics (4)

#### Sciences—Physical and Biological

Physical science—chemistry (10-15)  
Biological sciences—one-year series (12)

#### Math

MTH 105. \*Intro to Contemporary Mathematics (3)  
Electives (48-52)

**Total=180**

## AGRICULTURAL SCIENCES MINOR

### Lower-Division Core

AG 111. Computer Applications in Agriculture (3)  
One agricultural resource management course (3-4)  
One production agriculture course (3-4)

### Upper-Division Core

Two courses from a department in the College of Agricultural Science (6-8)  
Two courses from a second department in the College of Agricultural Science (6-8)

### Electives (0-9)

**Total=27**

## INTERNATIONAL AGRICULTURAL DEVELOPMENT MINOR

### Undergraduate Curriculum

AG 421. ^Leadership Development (3)  
Language competency  
Technical electives in agriculture (9)

Social, cultural and economic electives (5)  
Minimum of 27 credits of which 12 credits must be upper division.

### Graduate Curriculum

AG 521. Leadership Development (3)  
Language competency  
Technical electives in agriculture (5 for master's, 9 for doctorate)  
Social, cultural and economic electives (5)  
Minimum of 21 credits for master's, 25 for doctorate.

**Note:** A graduate international agricultural development minor is not available to a student who took an undergraduate international agricultural development minor at Oregon State University.

## AGRICULTURAL EDUCATION (MAg, MS)

### Graduate Areas of Concentration

*Teacher preparation, leadership and communication in agriculture*

The Department of Agricultural Education and General Agriculture offers course work that serves teachers and leaders in agriculture. The Master of Science, Master of Agriculture, and Master of Arts in Interdisciplinary Studies degrees may be pursued with an emphasis in leadership, communication, pedagogy, extension, and/or technical agriculture. Candidates work with an advisor to develop programs that meet their specific needs as indicated by their occupational objectives. A person who completes an Agricultural Education master's degree is not solely locked into teaching. Potential occupations also include lobbyist, journalist, and Extension work.

### MASTER OF AGRICULTURE

#### Graduate Areas of Concentration

*Three agriculturally related areas are required. Areas may be agricultural economics, agricultural education, animal science, botany and plant pathology, crop science, fisheries science, food science, horticulture, rangeland resources, soil science, wildlife science, or other areas approved by the College of Agricultural Sciences.*

The Department of Agricultural Education and General Agriculture offers course work that serves teachers and leaders in agriculture. The Master of Science (MS), Master of Agriculture (MAg), and Master of Arts in Interdisciplinary Studies (MAIS) degrees may be pursued with an emphasis in leadership, communication, pedagogy, extension, and/or technical agriculture. Candidates work with an advisor to develop programs that meet their specific needs as indicated by their occupational objectives.

## AGRICULTURAL EDUCATION GRADUATE MINOR

Develop a teaching, pedagogical, leadership development in agriculture minor by working with a departmental advisor.

## INTERNATIONAL AGRICULTURAL DEVELOPMENT GRADUATE MINOR

### Graduate Curriculum

AG 521. Leadership Development (3)  
Language competency  
Technical electives in agriculture (5 for master's, 9 for doctorate)  
Social, cultural and economic electives (5)  
Minimum of 21 credits for master's, 25 for doctorate.

**Note:** A graduate international agricultural development minor is not available to a student who took an undergraduate international agricultural development minor at Oregon State University.

## COURSES

**AED 313. THEORY AND PRACTICUM III: FIELD (4).** Field based experience for students preparing to be agricultural teachers. Focus on teaching models. **PREREQS:** Advising and placement by AED staff.

**AED 407. SEMINAR (1-16).**

**AED 476. ADULT PROGRAMS AND DEVELOPMENT (4.5).** Designed for students at a distance for developing, organizing and conducting adult educational programs for the agricultural community. **PREREQS:** Junior or senior standing or instructor approval required.

**AED 499. SPECIAL TOPICS (1-16).**

**AED 501. RESEARCH (1-16).**

**AED 503. THESIS (1-16).**

**AED 505. READING AND CONFERENCE (1-16).**

**AED 507. SEMINAR (1-16).**

**AED 508. WORKSHOP (1-16).**

**AED 509. PRACTICUM (1-16).**

**AED 510. PROFESSIONAL INTERNSHIP: AGRICULTURE EDUCATION (1-16).** A field experience in which the intern will integrate academic study with classroom teaching experience to learn specific competencies relating to functioning well in the context of the classroom and the school, and demonstrate this competency through the assessment of work by supervisors and by evidence collected and presented in work samples.

**AED 518. EXTENSION COURSE IN TEACHER EDUCATION/PEDAGOGY (1-3).** Enables present and prospective teachers of agriculture to continue their professional development on pedagogical topics of current importance.

**AED 533. RURAL SURVEY METHODS (3).** Technique; analyzing, interpreting, and using results of survey data; identifying and utilizing community resources; develop and organize agriculture programs to meet community needs.

**AED 552. PROGRAM ORGANIZATION AND MANAGEMENT (3).** Explores the foundations of vocational education, essential learning skills, advisory committees, and development of a vocational education philosophy. Students will study the elements of educational reform as they apply to specific service areas. Resource analysis, student organizations, and school-to-work transitions will also be studied.

**AED 553. APPLIED INSTRUCTIONAL STRATEGIES (3).** Helps students in the identification and development of goals, objectives and units. The course includes the development and application of subject area instructional strategies/models, including applied math, writing, communication skills, measurement and evaluation of achievement, and delivery of instruction to at-risk students. Safety is a primary focus.

**AED 554. MICRO-TEACHING (3).** Planning, presenting and evaluating lessons in a micro-teaching lab. It includes application of content pedagogy strategies, subject matter principles and media technology. Lessons presented on safety.

**AED 556. LINK RESEARCH, TEACHING, AND PRACTICE (3).** Links research to teaching. Students will work with cooperating teachers to identify and apply research to teaching.

**AED 557. ISSUES AND TRENDS IN CURRICULUM AND INSTRUCTION (3).** Emphasizes trends related to subject matter curriculum issues unique to agricultural education at the secondary level.

**AED 558. IMPROVING VOCATIONAL EDUCATION PROGRAMS (3).** Stresses evaluation of programs and students, standardization and accreditation, legislation and state criteria for improving programs. Students will review applied research, and apply criteria for improving service area program and occupational guidance.

**AED 599. SPECIAL TOPICS (1-16).**

**AG 111. COMPUTER APPLICATIONS IN AGRICULTURE (3).** Computer use in agriculture and agribusiness; practical experience with computer programs applicable to all agricultural disciplines.

**AG 199. SPECIAL STUDIES (1-16).**

**AG 211. SURVEY AND CONSTRUCTION (3).** Land measurement and leveling as applied to agricultural uses. Concrete and agricultural building construction including the use of construction power tools, selection of materials and cost estimating.

**AG 221. METALS AND WELDING (3).** Practices of metal working including the use of metal working machines, metal identification, heat treating and metal properties. Fabrication of metals including arc and oxy-acetylene welding and cutting. Lec/lab.

**AG 301. \*ECOSYSTEM SCIENCE OF PACIFIC NW INDIANS (3).** Designed and presented in partnership with Pacific Northwest Indians and Alaska Natives, focusing on natural ecosystems, differing views, power relationships, policymaking, and gender roles. (Bacc Core Course)

**AG 312. ENGINE THEORY AND OPERATION (3).** Engine construction, operational theories and principles, lubrication, fuels and oils, emissions and preventive maintenance are taught through the process of small engine lab activities. Engine efficiency theories and measurement are presented.

**AG 318. ACCESSING INFORMATION FOR AGRICULTURAL RESEARCH (1).** Designed for students at a distance to develop library skills and improve access to information used to conduct technical agricultural research.

**AG 391. FARM IMPLEMENTS (3).** Power farming implements including operation, maintenance, adjustments, calibration and use are covered. Field trips may be required.

**AG 401. RESEARCH (1-16).**

**AG 402. INDEPENDENT STUDIES (1-16).**

**AG 403. THESIS (1-16).** PREREQS: Departmental approval required.

**AG 405. READING AND CONFERENCE (1-16).**

**AG 406. SPECIAL PROBLEMS (1-16).**

**AG 407. SEMINAR (1-16).**

**AG 409. PRACTICUM (1-16).**

**AG 410. INTERNSHIP (1-15).** A work internship to give students practical on-the-job preparation in any of the main facets of agriculture or related industries. PREREQS: College and instructor approval.

**AG 412. AG SAFETY AND HEALTH (3).** An examination of various hazards associated with agriculture. Control strategies will be explored and prevention methods identified. Hazards examined include machinery, livestock, controlled spaces, pesticides, and other items common to the agricultural workplace. Lec/lab.

**AG 421. ^LEADERSHIP DEVELOPMENT (3).** Principles of leadership development, leadership analysis and style, record keeping procedures, youth organizations, and activities in leadership for youth. (Writing Intensive Course) PREREQS: Senior standing.

**AG 425. DEVELOPMENTS IN AGRICULTURAL MECHANICS (3).** Emphasis on the development of instructional units for agricultural instruction programs. Wide applications to agricultural mechanization and biotechnology. PREREQS: Senior standing.

**AG 492. TECHNOLOGY TRANSFER IN AGRICULTURE (3).** Examination of processes by which formal and informal agricultural instruction programs influence the introduction and acceptance of technology in agriculture. An emphasis in the international arena will be maintained. The focus throughout the course will be on the role of a professional change agent working with technological change. PREREQS: Senior standing.

**AG 507. SEMINAR (1-16).**

**AG 509. PRACTICUM (1-16).**

**AG 518. EXTENSION COURSE IN TEACHER EDUCATION: TECHNICAL (1-3).** Enables present and prospective teachers of agriculture to continue their professional development on technical topics of current importance.

**AG 521. LEADERSHIP DEVELOPMENT (3).** Principles of leadership development, leadership analysis and style, record keeping procedures, youth organizations, and activities in leadership for youth. PREREQS: Graduate standing.

**AG 525. DEVELOPMENTS IN AGRICULTURAL MECHANICS (3).** Emphasis on the development of instructional units for agricultural instruction programs. Wide applications to agricultural mechanization and biotechnology. PREREQS: Graduate standing.

**AG 541. COMMUNITY PROGRAMS IN AGRICULTURE (3).** Evaluating agricultural education program effectiveness and technical appropriateness. Development of long-range plans for agricultural programs to meet the technical needs of a community. PREREQS: Teaching or Extension experience will be verified by the instructor for approval.

**AG 592. TECHNOLOGY TRANSFER IN AGRICULTURE (3).** Examination of processes by which formal and informal agricultural instruction programs influence the introduction and acceptance of technology in agriculture. An emphasis in the international arena will be maintained. The focus throughout the course will be on the role of a professional change agent working with technological change. PREREQS: Graduate standing.

## ANIMAL SCIENCES

**James R. Males, Department Head**  
112 Withycombe Hall  
Oregon State University  
Corvallis, OR 97331-6702  
541-737-4761  
E-mail: dodi.reesman@oregonstate.edu  
Website: <http://ans.oregonstate.edu>

### FACULTY

**Professors** Froman, Gamroth, Koong, Males, Menino, Pirelli, Savage  
**Associate Professors** Bohnert, Chamberlain, Cherian, Croney, DelCurto, Downing, Engel, Estill, Filley, Hermes, Mills, Parsons, Riggs, Thompson  
**Assistant Professors** M. Cannon, Davidson, Mueller, Sherwood, Villarreal  
**Instructors** V. Cannon, Salazar, Sexson  
**Senior Research Assistants** Feltmann, Keller  
**Research Assistant** D. Goeger  
**Professionals** Brown, Krahn, Nichols, Pilgrim, Reesman, Ross

### Undergraduate Major

**Animal Sciences (BS)**

#### Options

*Animal Behavior/Bioethics*

*Animal Products*

*Beef*

*Communications, Leadership, Industry and Policy (CLIP)*

*Dairy*

*Equine*

*Poultry*

*Pre-veterinary Medicine*

*Sheep*

### Minors

**Animal Sciences**

**Equine**

### Graduate Majors

**Animal Science (MS, PhD)**

#### Graduate Areas of Concentration

*Animal Genetics*

*Animal Nutrition*

*Dairy Production (MS only)*

*Embryo Physiology*

*Endocrinology*

*Growth and Development*

*Livestock Management (MS only)*

*Nutritional Biochemistry*

*Reproductive Physiology*

**Poultry Science (MS, PhD)**

#### Graduate Areas of Concentration

*Poultry Genetics*

*Poultry Management (MS only)*

*Poultry Nutrition*

*Poultry Reproductive Physiology*

### Graduate Minors

**Animal Sciences**

**Poultry Science**

Programs in animal sciences provide up-to-date information on methods of rearing livestock and poultry, that produce meat, milk, eggs, wool, and other animal products. In addition, the department addresses the care of animals that enhance human well-being through companionship, recreation, and human aid such as horses and companion animals. Essential to this information is knowledge generated from the fields of animal behavior/bioethics, genetics, nutrition, and physiology. The various teaching and research programs explore modern areas of animal biotechnology and data processing and how they apply to present day livestock and poultry production. Study in these areas provides the core around which various curricula leading to the BS degree in Animal Sciences can be developed. To allow students flexibility in course arrangement, eight specialized program options are offered.

Increasing demands for livestock and poultry products by a rapidly expanding human population mean potential employment for well-trained individuals in such areas as farm, ranch, feedlot operation; meat, poultry, egg and milk processing, meat grading with the USDA; Federal Cooperative Extension Service, county and 4-H work; sales or technical employment with commercial feed, seed, and chemical companies and pharmaceutical houses; agricultural loan officer; government agency positions at local, state and federal levels; the Peace Corps; animal welfare auditing; as well as in journalism, mass media, and public policy. The expanding support structure for companion animals has created a growing job market for graduates in areas such as animal behavior consultant; vet tech (animal nurse); and business management. In addition, students become prepared to go on to advanced studies in animal sciences, veterinary medicine, and education.

Graduate students may pursue research projects through the Agricultural Experiment Station as part of their programs for MS or PhD degrees. Graduate majors are offered in animal behavior, animal genetics, animal nutrition, animal physiology, growth and development, nutritional biochemistry, and production.

#### COOPERATIVE PROGRAMS

Residents of Washington and Idaho who are interested in poultry science may begin their undergraduate training within the Department of Animal Sciences at Washington State University or the University of Idaho. Following their sophomore year, these students may transfer to the OSU Department of Animal Sciences without paying out-of-state tuition. Students transferring after one or two years at a community college should also be

able to complete the requirements for a BS after three or two years, respectively.

#### ANIMAL SCIENCES (BS, CRED, HBS)

##### Baccalaureate Core (51)

##### Animal Sciences Core

- ANS 100. Orientation to Animal Sciences (2)
- ANS 121. \*Intro to Animal Sciences (4)
- ANS 207. Sophomore Seminar (1)
- ANS 251. Principles of Animal Foods Technology (3)
- ANS 311. Principles of Animal Nutrition (3)
- ANS 313. Applied Animal Nutrition: Feeds and Ration Formulation (4)
- ANS 314. Animal Physiology (4)
- ANS 316. Reproduction in Domestic Animals (4)
- ANS 317. Reproduction in Domestic Animals Laboratory (1)
- ANS 378. Animal Genetics (4)
- ANS 420. ^Ethical Issues in Animal Agriculture (3)

##### Two animal industries courses from:

- ANS 215. Beef/Dairy Industries (3)
- ANS 216. Sheep/Swine Industries (3)
- ANS 217. Poultry Industries (3)
- ANS 220. Introductory Horse Science (3)
- ANS 231. Livestock Evaluation (2)
- ANS 280. Companion Animal Management (3)

##### Two production courses from:

- ANS 430. Equine Systems I: Exercise Science (3)
- or ANS 431. Equine Systems II: Nutrition (3)
- ANS 433. Poultry Meat Production Systems (3)
- or ANS 434. Egg Production Systems (3)
- ANS 436. Sheep Production Systems (3)
- ANS 439. Dairy Production Systems (4)
- ANS 443. Beef Production Systems: Cow/Calf (3)
- or ANS 444. Beef Production Systems: Stocker/Feedlot (3)

##### +Select TWO courses from the following advanced ANS classes or electives (minimum of 6 credits).

- ANS 315. \*Contentious Social Issues in Animal Agriculture (3)
- ANS 321. Avian Embryo (4)
- ANS 322. Equestrian Coaching (2)
- ANS 323. Principles of Colt Training (3)
- ANS 324. Advanced Colt Training (3)
- ANS 327. Applied Physiology of Reproduction (5)
- ANS 331. Advanced Livestock Evaluation (4)
- ANS 333. Equine Stable Management (3)
- ANS 351. Advanced Principles of Animal Food Technology (4)
- ANS 401. Research (1-16)
- ANS 410. Animal Science Internship (3 credits maximum will count toward the two-class requirement)
- ANS 411/ANS 511. Digestive Physiology and Nutrition of Ruminant Animals (4)
- ANS 412/ANS 512. Monogastric and Poultry Nutrition (3)
- ANS 415. Livestock Judging Team (3)
- ANS 435/ANS 535. Applied Animal Behavior (3)

- ANS 438. Exploring World Agriculture (2)
- ANS 441/ANS 541. Topics in Animal Learning (2)
- ANS 452/ANS 552. Livestock Housing and Waste Management (3)
- ANS 453. Practical Broiler Production (1-3)
- ANS 465. Foodborne Disease (3)
- ANS 478/ANS 578. Animal Breeding and Genetics (3)
- ANS 480/ANS 580. Animal Growth (3)
- ANS 485/ANS 585, SOC 485/SOC 585. \*Consensus and Natural Resource Issues (3)
- ANS 490/ANS 590. Toxicants and Poisonous Plants (4)
- Additional ANS Production Systems Course (3)

##### Select 20 credits from the Agriculture Category (Choose any courses in agricultural field or natural resources area.)

##### Physical and Biological Sciences

- BI 211, BI 212, BI 213. \*Principles of Biology (4,4,4)
- CH 121. General Chemistry (5) and CH 122, CH 123. \*General Chemistry (5,5) or CH 221, CH 222, CH 223. \*General Chemistry (5,5,5)
- CH 130. General Chemistry of Living Systems (4) or CH 331. Organic Chemistry (4) or BB 331. \*Intro to Molecular Biology (3)
- MB 230. \*Introductory Microbiology (4) or MB 302. General Microbiology (3)
- MTH 111. \*College Algebra (4)

##### Statistics

- ST 201. Principles of Statistics (3) and ST 209. Principles of Hypothesis Testing (1) or ST 351. Intro to Statistical Methods (4)

##### Business

##### Choose one from below:

- AREC 211. Management in Agriculture (4)
- AREC 221. Marketing in Agriculture (3)
- BA 215. Money and Investment Management: Manager, Lender, Investor Viewpoint (4)
- BA 230. Business Law I (4)

#### ANIMAL BEHAVIOR/BIOETHICS OPTION

The Animal Behavior/Bioethics option\* is designed for students who are looking for a animal behavior/welfare career path that is based in science. It will serve the needs of students interested in careers in government, welfare auditing programs, consultants, graduate school, zoos, aquariums, and wildlife sanctuaries.

##### Required (16)

- ANS 420. Ethical Issues in Animal Agriculture (3)
- ANS 435/ANS 535. Applied Animal Behavior (3)
- PHL 205. \*Ethics (4)
- Upper-division PHL course dealing with ethics (3)
- Z 350. Animal Behavior (3)

**Select a minimum of 11 credits from the following:**

- ANS 323. Principles of Colt Training (3)  
 ANS 324. Advanced Colt Training (3)  
 ANS 401. Research (1–3)\*\*  
 or ANS 410. Animal Sciences Internship (1–3)\*\*  
 ANS 441. Topics in Animal Learning (2)  
 FW 475. Wildlife Behavior (4)  
 FW 481. Wildlife Ecology (4)  
 PSY 201. \*General Psychology (3)  
 PSY 202. \*General Psychology (3)  
 PSY 340. Cognition (3)  
 Z 438. Behavioral Neurobiology (3)  
 Z 453. Scientific Writing and Behavioral Observations (3)  
 Z 593. Behavioral Ecology (3)

\* 15 credits must be upper division.

\*\* Research and/or Internship courses must be taken in the field of Animal Behavior/Bioethics.

**ANIMAL PRODUCTS OPTION**

This option\* provides background for making decisions in the production and management of poultry, dairy cattle and meat animal enterprises, including beef cattle, sheep and swine. The option covers five areas of emphasis: basic sciences, animal sciences, crops, soils, and business. The requirements include the core curriculum and additional credits in consultation with the advisor.

\*15 credits must be upper division.

**BEEF OPTION**

This option\* provides background for making decisions in the production and management of beef cattle. The option covers five areas of emphasis: basic sciences, animal sciences, crops, soils, and business. The requirements include the core curriculum and additional credits in consultation with the advisor.

**Required**

- ANS 215. Beef/Dairy Industries (3)  
 ANS 231. Livestock Evaluation (2)  
 ANS 313. Applied Animal Nutrition: Feeds and Ration Formulation (4)  
 ANS 327. Applied Physiology of Reproduction (4)  
 ANS 443/ANS 543. Beef Production Systems: Cow/Calf (3)  
 ANS 444/ANS 544. Beef Production Systems: Stocker/Feedlot (3)  
 ANS 452. Livestock Housing and Waste Management (3)

**Select 8 credits from the following:**

- ANS 331. Adv. Livestock Evaluation (4)  
 ANS 405. Reading and Conference (2 credits each time)  
 ANS 411/ANS 511. Digestive Physiology and Nutrition of Ruminant Animals (4)  
 ANS 415. Livestock Judging Team (3)  
 ANS 445/ANS 545. Beef Production Systems: Steer-a-Year (3)  
 ANS 478/ANS 578. Animal Breeding and Genetics (3)

\*15 credits must be upper division.

**COMMUNICATION, LEADERSHIP, INDUSTRY, AND POLICY OPTION**

The CLIP (Communications, Leadership, Industry and Policy) option\* is for students looking for a communication/policy career path that is based in science. It serves the needs of students interested in careers in government, journalism, mass media, and natural resources. It can also facilitate third-year Pre-vet students searching for a different career path.

The courses below are in addition to the Animal Sciences Core courses.

**Writing/Communication (10)**

- COMM 280. Media Communication in the Information Age (3)  
 WR 201. \*Writing for Media (3) (Meets WR II BCC requirement)  
 WR 301. Reporting (4)  
 WR 448. Magazine Article Writing (3)

**Political Science—Select 12 credits from the following:**

- PS 201. \*Introduction to United States Government and Politics (4)

**Plus choose 8 credits from the following:**

- PS 371. Public Policy Problems (4)  
 PS 474. Natural Resource Policy and Bureaucratic Politics (4)  
 PS 475. Environmental Politics and Policy (4)  
 PS 476. \*Science and Politics (4)

**AREC Requirements—Select 9–10 credits from the following:**

- AREC 253. \*Evolution of U.S. Environmental and Natural Resources Law (4)  
 AREC 352. \*Environmental Economics and Policy (3)  
 AREC 353. Public Land Statutes and Policy (4)  
 AREC 453. Public Land and Resource Law (4)

**Miscellaneous (13)**

- FOR 365. \*Issues in Natural Resources Conservation (3)  
 FW 251. Principles of Fish and Wildlife Conservation (3)  
 RNG 241. Rangeland Ecology and Management (3)  
 RNG 442. Range-Animal Relations (4)

**Select one of the following ANS courses (6):**

*This choice will replace the upper-division production courses.*

- ANS 401. Senior Research (6)  
 or ANS 410. Animal Science Internship (6)

\*15 credits must be upper division.

**DAIRY OPTION****Required**

- ANS 215. Beef/Dairy Industries (3)  
 ANS 313. Applied Animal Nutrition: Feeds and Ration Formulation (4)  
 ANS 439/ANS 539. Dairy Production Systems (4)  
 ANS 452. Livestock Housing and Waste Management (3)  
 ANS 538. Biology of Lactation (3)  
 FST 212. Dairy Processing (2)  
 FST 213. Dairy Processing Lab (1)

**Select a minimum of 9 credits from the following:**

- ANS 327. Applied Physiology of Reproduction (5)  
 ANS 351. Advanced Principles of Animal Foods Technology (4)  
 ANS 405. Reading and Conference (Dairy Evaluation) (2)  
 ANS 410. Animal Science Internship (max. of 6 credits will count) (1–12)  
 ANS 411/ANS 511. Digestive Physiology and Nutrition of Ruminant Animals (4)  
 ANS 415. Livestock Judging Team (3)  
 ANS 440/ANS 540. Dairy Production Systems (3)  
 ANS 478/ANS 578. Animal Breeding and Genetics (3)  
 CSS 310. Forage Production (4)  
 CSS 315. ^Nutrient Management and Cycling (4)

**Total=29\***

\*15 credits must be upper division.

**EQUINE OPTION**

This option provides background for making decisions in the production and management of horses. The option covers five areas of emphasis: basic sciences, animal sciences, crops, soils, and business. The requirements include the core curriculum and additional credits in consultation with the advisor.

**Required**

- ANS 220. Introductory Horse Science (3)  
 ANS 313. Applied Animal Nutrition: Feeds and Ration Formulation (4)  
 ANS 430/ANS 530. Equine Systems I: Exercise Science (3)  
 ANS 431/ANS 531. Equine Systems II: Nutrition (3)

**Select two courses from the following:**

- ANS 192. Intermediate Horsemanship (1)  
 ANS 193. Dressage (1)  
 ANS 194. Jumping (1)  
 ANS 221. Equine Conformation and Performance (2)  
 ANS 295. Reining (1)  
 ANS 296. Advanced Jumping/Eventing (1)  
 ANS 297. Working Cowhorse (1)  
 ANS 323. Principles of Colt Training (3)  
 ANS 324. Advanced Colt Training (3)

**Select a minimum of 1–7 credits from the following:**

- ANS 223. Equine Marketing (2)  
 ANS 322. Equestrian Coaching (2)  
 ANS 327. Applied Physiology of Reproduction (5)  
 ANS 331. Adv. Livestock Evaluation (4)  
 ANS 333. Equine Stable Management (3)  
 ANS 410. Animal Science Internship (1–12) (max. of 6 credits will count)  
 RNG 241. Rangeland Ecology and Management (3)

**Total=27\***

\*15 credits must be upper division.

**POULTRY OPTION**

This option\* provides background for making decisions in the production and management of poultry. The option covers five areas of emphasis: basic sciences, animal sciences, crops, soils, and business. The requirements include the core curriculum and additional credits in consultation with the advisor.

**Required:**

ANS 217. Poultry Industries (3)  
ANS 433/ANS 533. Poultry Meat Production Systems (3)  
ANS 434/ANS 534. Egg Production Systems (3)

**Select 18 credits from the following:**

ANS 313. Applied Animal Nutrition: Feeds and Ration Formulation (4)  
ANS 321. Avian Embryo (4)  
ANS 351. Advanced Principles of Animal Food Technology (4)  
ANS 412/ANS 512. Monogastric and Poultry Nutrition (3)  
ANS 452. Livestock Housing and Waste Management (3)  
AREC 221. Marketing in Agriculture (3)  
BA 215. Money and Investment Management: Manager, Lender, Investor Viewpoint (4)  
ECON 201. \*Intro to Microeconomics (4)  
MB 302. General Microbiology (3)  
ST 351. Intro to Statistical Methods (4)

**Total=27\****\*15 credits must be upper division.***PRE-VETERINARY MEDICINE OPTION**

This option is designed for students interested in fulfilling requirements for admission to the OSU College of Veterinary Medicine. It allows students who are admitted to the college, upon completion of three years of undergraduate study, to apply credit earned during the first year of professional study toward the BS degree in Animal Sciences.

Students not admitted to veterinary school after completing the three-year program may complete additional requirements to qualify for the BS degree in Animal Sciences. The pre-veterinary medicine option is also offered for students preparing for professional careers in animal science teaching and research. More intense training is provided in the biological and physical sciences, offering an excellent foundation for graduate study. Requirements include the core curriculum and additional credits as required by the College of Veterinary Medicine.

In addition to the Animal Sciences core courses, students in the Pre-Veterinary Medicine option are required to take:

BB 450, BB 451. General Biochemistry (4,4)  
CH 331, CH 332, CH 337. Organic Chemistry (4,4,4)  
MB 302. General Microbiology (3)  
MB 303. General Microbiology Lab (2)

MTH 111. \*College Algebra (4)  
or MTH 112. \*Elementary Functions (4)  
**And** MTH 241. \*Calculus for Management and Social Science (4)  
or MTH 251. \*Differential Calculus (4)  
PH 201, PH 202, PH 203. \*General Physics (5,5,5)  
\* Baccalaureate core course

**SHEEP OPTION**

This option\* provides background for making decisions in the production and management of sheep. The option covers five areas of emphasis: basic sciences, animal sciences, crops, soils, and business. The requirements include the core curriculum and additional credits in consultation with the advisor.

**Required**

ANS 216. Sheep/Swine Industries (3)  
ANS 313. Applied Animal Nutrition: Feeds and Ration Formulation (4)  
ANS 327. Applied Physiology of Reproduction (5)  
ANS 436/ANS 536. Sheep Production Systems (3)  
ANS 478/ANS 578. Animal Breeding and Genetics (3)

**Select 11 credits from the following:**

ANS 411/ANS 511. Digestive Physiology and Nutrition of Ruminant Animals (4)  
ANS 452. Livestock Housing and Waste Management (3)  
ANS 490/ANS 590. Toxicants and Poisonous Plants (4)  
AREC 221. Marketing in Agriculture (3)  
CSS 310. Forage Production (4)  
RNG 241. Rangeland Ecology and Management (3)

**Total=27\****\*15 credits must be upper division.***ANIMAL SCIENCES MINOR****Required****Select a minimum of 12 credits from:**

ANS 121. \*Intro to Animal Sciences (4)  
ANS 192. Intermediate Horsemanship (1)  
ANS 193. Dressage (1)  
ANS 194. Jumping (1)  
ANS 215. Beef/Dairy Industries (3)  
ANS 216. Sheep/Swine Industries (3)  
ANS 217. Poultry Industries (3)  
ANS 220. Introductory Horse Science (3)  
ANS 221. Equine Conformation and Performance (2)  
ANS 223. Equine Marketing (2)  
ANS 231. Livestock Evaluation (2)  
ANS 251. Principles of Animal Food Technology (3)  
ANS 280. Companion Animal Management (3)  
ANS 295. Reining (1)  
ANS 296. Advanced Jumping/Eventing (1)  
ANS 297. Working Cowhorse (1)

**And select a minimum of 15 credits from:**

ANS 311. Principles of Animal Nutrition (3)  
ANS 313. Applied Animal Nutrition: Feeds and Ration Formulation (4)  
ANS 314. Animal Physiology (4)

ANS 315. \*Contentious Social Issues in Animal Agriculture (3)  
ANS 316. Reproduction in Domestic Animals (4)  
ANS 317. Reproduction in Domestic Animals Laboratory (1)  
ANS 321. Avian Embryo (4)  
ANS 322. Equestrian Coaching (2)  
ANS 323. Principles of Colt Training (3)  
ANS 324. Advanced Colt Training (3)  
ANS 327. Applied Physiology of Reproduction (5)  
ANS 331. Advanced Livestock Evaluation (4)  
ANS 333. Equine Stable Management (3)  
ANS 351. Advanced Principles of Animal Foods Technology (4)  
ANS 378. Animal Genetics (4)  
ANS 401. Research (1-16)  
ANS 405. Reading and Conference (1-16)  
ANS 410. Animal Sciences Internship (1-12)  
ANS 411. Digestive Physiology and Nutrition of Ruminant Animals (4)  
ANS 413. Comparative Nutrition of Domestic and Wild Animals (3)  
ANS 412. Monogastric and Poultry Nutrition (3)  
ANS 415. Livestock Judging Team (3)  
ANS 430. Equine Systems I: Exercise Science (3)  
ANS 431. Equine Systems II: Nutrition (3)  
ANS 433. Poultry Meat Production Systems (3)  
ANS 434. Egg Production Systems (3)  
ANS 435. Applied Animal Behavior (3)  
ANS 436. Sheep Production Systems (3)  
ANS 439. Dairy Production Systems (4)  
ANS 440. Dairy Production Systems (3)  
ANS 443. Beef Production Systems: Cow/Calf (3)  
ANS 444. Beef Production Systems: Stocker/Feedlot (3)  
ANS 445. Beef Production Systems: Steer-a-Year (3)  
ANS 453. Practical Broiler Production (1-3)  
ANS 465. Foodborne Disease (3)  
ANS 478. Animal Breeding and Genetics (3)  
ANS 480. Animal Growth (3)  
ANS 485. \*Consensus and Natural Resources Issues (3)  
ANS 490. Toxicants and Poisonous Plants (4)

**Total=27-28**

**Note:** These courses should be taken in consultation with an academic advisor in the Department of Animal Sciences.

**EQUINE MINOR**

ANS 121. \*Intro to Animal Sciences (4)  
ANS 220. Introductory Horse Science (3)

**Select two of the following three courses:**

ANS 430. Equine Systems I: Exercise Science (3)  
ANS 431. Equine Systems II: Nutrition (3)  
ANS 432. Equine Systems III: Reproduction (4)

**Select two courses from the following:**

ANS 192. Intermediate Horsemanship (1)  
ANS 193. Dressage (1)  
ANS 194. Jumping (1)  
ANS 295. Reining (1)

ANS 297. Working Cowhorse (1)  
ANS 323. Principles of Colt Training (3)  
ANS 324. Advanced Colt Training (3)

**Select a minimum of 7–10 credits from the following:**

ANS 221. Equine Conformation and Performance (2)  
ANS 223. Equine Marketing (2)  
ANS 313. Applied Animal Nutrition: Feeds and Ration Formulation (4)  
ANS 322. Equestrian Coaching (2)  
ANS 331. Advanced Livestock Evaluation (4)  
ANS 333. Equine Stable Management (3)  
ANS 415. Livestock Judging Team (3)

**Total=28–30**

*\*15 credits must be upper division.*

**ANIMAL SCIENCE  
(MAG, MS, PhD)**

**Graduate Areas of Concentration**

*Animal genetics, animal nutrition, dairy production (MS only), embryo physiology, endocrinology, growth and development, livestock management (MS only), nutritional biochemistry, reproductive physiology*

The Department of Animal Sciences offers graduate work leading to a Master of Science degree with emphasis in livestock, dairy, or poultry management. Master of Science and Doctor of Philosophy degrees are offered in Animal Science or Poultry Science with emphasis in nutrition, reproductive physiology, breeding/genetics, or growth and development.

**POULTRY SCIENCE  
(MAG, MS, PhD)**

**Graduate Areas of Concentration**  
*Poultry genetics, management (MS only), nutrition, reproductive physiology*

The Department of Animal Sciences offers graduate work leading to a Master of Science degree with emphasis in livestock, dairy, or poultry management. Master of Science and Doctor of Philosophy degrees are offered in Animal Science or Poultry Science with emphasis in nutrition, reproductive physiology, breeding/genetics, or growth and development.

**ANIMAL SCIENCE  
GRADUATE MINOR**

For more details, see the departmental advisor.

**POULTRY SCIENCE  
GRADUATE MINOR**

For more details, see the departmental advisor.

**COURSES**

**ANS 100. ORIENTATION TO ANIMAL SCIENCES (2).** Orientation of incoming animal sciences students to college life with emphasis on faculty, facilities, services and curricula of the Department of Animal Sciences.

**ANS 121. \*INTRODUCTION TO ANIMAL SCIENCES (4).** Principles of breeding, physiology, nutrition, and management as they apply to modern livestock and poultry production. Lec/lab. (Bacc Core Course)

**ANS 191. INTRODUCTION TO HORSEMANSHIP (1).** Designed for beginning riders or those wishing to improve their basic skills. Offers an introduction to the basic Western or English (separate sections) riding position and control of the horse at the walk, trot, and lope/canter. Upon completion of the course, the student will be familiar with handling and leading a horse, grooming, tacking-up and riding simple school figures in an indoor arena. Instructors for this course will be OSU-certified coaching students or graduates. May be repeated.

**ANS 192. INTERMEDIATE HORSEMANSHIP (1).** Designed for beginning riders who can comfortably walk, trot and canter on a trained horse. It offers a review of the basics, and opportunity to improve a rider's position and control at the trot and canter, either English or Western (Separate sections). Upon completion of the course, the student will be a more effective rider at all three gaits. This course is recommended for riders who have NOT had formal instruction or who are making a transition from the Western to English style of riding. Instructors for this course will be OSU-certified coaching students or graduates. May be repeated. **PREREQS:** ANS 191 or equivalent.

**ANS 193. DRESSAGE (1).** Designed for riders who have taken Beginner Riding I and II (or the equivalent) and are interested in discovering and/or pursuing the art of dressage. Riders will be gently introduced to the terminology and techniques of dressage training through second level with ample demonstrations and hands-on experience. Upon completion of the course, riders will feel competent in riding a training level test for competition. May be repeated. **PREREQS:** ANS 192 or equivalent.

**ANS 194. JUMPING (1).** Designed for riders who have taken ANS 193 (or the equivalent) and are interested in learning control of the horse over fences. Riders will be coached through several exercises designed to improve their ability to establish pace, rhythm and balance, adjust stride, and direct and control the horse over trotting and cantering poles, gymnastics, single fences, combinations, and an eight-fence hunter course. Aspects of course design will also be covered for interested students. May be repeated. **PREREQS:** ANS 193 or equivalent. Departmental approval.

**ANS 207. SOPHOMORE SEMINAR (1).** Examination of career opportunities in animal sciences. **PREREQS:** Sophomore standing.

**ANS 215. BEEF/DAIRY INDUSTRIES (3).** Introduction to beef and dairy industries; history, current industry status, and demonstration and practice of basic husbandry skills. **PREREQS:** ANS 121.

**ANS 216. SHEEP/SWINE INDUSTRIES (3).** Introduction to the sheep and swine industries including history, current status and production practices, with demonstration and hands-on experience of basic husbandry practices. **PREREQS:** ANS 121.

**ANS 217. POULTRY INDUSTRIES (3).** Familiarization of the organizational structure and marketing arrangement of poultry industries; hands-on managerial techniques, practices and procedures carried out by the poultry industries.

**ANS 220. INTRODUCTORY HORSE SCIENCE (3).** Introduction to horses, their history, breeds, form and function, performance evaluation, current industry status, and general management. **PREREQS:** ANS 121.

**ANS 221. EQUINE CONFORMATION AND PERFORMANCE (2).** Students will learn systems of evaluating conformation and for judging current horse show disciplines typically

featured in intercollegiate horse judging contests. Emphasis will be on the stock-type (AQHA) halter and performance classes. Students will learn to place classes objectively and give written and oral justifications of their judgements.

**ANS 223. EQUINE MARKETING (2).** Course covers practical concepts of equine marketing. Emphasis on market assessment, targeting buyers, marketing and advertising strategies, hands-on experience in product preparation and presentation, marketing legalities. **PREREQS:** ANS 121 and ANS 220, also ANS 192 or instructor approval required.

**ANS 230. DAIRY CATTLE EVALUATION (3).** Phenotypic evaluation of dairy cattle in relation to the productive life of the animals as well as efficiency and the economic impact on dairy producers. Labs consist of students spending time cow-side evaluating animals via knowledge gained from lectures. Cow anatomy will be mastered, value of type traits will be learned, differentiation of the dairy breeds will be understood, and oral presentation skills honed. \$20 course fee assessed. **PREREQS:** ANS 121 and ANS 215 are recommended.

**ANS 231. LIVESTOCK EVALUATION (2).** Visual appraisal of market and breeding classes of beef cattle, sheep, and swine. Live animal and carcass comparisons. **PREREQS:** ANS 121.

**ANS 251. PRINCIPLES OF ANIMAL FOODS TECHNOLOGY (3).** Processing of meat, milk and eggs into human food products. Lec/lab. **PREREQS:** ANS 121.

**ANS 280. COMPANION ANIMAL MANAGEMENT (3).** Care and management of companion animals, including dogs, cats, small mammals, reptiles, birds, and tropical fish. Responsibilities of pet ownership and the beneficial aspects of the human-animal relationship.

**ANS 295. REINING (1).** Reining will give the advanced rider the technical and theoretical knowledge of training reining horses in the stock seat style of riding. Focus will be on preparation and execution of the reining maneuvers. **PREREQS:** ANS 192 or instructor's approval.

**ANS 296. ADVANCED JUMPING/EVENTING (1).** Advanced jumping/eventing will introduce and practice training methods, conditioning, preparation, and skill building in the areas of dressage, jumping, and eventing (as weather permits). **PREREQS:** ANS 194 or instructor's approval.

**ANS 297. WORKING COWHORSE (1).** Working Cowhorse will give the advanced rider the technical and theoretical knowledge of starting and training colts on cattle. **PREREQS:** ANS 295 or instructor's approval.

**ANS 311. PRINCIPLES OF ANIMAL NUTRITION (3).** Classification, digestion, absorption, and metabolism of nutrients in animals; consequences of nutritional deficiencies and toxicities. **PREREQS:** BI 211 and BI 212, ANS 313.

**ANS 312. FEEDSTUFFS AND RATION FORMULATION (4).** Presents the feedstuffs utilized by domestic animals including their characteristics and processing. Provides instruction in ration formulation and evaluation leading to development of the basic skills required to formulate and evaluate rations for domestic animals. Taught as a distance education course. **PREREQS:** ANS 121, MTH 111 or equivalent or instructor approval.

**ANS 313. APPLIED ANIMAL NUTRITION: FEEDS AND RATION FORMULATION (4).** Discusses topics relevant to feedstuff identification and nutrient analysis, feed processing and formulation of balanced animal diets based on nutrient requirements. Provides students hands-on experiences in identifying various feedstuffs and formulating rations based on the nutrient composition of those feedstuffs. **PREREQS:** Junior standing, ANS 121 and ANS 311

recommended but not required.

**ANS 314. ANIMAL PHYSIOLOGY (4).** Biological basis of animal performance; describes how networks of cells act cooperatively to enable locomotion, provide a stable internal environment, allocate resources, remove metabolic end-products, and counteract microorganisms. **PREREQS:** General biology and sophomore standing or higher.

**ANS 315. \*CONTENTIOUS SOCIAL ISSUES IN ANIMAL AGRICULTURE (3).** Discussion of contentious issues including role of animal products and human health; use of hormones and antibodies; new animal biotechnologies; animal rights/welfare; livestock grazing on public lands. (Bacc Core Course).

**ANS 316. REPRODUCTION IN DOMESTIC ANIMALS (4).** Anatomy and physiology of mammalian and avian reproductive systems; fertilization, embryonic and fetal development, placentation and parturition; reproductive technologies. Lec/rec. **PREREQS:** (BI 211 or BI 211H) and (CH 121 or CH 221), ANS 121 or CH 221, sophomore standing or higher.

**ANS 317. REPRODUCTION IN DOMESTIC ANIMALS LABORATORY (1).** Gross and microscopic anatomy of the reproductive tract; semen collection, evaluation and extension; evaluation of fertilization, embryo and fetal development and placentation. Lec/lab. **PREREQS:** ANS 316\*

**ANS 321. AVIAN EMBRYO (4).** Discussion and experimentation involving the development and the environmental requirements for the artificial incubation of avian embryos. Lec/lab. Offered even-numbered years. **PREREQS:** ANS 121, ANS 217, BI 211.

**ANS 322. EQUESTRIAN COACHING (2).** Practical development of coaching skills with novice to intermediate English/Western riders. Emphasis on knowledge of basic riding principles and stable management skills, teaching ability and sport safety. Students required to enroll in a 1-credit internship program the following term for advanced teaching experience. **PREREQS:** ANS 193, ANS 194, ANS 221.

**ANS 323. PRINCIPLES OF COLT TRAINING (3).** Students acquire the technical and theoretical knowledge of starting and training colts in the stock seat style of riding. **PREREQS:** ANS 295 or instructor's approval. Departmental approval.

**ANS 324. ADVANCED COLT TRAINING (3).** Students acquire the technical and theoretical knowledge of advancing the training of young horses in the stock seat style of riding. Lec/lab. **PREREQS:** ANS 295 and ANS 323 or instructor approval required.

**ANS 327. APPLIED PHYSIOLOGY OF REPRODUCTION (5).** Principles, techniques and recent development in semen collection, evaluation, extension and preservation; artificial insemination, estrus detection and synchronization; pregnancy diagnosis and embryo transfer. **PREREQS:** ANS 316 and ANS 317

**ANS 331. ADVANCED LIVESTOCK EVALUATION (4).** Aspects of an individual animal's economic merit are compared to a sample group. Emphasis is placed on beef, swine and sheep. Visual appraisal, performance data and carcass merit are stressed. Designed to prepare students for the intercollegiate livestock judging team. **PREREQS:** ANS 231, sophomore standing or higher.

**ANS 333. EQUINE STABLE MANAGEMENT (3).** Discusses developing a business plan, financial statements, and ratios, budgeting, financial planning, taxation, and employment issues within the current equine industry. **PREREQS:** ANS 220, ANS 222, or instructor's approval.

**ANS 351. ADVANCED PRINCIPLES OF ANIMAL FOODS TECHNOLOGY (4).** Provides in-depth coverage of both fresh and processed meats

and eggs into products suitable for human consumption. **PREREQS:** ANS 251.

**ANS 378. ANIMAL GENETICS (4).** Fundamentals of inheritance, principles of genetic segregation, population and quantitative genetics, response to natural selection and artificial manipulation of populations. **PREREQS:** ANS 121, BI 211, BI 212, BI 213, ST 351 or equivalent.

**ANS 401. RESEARCH (1-16).** Graded P/N. **PREREQS:** Departmental approval required.

**ANS 403. THESIS (1-16).** **PREREQS:** Departmental approval required.

**ANS 405. READING AND CONFERENCE (1-16).** Graded P/N. **PREREQS:** Departmental approval required.

**ANS 407. SEMINAR (1-17).** Graded P/N.

**ANS 410. ANIMAL SCIENCE INTERNSHIP (1-12).** On- or off-campus, occupational work experience supervised by the department. Graded P/N. **PREREQS:** Departmental approval required.

**ANS 411. DIGESTIVE PHYSIOLOGY AND NUTRITION OF RUMINANT ANIMALS (4).** Anatomy and physiology of the ruminant digestive tract including rumen microbiology and digestive processes. Nutritional biochemistry and physiology of ruminants. Feed chemistry, feed intake and principles of ration balancing. Theory of energy and protein metabolism. **PREREQS:** ANS 311 or ANS 313.

**ANS 412. MONOGASTRIC AND POULTRY NUTRITION (3).** Anatomical differences in digestive tracts of monogastrics; nutritional biochemistry of poultry; practical feeding of avian species; least-cost ration techniques; techniques for determining nutrient needs of monogastrics. **PREREQS:** ANS 311 and 313.

**ANS 413. COMPARATIVE NUTRITION OF DOMESTIC AND WILD ANIMALS (3).** A comprehensive discussion of comparative similarities and differences in nutrient digestion and metabolism of domestic and wild animals. Herbivores such as ruminants and hindgut fermentors will be emphasized, as will mammalian and avian carnivorous species. Emphasis will be on protein, carbohydrate and lipid metabolism, with other topics selected from the syllabus in accordance with student interest in a particular year. Student course fee: \$10. **PREREQS:** Junior or senior status and CH 331 required. An introduction to biochemistry is recommended but not required.

**ANS 415. LIVESTOCK JUDGING TEAM (3).** Designed to train students for participation in the intercollegiate livestock judging team. **PREREQS:** ANS 331.

**ANS 420. ^ETHICAL ISSUES IN ANIMAL AGRICULTURE (3).** Students are provided with an opportunity to discuss, debate and write extensively about current, relevant, and controversial social issues dealing with modern animal agriculture. (Writing Intensive Course)

**ANS 421X. CONTEMPORARY ISSUES IN ANIMAL AGRICULTURE (3).** Focuses on contributions of domestic animals to human welfare; animal products in the human diet; societal concerns (food safety, health aspects of consumption of animal products, environmental issues); industrial animal production; and the future of animal agriculture. \$10 course fee will be assessed. **PREREQS:** ANS majors only. ANS 121 and ANS 315 recommended.

**ANS 430. EQUINE SYSTEMS I: EXERCISE SCIENCE (3).** Seniors and graduate students intensively explore and apply science to real-life situations regarding cardiorespiratory, muscle physiology, and bone physiology responses to exercise, climate, and altitude. **PREREQS:** ANS 314.

**ANS 431. EQUINE SYSTEMS II: NUTRITION (3).** Senior and graduate students intensively explore and apply science to real-life situations regarding

starch, fiber, protein, and fat metabolism in performance horses, breeding stock, and growing horses. **PREREQS:** ANS 313.

**ANS 432. EQUINE SYSTEMS III: REPRODUCTION (4).** Senior and graduate students explore the fundamentals of equine reproduction and their application in horse breeding. Includes practical training of laboratory techniques. Lec/lab. **PREREQS:** ANS 220 and ANS 316, ANS 327.

**ANS 433. POULTRY MEAT PRODUCTION SYSTEMS (3).** Fundamental applications and the analysis of management principles applied to brooding, rearing, feeding and housing meat-type chickens and turkeys and their respective breeders. Decision case studies and practical management problems are incorporated into the course. Offered odd number years. **PREREQS:** ANS 217, ANS 313, ANS 316, ANS 378 or instructor's approval.

**ANS 434. EGG PRODUCTION SYSTEMS (3).** Applications and analyses of egg production systems for brooding, rearing, feeding and housing egg producing chickens. Decision case studies and practical management problems are incorporated into the course. Offered even-numbered years. **PREREQS:** ANS 217, ANS 313, ANS 316, ANS 378 or instructor's approval.

**ANS 435. APPLIED ANIMAL BEHAVIOR (3).** Exploration of the fundamental processes of animal behavior and implications for animal management, production, housing and welfare. Examples provided in class will cover a range of species, with emphasis on domestic animals. Lec/lab. **PREREQS:** ANS 314, BI 350 or Z 350 or equivalent.

**ANS 436. SHEEP PRODUCTION SYSTEMS (3).** Integration of nutrition, genetics, reproduction, behavior, and health principles into management systems for production and marketing of lamb and wool. **PREREQS:** ANS 216, ANS 311, ANS 316, ANS 378.

**ANS 438. EXPLORING WORLD AGRICULTURE (2).** Survey of crop and livestock production in a designated section of the world, including history, culture, and political situation. Course is designed to prepare students for a tour of study area. CROSSLISTED as AREC 438, CSS 438, HORT 438. Graded P/N.

**ANS 439. DAIRY PRODUCTION SYSTEMS (4).** Fundamentals of nutrition, breeding, reproductive physiology and health programs and their applications in the care and management of dairy cattle. **PREREQS:** ANS 215, ANS 313, ANS 316, ANS 378.

**ANS 440. DAIRY PRODUCTION SYSTEMS (3).** Decision case analysis or special topics in application of dairy management principles. **PREREQS:** ANS 215, ANS 313, ANS 316, ANS 378.

**ANS 441. TOPICS IN ANIMAL LEARNING (2).** Studies of animals' cognitive abilities have revealed a broad spectrum of learning capabilities in various species. Covers fundamental concepts associated with animal learning and cognition; the focus is on types of learning demonstrated by various animals and challenges associated with designing animal cognition experiments. Readings will cover a range of species. **PREREQS:** Junior standing.

**ANS 443. BEEF PRODUCTION SYSTEMS: COW/CALF (3).** Fundamentals of nutrition, reproductive physiology and health programs and their applications in the care and management of beef cattle. Overnight field trip with extra fee charged. Lec/lab. **PREREQS:** ANS 313, ANS 315, ANS 316, ANS 378.

**ANS 444. BEEF PRODUCTION SYSTEMS: STOCKER/FEEDLOT (3).** Continuation of the study of beef cattle management. Students will practice decision-making processes using area beef cattle operations as case studies. Overnight

field trip with extra fee charged. **PREREQS:** ANS 443/ANS 543.

**ANS 445. BEEF PRODUCTION SYSTEMS: STEER-A-YEAR (3).** Discussion of the feedlot industry including the types of operations, nutrition, management, diseases, parasites and marketing. Practical feedlot management decisions are made by the students through the Steer-A-Year project. Overnight field trip with extra fee charged. **PREREQS:** ANS 444\* or ANS 544\* or instructor approval required.

**ANS 452. LIVESTOCK HOUSING AND WASTE MANAGEMENT (3).** Basics in where, how, and why one would build, insulate, and ventilate livestock buildings. Manure and wastewater collection, treatment, storage, and utilization.

**ANS 453. PRACTICAL BROILER PRODUCTION (1-3).** Students will be considered the growers and will be required to provide the management of the flock. The instructor will act the field supervisor, making suggestions for management changes if the student growers do not make timely adjustments. Students will be closely involved with the day-to-day responsibilities of broiler production, in a system virtually identical to that used in the commercial industry nationwide. They will be determining management, including ventilation, temperature, lighting, water, and feed availability. Attendance in the form of two visits per day (weekends included) is a major component of the class. All decisions on management are under the indirect supervision of the instructor. **PREREQS:** Instructor approval required.

**ANS 465. FOODBORNE DISEASE (3).** Examines ways pathogenic bacteria can enter the human diet via animal products, discusses rationale for the limitations of government meat inspection, explains disease symptoms in terms of intestinal physiology, and discusses food processing technology and food handling techniques that serve to minimize the risk of infection.

**ANS 478. ANIMAL BREEDING AND GENETICS (3).** Application of genetic principles to selection and improvement of livestock. Topics include breeding value and heritability estimation, mating systems and selection strategies. Emphasis on quantitative traits of importance in domestic livestock. **PREREQS:** ANS 378.

**ANS 480. ANIMAL GROWTH (3).** A discussion and analysis of growth and development of skeletal, muscle and adipose tissue in the domestic meat animal. Topics include synthesis and degradation (turnover) of skeletal muscle, adipose tissue, and factors regulating these processes. In addition, biotechnological applications to modulate growth will be discussed. **PREREQS:** ANS 311, or ANS 411/ANS 511 and ANS 314, junior standing or higher.

**ANS 485. \*CONSENSUS AND NATURAL RESOURCES (3).** Students will use a working group approach. They will select a natural resource topic, study the team process and interaction as a method of learning, explore the issue using systems practice, and strive for consensus on solutions to their issue. **CROSSLISTED** as FW 485/FW 585, FOR 485, FW 485/FW 585, SOC 485/SOC 585. (Bacc Core Course)

**ANS 490. TOXICANTS AND POISONOUS PLANTS (4).** Natural toxicants and their biological effects, metabolism of toxicants, impacts of toxicants on livestock production, and consideration of the chemical structure, plant sources, toxicity problems, metabolism and metabolic effects, toxicity signs, and prevention of toxicoses. **PREREQS:** ANS 313.

**ANS 501. RESEARCH (1-16).** Graded P/N. **PREREQS:** Departmental approval required.

**ANS 503. THESIS (1-12).** Graded P/N.

**ANS 505. READING AND CONFERENCE (1-16).** Graded P/N. **PREREQS:** Departmental approval required.

**ANS 507. GRADUATE SEMINAR (1).** Section 1: Seminar/general for all graduate students. Preparation of effective visual aids. Practice explaining the validity or significance of experimental results to an informed audience. Section 2: Seminar/endocrinology, for graduate students interested in physiology.

**ANS 511. DIGESTIVE PHYSIOLOGY AND NUTRITION OF RUMINANT ANIMALS (4).** Anatomy and physiology of the ruminant digestive tract including rumen microbiology and digestive processes. Nutritional biochemistry and physiology of ruminants. Feed chemistry, feed intake and principles of ration balancing. Theory of energy and protein metabolism. **PREREQS:** ANS 311 or ANS 313.

**ANS 512. MONOGASTRIC AND POULTRY NUTRITION (3).** Anatomical differences in digestive tracts of monogastrics; nutritional biochemistry of poultry; practical feeding of avian species; least-cost ration techniques; techniques for determining nutrient needs of monogastrics. **PREREQS:** ANS 311 and ANS 313.

**ANS 515. REVIEW OF APPLIED RUMINANT NUTRITION RESEARCH TECHNIQUES (3).** Review and discussion and applied techniques and methodology used for ruminant nutrition research.

**ANS 530. EQUINE SYSTEMS I: EXERCISE SCIENCE (3).** Senior and graduate students intensively explore and apply science to real-life situations regarding cardiorespiratory, muscle physiology, and bone physiology responses to exercise, climate, and altitude. **PREREQS:** ANS 314.

**ANS 531. EQUINE SYSTEMS II: NUTRITION (3).** Senior and graduate students intensively explore and apply science to real-life situations regarding starch, fiber, protein, and fat metabolism in performance horses, breeding stock, and growing horses. **PREREQS:** ANS 313.

**ANS 532. EQUINE SYSTEMS III: REPRODUCTION (4).** Designed for seniors and graduate students to explore the fundamentals of equine reproduction and their application in horse breeding. Includes practical training in laboratory techniques. Lec/lab. **PREREQS:** ANS 220, ANS 316, and ANS 327.

**ANS 533. POULTRY MEAT PRODUCTION SYSTEMS (3).** Fundamental applications and the analysis of management principles applied to brooding, rearing, feeding and housing meat-type chickens and turkeys and their respective breeders. Decision case studies and practical management problems are incorporated into the course. Offered odd number years. **PREREQS:** ANS 217, ANS 313, ANS 316, ANS 378 or instructor's approval.

**ANS 534. EGG PRODUCTION SYSTEMS (3).** Applications and analyses of egg production systems for brooding, rearing, feeding and housing egg producing chickens. Decision case studies and practical management problems are incorporated into the course. Offered even-numbered years. **PREREQS:** ANS 217, ANS 313, ANS 316, ANS 378 or instructor's approval.

**ANS 535. APPLIED ANIMAL BEHAVIOR (3).** Exploration of the fundamental processes of animal behavior and implications for animal management, production, housing and welfare. Examples provided in class will cover a range of species, with emphasis on domestic animals. Lec/lab. **PREREQS:** BI 350 or Z 350 or ANS 314 or equivalent.

**ANS 536. SHEEP PRODUCTION SYSTEMS (3).** Integration of nutrition, genetics, reproduction, behavior, and health principles into management systems for production and marketing of lamb and wool. **PREREQS:** ANS 216, ANS 311, ANS 316, ANS 378.

**ANS 538. BIOLOGY OF LACTATION (3).** Physiological and environmental factors affecting

mammary gland development and function. Offered alternate years. **PREREQS:** Z 431/Z 531.

**ANS 539. DAIRY PRODUCTION SYSTEMS (4).** Fundamentals of nutrition, breeding, reproductive physiology and health programs and their applications in the care and management of dairy cattle. **PREREQS:** ANS 215, ANS 313, ANS 316, ANS 378.

**ANS 540. DAIRY PRODUCTION SYSTEMS (3).** Decision case analysis or special topics in application of dairy management principles. **PREREQS:** ANS 215, ANS 313, ANS 316, ANS 378.

**ANS 541. TOPICS IN ANIMAL LEARNING (2).** Studies of animal's cognitive abilities have revealed a broad spectrum of learning capabilities in various species. This course covers fundamental concepts associated with animal learning and cognition; the focus is on types of learning demonstrated by various animals and challenges associated with designing animal cognition experiments. Readings will cover a range of species. **PREREQS:** Junior standing.

**ANS 543. BEEF PRODUCTION SYSTEMS: COW/CALF (3).** Fundamentals of nutrition, reproductive physiology and health programs and their applications in the care and management of beef cattle. Overnight field trip with extra fee charged. Lec/lab. **PREREQS:** ANS 315, ANS 313, ANS 316, ANS 378.

**ANS 544. BEEF PRODUCTION SYSTEMS: STOCKER/FEEDLOT (3).** Continuation of the study of beef cattle management. Students will practice decision-making processes using area beef cattle operations as case studies. Overnight field trip with extra fee charged. **PREREQS:** ANS 443/ANS 543.

**ANS 545. BEEF PRODUCTION SYSTEMS: STEER-A-YEAR (3).** Discussion of the feedlot industry including the types of operations, nutrition, management, diseases, parasites and marketing. Practical feedlot management decisions are made by the students through the Steer-A-Year project. Overnight field trip with extra fee charged. **PREREQS:** ANS 444/ANS 544 or instructor approval required.

**ANS 552. LIVESTOCK HOUSING AND WASTE MANAGEMENT (3).** Basics in where, how, and why one would build, insulate, and ventilate livestock buildings. Manure and wastewater collection, treatment, storage, and utilization. Offered alternate years.

**ANS 560. LIPID METABOLISM (3).** Digestion, absorption and metabolism of lipids with emphasis on lipoprotein metabolism, regulation of lipid metabolism in various tissues and metabolism of eicosanoids. Offered alternate years. **CROSSLISTED** as NFM 560. **PREREQS:** BB 452, BB 492 or equivalent.

**ANS 578. ANIMAL BREEDING AND GENETICS (3).** Application of genetic principles to selection and improvement of livestock. Topics include breeding value and heritability estimation, mating systems and selection strategies. Emphasis on quantitative traits of importance in domestic livestock. **PREREQS:** ANS 378.

**ANS 580. ANIMAL GROWTH (3).** A discussion and analysis of growth and development of skeletal, muscle and adipose tissue in the domestic meat animal. Topics include synthesis and degradation (turnover) of skeletal muscle, adipose tissue, and factors regulating these processes. In addition, biotechnological applications to modulate growth will be discussed. **PREREQS:** ANS 311, or ANS 411/ANS 511 and ANS 314, junior standing or higher.

**ANS 585. CONSENSUS AND NATURAL RESOURCES (3).** Students will use a working group approach. They will select a natural resource topic, study the team process and interaction as a method of learning, explore the issue using systems practice, and strive

for consensus on solutions to their issue. CROSSLISTED as FW 485/FW 585, FOR 485, FW 485/FW 585, SOC 485/SOC 585

**ANS 590. TOXICANTS AND POISONOUS PLANTS (4).** Natural toxicants and their biological effects, metabolism of toxicants, impacts of toxicants on livestock production, and consideration of the chemical structure, plant sources, toxicity problems, metabolism and metabolic effects, toxicity signs, and prevention of toxicoses. **PREREQS:** ANS 313.

**ANS 601. RESEARCH (1-16).** Graded P/N. **PREREQS:** Departmental approval required.

**ANS 603. THESIS (1-16).**

**ANS 605. READING AND CONFERENCE (1-16).** **PREREQS:** Departmental approval required.

**ANS 606. PROJECTS (1-16).**

**ANS 607. GRADUATE SEMINAR (1).**

**ANS 662. HORMONE ACTION (3).** Mechanisms of action of peptide and steroid hormones and related compounds at the cellular level. Offered alternate years. CROSSLISTED as BB 662. **PREREQS:** BB 452/BB 552 or BB 492/BB 592 or equivalent.

**ANS 673. BIOLOGY OF MAMMALIAN REPRODUCTION (4).** Physiological, neuroendocrine, endocrine and environmental factors that regulate reproduction of mammals. Offered alternate years. Offered 2005-06. **PREREQS:** ANS 316 or equivalent; BB 350.

## BIOENGINEERING

See the College of Engineering.

## BIORESOURCE RESEARCH

See the complete description under Interdisciplinary Studies.

## BOTANY AND PLANT PATHOLOGY

See College of Science.

## CROP AND SOIL SCIENCE

**Russ Karow, Head**

107 Crop Science  
3017 Ag and Life Sciences  
Oregon State University  
Corvallis, OR 97331  
541-737-2821 and 541-737-2441  
E-mail: russell.s.karow@oregonstate.edu  
Website: <http://cropandsoil.oregonstate.edu>

### FACULTY

**Professors** Aldrich-Markham, Ball, Bottomley, Butler, Fisher, D. Hannaway, Hart, Hayes, Jensen, Karow, Kling (sr. research), Macnab, Mallory-Smith, Mellbye, Myrold, Peterson, Petrie, Shock, Tuck, Young

**Associate Professors** Baham, Bohle, Chastain, Corp, Dragila, Horneck, Huber, Kiemnec, Lutcher, Machado, Noller, Parke (sr. research), Rao, Riera-Lizarazu, Roseberg, Ross, Schruppf (retired, part-time appointment), Stephenson, Sullivan, Vales, Walenta, Wysocki  
**Assistant Professors** Angima, Duggan, Elias (sr. research), Felix,

Flowers, Hulting, Kleber, Motazedian (fixed term), Nonogaki, Norberg, Rendon, Silberstein

**Senior Instructors** Lundeen, McMorran

**Instructors** Burr, Cassidy, Fery, Hane, K. Hannaway, Knight, Maley, Shafabakhsh, S. Smith, Verhoeven, Zielinski

### COURTESY FACULTY

**Professors** Albrecht, Barker, Brilman, Brown, Griffith, Haunold, Knapp, Metzger, Olszyk

**Associate Professors** Mueller-Warrant, Henning

**Assistant Professors** Clausnitzer, M. Johnson, M. Rogers, Weisbrod

**Instructors** Darris

### PROFESSIONAL FACULTY

Curry, Garay

### Undergraduate Major

#### Crop and Soil Science (BS)

##### Options

*Crop Management*

*Soil Resource Management*

### Minors

Crop Science

Soil Science

### Graduate Majors

#### Crop Science (MS, PhD)

##### Graduate Areas of Concentration

*Crop Breeding, Genetics and Cytogenetics (cereals, grasses, oilseeds)*

*Crop Physiology and Biochemistry*

*Forage and Pasture Management*

*Grain Crop Production*

*New Crop Development*

*Post-Harvest Seed Technology*

*Potato Production*

*Seed Biology*

*Seed Crop Physiology*

*Seed Production*

*Weed Biology*

*Weed Management*

#### Soil Science (MS, PhD)

##### Graduate Areas of Concentration

*Environmental Soil Science*

*Forest Soils*

*Nutrient Cycling*

*Soil Geochemistry*

*Soil Conservation and Land Use*

*Soil Fertility and Plant Nutrition*

*Soil Genesis and Classification*

*Soil Microbiology*

*Soil Physics*

#### Water Resources Science (MS, PhD)

(See *Interdisciplinary Studies*)

### Graduate Minors

Crop Science

Soil Science

The discipline of crop science provides the knowledge and understanding for technologies that contribute directly to improvements in production and quality of food, feed, fiber, seed, energy, and nutraceutical crops for the world. The art and science of plant improvement are key elements in efforts to feed, clothe and provide energy for the world's ever-growing population. Conventional and molecular tools assist in the development of new genetic strains of food and energy crops. Crop plants play an important role in the future of sustainable food and energy production.

The discipline of soil science provides the basic understanding of the physical, chemical, and biological properties of this important natural resource. Why is soil important? Soil is the fundamental substrate for life on terrestrial landscapes. Soil plays a vital role in sustaining human welfare and assuring future agricultural productivity and environmental stability. An understanding of global and local ecology depends on an awareness of the soil and its properties. Global information and mapping systems are essential tools for characterizing the landscape and its constituent soils.

Agronomists are crop and soil scientists who work to improve crops and agricultural productivity while effectively managing pests and weeds. Students in crop and soil science explore important contemporary issues faced by our society, including water quality and management, sustainability of different types of crop production, organic crop production, erosion and sedimentation, growing crops for biofuel production, land-use and reclamation, genetic modification of crop plants, and soil quality and sustainability. An array of careers are available in such areas as crop production and management, new crop development, soil management, soil ecology, ecosystem restoration, agricultural business and marketing, etc.

### CAREER OPPORTUNITIES

Careers for crop scientists are available in business, industry, farming, research, agricultural chemical industries, seed production, seed technology, communications, conservation, and education. Positions are available in agricultural experiment stations and extension services, state departments of agriculture, food processing companies, insurance agencies, lending institutions, and commercial firms, both domestic and international, dealing in the processing and sale of farm products, chemicals, and seed.

Careers for soil scientists are available in agriculture, forestry, education, state and federal resource agencies, private consulting, and research. Farms, ranches, and agricultural supply companies employ soil scientists as managers or

field representatives. Soil scientists may become teachers of vocational agriculture or environmental education, or they may become county extension agents in agriculture or natural resources. The U.S. Department of Agriculture's Forest Service and Natural Resource Conservation Service often employ soil scientists, as do private consulting firms in environmental engineering and land use planning.

### ACADEMIC ADVISING

Undergraduate curricula in crop and soil science are flexible enough to provide for the student's individual professional needs and interests and for a broad-based general education by allowing electives in other colleges throughout the university. Undergraduate advising is a vital part of the program, and the department is well known for excellence in advising. Advisors and faculty provide curricular guidance and aid in professional extra-curricular activities, career decisions, and job placement.

### SCHOLARSHIPS

The Department of Crop and Soil Science administers a number of scholarships available only to students majoring in the department.

### STUDENT CLUBS

The department supports a Crop Science Club that provides valuable co-curricular professional development, a Soil Science Club, a collegiate Soil Judging Team that participates in both regional and national competitions, the OSU Organic Growers Club that provides hands-on experience in organic production of vegetable crops, and the OSU Bug Zoo, a student club whose members are actively engaged in insect education outreach to local schools and communities.

### CROP AND SOIL SCIENCE (BS, CRED, HBS)

The BS in Crop and Soil Science degree requires the choice of one of two options below.

#### CROP MANAGEMENT OPTION

##### Crop and Soil Science Departmental Core

- CSS 100. Orientation/Career Planning (1)
- CSS 200. Crop Ecology and Morphology (3)
- CSS 305. Principles of Soil Science (4)
- CSS 306. Problem Solving: Soil Science Applications (1)
- CSS 315. ^Nutrient Management and Cycling (4)
- CSS 407. Senior Seminar (1)

##### Crops Core

- CSS 300. Intro to Crop Production (4)
- CSS 415. Soil Fertility Management (3)
- CSS 430. Plant Genetics (3)
- CSS 440. Weed Management (4)
- CSS 480. Case Studies in Cropping Systems Management (4)

#### Choose at least one of the following courses:

- BOT 350. Introductory Plant Pathology (4)
- CSS 311. Introduction to Insect Pest Management (5)
- CSS 460. Seed Production (3)

#### Senior capstone—1 credit minimum:

- CSS 401. Research (1–3)
- CSS 405. Reading and Conference Directed in Career Planning-Job Search (1)
- CSS 410. Internship (1–6)

#### Choose at least 12 credits from the following courses:

- CSS 199. Special Studies: Issues in Sustainable Agriculture (can be repeated for credit) (1)
- CSS 310. Forage Production (4)
- CSS 320. Principles of Oil and Fiber Crop Production (1)
- CSS 321. Principles of Cereal Crop Production (1)
- CSS 322. Principles of Potato Production (1)
- CSS 363. Seed Biology (3)
- CSS 408. Workshop (1–16)

#### Choose at least 1 credit from the following:

- CSS 330. \*World Food Crops (3)
- CSS 395. \*World Soil Resources (3)
- Any other relevant courses in BEE, CSS, FOR, HORT, RNG or another department.

#### Technology

##### Choose at least 1 credit from the following:

- GEO 365. Introduction to Geographic Information Systems (4)
- HORT 414. Information Systems in Agriculture (Four 1-credit modules) (1–4)

#### Business

- AREC 211. Management in Agriculture (4)
- AREC 221. Marketing in Agriculture (3)
- ECON 201. \*Introduction to Microeconomics (4)

#### Choose at least one of the following courses:

- AG 111. Computer Applications in Agriculture (3)
- BA 131. Business Productivity Software (2) [Terminates fall 2007]

#### Electives in Business (Select a minimum of 8 credits)

- AREC 372. Agricultural Cooperatives (2)
- AREC 388. Agricultural Law (4)
- AREC 468. M/Crop Enterprise Budgeting (Module) (1)
- AREC 470. M/Farm Budgeting and Planning (Module) (1)
- AREC 471. M/Entrepreneurial Skills in Agribusiness Management (Module) (1)
- AREC 472. M/Competitive Strategies (Module) (1)
- AREC 473. M/Risk Management in Agribusiness (Module) (1)
- AREC 476. M/Agricultural Personnel Management (Module) (2)
- BA 215. Money and Investment Management: Manager, Lender, Investor Viewpoint (4)
- BA 463. Family Business Management (4)

#### Electives in Ethics or Conflict Management

##### Choose at least one of the following for a minimum of 3 credits:

- ANTH 481. \*Natural Resources and Community Values (3)
- ANTH 482. \*World Food and Cultural Implications of International Ag Development (3)
- FOR 365. \*Issues in Natural Resource Conservation (3)
- PHL 205. \*Ethics (4)
- PHL 440. \*Environmental Ethics (3)
- PHL 443. \*World Views and Environmental Values (3)

#### Electives in Ecology

##### Choose at least one of the following for 3 credits:

- BI 370. Ecology (3)
- RNG 441. Rangeland Analysis (4) Biological Sciences
- BI 211, BI 212, BI 213. \*Principles of Biology (4,4,4)
- BI 211–BI 213 requirement may be satisfied with BI 101, BI 102, BI 103 (including lab) and/or a 200-level Botany sequence

#### Physical Sciences

- CH 121. General Chemistry (5)
- CH 122. \*General Chemistry (5)
- CH 130. General Chemistry of Living Systems (4)

#### Mathematics

- MTH 111. \*College Algebra (4)
- ST 351. \*Intro to Statistical Methods (4)

#### SOIL RESOURCE MANAGEMENT OPTION

##### Crop and Soil Science

##### Departmental Core

- CSS 100. Orientation/Career Planning (1)
- CSS 200. Crop Ecology and Morphology (3)
- CSS 305. Principles of Soil Science (4)
- CSS 306. Problem Solving: Soil Science Applications (1)
- CSS 315. ^Nutrient Management and Cycling (4)
- CSS 407. Seminar (1)

##### Soils Core

- CSS 455. Biology of Soil Ecosystems (4)
- CSS 466. Soil Morphology and Classification (4)
- CSS 480. Case Studies in Cropping Systems Management (4)
- CSS 535. Physics of Soil Ecosystems (3)
- CSS 536. Vadose Zone Hydrology Laboratory (1)
- CSS 545. Geochemistry of Soil Ecosystems (4)

##### Independent Studies

##### Select a minimum 3 credits from any combination of courses below:

- CSS 401. Research
- CSS 403. Thesis
- CSS 410. Internship

##### Basic Science Core

- BI 211, BI 212, BI 213. \*Principles of Biology (4,4,4)
- CH 121. General Chemistry (5)
- CH 122, CH 123. \*General Chemistry (5,5)

GEO 201. \*Physical Geology (4)  
 GEO 202. \*Earth Systems Science (4)  
 GEO 203. \*Evolution of Planet Earth (4)  
 MTH 111. \*College Algebra (4)  
 ST 351. Intro to Statistical Methods (4)

### Electives

Minimum of 44 credits in additional basic science, soil science, and related supporting courses from other departments. Electives can be structured to emphasize different aspects of soil resource management such as spatial analysis/land use, nutrient cycling, soil biology/ecology, soil water/hydrology, water/watershed management. Advisors can work with students to customize these electives to their specific needs and interests.

### Examples of suggested electives include:

#### Nutrient Cycling

AREC 211. Management in Agriculture (4)  
 BEE 439. Irrigation Principles and Practices (4)  
 BOT 331. Plant Physiology (4)  
 BOT 350. Introductory Plant Pathology (4)  
 CH 130. General Chemistry of Living Systems (4)  
 CSS 199. Special Studies: Issues in Sustainable Agriculture (2)  
 CSS 311. Introduction to Insect Pest Management (5)  
 CSS 440. Weed Management (4)  
 FOR 365. \*Issues in Natural Resource Conservation (3)  
 HORT 316. M/Plant Nutrition (4)  
 HORT 414. M/Information Systems in Agriculture (4)  
 RNG 241. Rangeland Ecology and Management (3)

#### Soil Biology/Ecology

BI 311. Genetics (4)  
 BI 314. Cellular and Molecular Biology (4)  
 BI 315. ^Molecular Biology Laboratory (3)  
 BI 370. Ecology (3)  
 BOT 331. Plant Physiology (4)  
 BOT 332. Laboratory Techniques in Plant Biology (3)  
 BOT 341. Plant Ecology (3)  
 CH 331. Organic Chemistry (4)  
 FOR 341. Forest Ecology (3)  
 FS 430. \*Biotechnologies: Agriculture, Food, and Resource Issues (3)  
 FS 564. Interactions of Vegetation and Atmosphere (3)  
 MB 302. General Microbiology (3)  
 MB 303. General Microbiology Laboratory (2)  
 MB 390. \*The World According to Microbes (3)  
 MB 448. Microbial Ecology (3)

#### Soil Hydrology

BEE 439. Irrigation Principles and Practices (4)  
 CE 412. Hydrology (4)  
 CE 413. GIS in Water Resources (3)  
 CSS 335. \*Introduction to Water Science and Policy (3)  
 FE 430. Watershed Processes (4)  
 FE 434. Forest Watershed Management (4)  
 GEO 365. Introduction to Geographic Information Systems (4)

GEO 424. International Water Resources Management (3)  
 GEO 487. Hydrogeology (4)  
 MTH 251. \*Differential Calculus (4)  
 MTH 252. \*Integral Calculus (4)  
 PH 201. \*General Physics (5)  
 PH 202. \*General Physics (5)

#### Spatial Analysis/Land Use

AREC 353. Public Land Statutes and Policy (4)  
 CSS 335. \*Introduction to Water Science and Policy (3)  
 CSS 468. Soil Landscape Analysis (4)  
 FE 434. Forest Watershed Management (4)  
 FOR 141. Tree and Shrub Identification (3)  
 FOR 365. \*Issues in Natural Resource Conservation (3)  
 GEO 365. Introduction to Geographic Information Systems (4)  
 GEO 423. Land Use (3)  
 GEO 432. Applied Geomorphology (3)  
 MTH 241. \*Calculus for Management and Social Science (4)  
 PH 201, PH 202. \*General Physics (5,5)  
 RNG 241. Rangeland Ecology and Management (3)

#### Water/Watershed Management

AREC 250. \*Introduction to Environmental Economics and Policy (3)  
 AREC 353. Public Land Statutes and Policy (4)  
 BEE 439. Irrigation Principles and Practices (4)  
 CSS 335. \*Introduction to Water Science and Policy (3)  
 FE 430. Watershed Processes (4)  
 FE 434. Forest Watershed Management (4)  
 FOR 365. \*Issues in Natural Resource Conservation (3)  
 FOR 391. Natural Resource Communications (3)  
 FW 326. Integrated Watershed Management (3)  
 PS 475. Environmental Politics and Policy (4)  
 RNG 355. Desert Watershed Management (3)  
 RNG 455. Riparian Ecology and Management (3)

### CROP SCIENCE MINOR

To earn a Crop Science minor, students must complete the following courses to total 27 credits:

#### Requirements

CSS 200. Crop Ecology and Morphology (3)  
 CSS 300. Intro to Crop Production (4)  
 CSS 305. Principles of Soil Science (4)  
 CSS 306. Problem Solving: Soil Science Applications (1)

#### Select a minimum of 11 credits from below:

CSS 199. Special Studies: Issues in Sustainable Agriculture (1)  
 CSS 310. Forage Production (4)  
 CSS 320. Principles of Oil and Fiber Crop Production (1)  
 CSS 321. Principles of Cereal Crop Production (1)  
 CSS 322. Principles of Potato Production (1)  
 CSS 330. \*World Food Crops (3)

CSS 407. Seminar (1)  
 CSS 408. Workshop (1–16)  
 CSS 430. Plant Genetics (3)  
 CSS 440. Weed Management (4)  
 CSS 450. Plant Breeding (4)  
 CSS 460. Seed Production (3)  
 CSS 480. Case Studies in Cropping Systems Management (4)

### SOIL SCIENCE MINOR

To earn a Soil Science minor, students must complete the following courses to total 27 credits:

#### Requirements

CSS 305. Principles of Soil Science (4)  
 CSS 306. Problem Solving: Soil Science Applications (1)  
 CSS 315. ^Nutrient Management and Cycling (4)  
 Biological science elective (4)  
 Physical science elective (5)

#### Select a minimum of 9 credits from below:

CSS 335. \*Introduction to Water Science and Policy (3)  
 CSS 401. Research (1–16)  
 CSS 405. Reading and Conference (1–16)  
 CSS 407. Seminar (1)  
 CSS 408. Workshop (1–16)  
 CSS 455. Biology of Soil Ecosystems (4)  
 CSS 466. Soil Morphology and Classification (4)  
 CSS 468. Soil Landscape Analysis (4)  
 CSS 480. Case Studies in Cropping Systems Management (4)  
 CSS 499. Special Topics in Crop Science and Soil Science (1–16)

### CROP SCIENCE (MAG, MS, PhD)

#### Graduate Areas of Concentration

*Crop breeding, genetics and cytogenetics (cereals, grasses, oilseeds); crop physiology and biochemistry; forage and pasture management; grain crop production; new crop development; post-harvest seed technology; potato production; seed biology; seed crop physiology; seed production; weed biology; weed management*

The Department of Crop and Soil Science offers degrees in either crop science or soil science. Degrees include Master of Agriculture, Master of Science, and Doctor of Philosophy.

Specific areas in crop science in which a student can prepare for his or her thesis include cereal breeding and genetics, grass breeding and genetics, forage and pasture management, new crops, potato production, seed production and technology, seed crop physiology, seed biology, post-harvest seed technology, and weed science.

#### Graduate Level

##### Courses in Crop Science

CSS 540. Weed Management (4)  
 CSS 550. Plant Breeding (4)  
 CSS 560. Seed Production (3)  
 CSS 580. Case Studies in Cropping Systems Management (4)

CSS 590. Experimental Design in Agriculture (4)  
 CSS 598. Plant Chromosome Biology (3)  
 CSS 620. DNA Fingerprinting (1)  
 CSS 621. Genetic Mapping (1)  
 CSS 622. Mapping Quantitative Trait Loci (1)  
 CSS 650. Advanced Plant Breeding and Quantitative Genetics (3)  
 CSS 660. Herbicide Science (4)  
 CSS 670. Physiology of Crop Yield (3)

### SOIL SCIENCE (MAG, MS, PhD)

**Graduate Areas of Concentration**  
*Environmental soil science, forest soils, nutrient cycling, soil geochemistry, soil conservation and land use, soil fertility and plant nutrition, soil genesis and classification, soil microbiology, soil physics*

The Department of Crop and Soil Science offers degrees in either crop science or soil science. Degrees include Master of Agriculture, Master of Science, and Doctor of Philosophy.

Areas of study in soil science are soil fertility and plant nutrition, soil physics, forest soils, soil chemistry, soil conservation, soil microbiology, soil classification, genesis and morphology of soils, and land use. A nonthesis MS in Environmental Soil Science degree is available. Diverse soils and soil problems are available for study.

#### Graduate Level Courses in Soil Science

CSS 513. Properties, Processes, and Functions of Soils (4)  
 CSS 523. Principles of Stable Isotopes (3)  
 CSS 525. Sustaining Soil Productivity (3)  
 CSS 535. Soil Physics (3)  
 CSS 536. Vadose Zone Hydrology Laboratory (1)  
 CSS 545. Geochemistry of Soil Ecosystems (4)  
 CSS 546. Soil Geochemistry Laboratory (1)  
 CSS 555. Biology of Soil Ecosystems (4)  
 CSS 566. Soil Morphology and Classification (4)  
 CSS 568. Soil Landscape Analysis (4)  
 CSS 635. Chemical Processes in Soil Systems (3)  
 CSS 645. Soil Biology and Biochemistry (3)  
 CSS 665. Soil Genesis and Classification (3)

### CROP SCIENCE GRADUATE MINOR

For more details, see the department advisor.

Approximately two-thirds (30 graduate credits) of the 45-credit total required for a graduate degree should be listed in the major field and one-third (15 graduate credits) in the minor field. The student's advisory committee must include a member from the minor department.

### SOIL SCIENCE GRADUATE MINOR

For more details, see the department advisor.

Approximately two-thirds (30 graduate credits) of the 45-credit total required for a graduate degree should be listed in the

major field and one-third (15 graduate credits) in the minor field. The student's advisory committee must include a member from the minor department.

### COURSES

**CSS 100. ORIENTATION/CAREER PLANNING (1).** Introduction to department, college and university programs. Individual and group counseling and baccalaureate program planning. Exposure to career opportunities in crop and soil science. **PREREQS:** Major and minor students only.

**CSS 199. SPECIAL STUDIES: ISSUES IN SUSTAINABLE AGRICULTURE (1-16).** Invited speakers present seminars on specific aspects of agriculture relating to sustainability. Topics vary from term to term and year to year. May be repeated for credit when topics differ.

**CSS 199H. SPECIAL STUDIES: ISSUES IN SUSTAINABLE AGRICULTURE (1-16).** Invited speakers present seminars on specific aspects of agriculture relating to sustainability. Topics vary from term to term and year to year. May be repeated for credit when topics differ. **PREREQS:** Honors College approval required.

**CSS 200. CROP ECOLOGY AND MORPHOLOGY (3).** An introduction to the concepts and principles of crop ecology and morphology and a foundation for other crop science classes. Examines the dynamics and function of crop communities, and the biotic and environmental interactions that influence productivity. Fundamentals of the developmental morphology of crop seeds, seedlings, and plants. Morphological features of seeds and plants in relation to the identification of crop families and species of economic importance.

**CSS 205. \*SOILS: SUSTAINABLE ECOSYSTEMS (4).** Soil ecosystems as a medium for plant and crop growth, the cycling of nutrients, supply and purification of water, and a habitat for a diverse population of soil organisms. Relationship of human activities to the sustainability of soil ecosystems. Lec/lab. Field trips required. (Bacc Core Course)

**CSS 300. INTRODUCTION TO CROP PRODUCTION (4).** Principles, practices and issues relating to production, marketing and improvement of horticultural and agronomic crops. Comparison of crop production systems; geography of crop production; cropping calendars. Lec/lab/rec. **CROSSLISTED** as HORT 300. **PREREQS:** One year of general biology or equivalent.

**CSS 305. PRINCIPLES OF SOIL SCIENCE (4).** Origin, formation, classification, physical, chemical, and biological characteristics; ecosystem functions of soils; effects of soil management on agricultural and forest crop production. Field trips. **PREREQS:** Two quarters of college chemistry or equivalent, and recommend CSS 306 recitation.

**CSS 306. PROBLEM SOLVING: SOIL SCIENCE APPLICATIONS (1).** Problem solving for, and in-depth exploration of, Principles of Soil Science (CSS 305). Real-world problems requiring knowledge of soil physical, chemical, and biological properties. **COREQS:** CSS 305

**CSS 310. FORAGE PRODUCTION (4).** Importance of, and current production practices for, forage crops. Lec/lab. **PREREQS:** CSS 300 or equivalent; CSS 305.

**CSS 311. INTRODUCTION TO INSECT PEST MANAGEMENT (5).** Recognition, biology and management of injurious and beneficial insects; insects and human welfare. Concurrent laboratory is designed to illustrate principles of insect pest management in agricultural cropping systems, including medical and veterinary entomology. Lec/lab. **CROSSLISTED** as ENT 311. **PREREQS:** One year of college biology.

**CSS 315. ^NUTRIENT MANAGEMENT AND CYCLING (4).** Nutrient forms, transformations, and plant availability as influenced by chemical and biological reactions in soils; soil pH and management of acid and alkaline soils; characteristics and use of fertilizers, soil amendments and organic wastes. Labs include routine soil testing procedures, computer applications for soil fertility management, and field trips. Lec/lab. (Writing Intensive Course) **PREREQS:** CSS 305, CH 122. Courses in computers are recommended.

**CSS 320. PRINCIPLES OF OIL AND FIBER CROP PRODUCTION (1).** An overview of production practices and characteristics of oil seed, essential oil, and fiber crops. **PREREQS:** CSS 300 or equivalent; CSS 305.

**CSS 321. PRINCIPLES OF CEREAL CROP PRODUCTION (1).** An overview of the principles underlying small grain production practices in the Pacific Northwest. **PREREQS:** CSS 300 or equivalent; CSS 305.

**CSS 322. PRINCIPLES OF POTATO PRODUCTION (1).** Principles and practices governing all aspects of potato production, storage and use. **PREREQS:** CSS 300 or equivalent; CSS 305.

**CSS 330. \*WORLD FOOD CROPS (3).** Origin, production, utilization, and improvement of the world's major food crops. The role of crop production in global economic and social development; food security and worldwide nutritional requirements. (Bacc Core Course) **PREREQS:** CSS 200 recommended.

**CSS 335. \*INTRODUCTION TO WATER SCIENCE AND POLICY (3).** Policy and science of the hydrologic cycle. Emphasis on interaction between water's natural time-space fluctuations and human uses. **CROSSLISTED** as GEO 335. (Bacc Core Course)

**CSS 363. SEED BIOLOGY (3).** Biological aspects of seed formation and development, germination, maturation, dormancy, and deterioration. Fundamentals of seed composition and function. Offered alternate years. Lec/lab. **CROSSLISTED** as HORT 363. **PREREQS:** BI 103 or BI 212.

**CSS 375. SOIL RESOURCE POTENTIALS (3).** Bridges the gap between introductory soil science classes and advanced mapping/classification courses. Emphasis is on the application of basic theoretical knowledge to understand practical, real world situations. **PREREQS:** CSS 305 or equivalent.

**CSS 381. \*AGRICULTURE, POWER, DISCRIMINATION, AND SURVIVAL (3).** Study and discussion of the effect of difference, power, and discrimination from an agricultural perspective with particular emphasis on how agriculture has shaped both earth's ecology and human culture by enabling an ever-increasing human population. (Taught at LaGrande campus only.) (Bacc Core Course)

**CSS 395. \*WORLD SOIL RESOURCES (3).** The properties, global distribution, and agricultural productivity of major world soil groups are described. Potentials for human-accelerated soil degradation are introduced for each soil group, and reasons for conflicting assessments of degradation are discussed. (Bacc Core Course) **PREREQS:** CH 121.

**CSS 401. RESEARCH (1-16).**

**CSS 403. THESIS (1-16).** Independent, original study and preparation of a senior thesis. **PREREQS:** Senior standing.

**CSS 405. READING AND CONFERENCE (1-16).**

**CSS 405H. READING AND CONFERENCE (1-16).** **PREREQS:** Honors College Approval Required.

**CSS 407. SEMINAR (1).** Senior seminar intended to instruct students on proper techniques for presentation of scientific material. Each student is expected to prepare and present a scientific seminar and to submit written documentation supporting that seminar. Graded P/N.

**CSS 408. WORKSHOP (1-16).** Evaluation and judging of soils in Oregon and other states; directed studies of soil morphology, soil survey, soil fertility, soil physics, soil chemistry, soil biology, and soil information systems.

**CSS 410. INTERNSHIP (1-6).** Professional work experience previously approved and supervised by the department, written report required. **PREREQS:** Junior standing.

**CSS 415. SOIL FERTILITY MANAGEMENT (3).** Management of plant nutrients in agronomic systems; diagnosis of nutrient availability and prediction of crop response to fertilizers; interactions between nutrient response and chemical, physical and biological properties of soils. **PREREQS:** CSS 315, Courses in statistics, chemistry and plant physiology.

**CSS 420. SEED TESTING TECHNOLOGIES (3).** Principles of seed quality testing including mechanical purity, genetic trait identification, viability, vigor, and seed pathology. Laboratory will provide practical application of lecture topics. **PREREQS:** CSS 300 or equivalent. CSS 363 is recommended.

**CSS 430. PLANT GENETICS (3).** Introduction to the principles of plant genetics with an emphasis on the structure and function of economically important plant genomes. **CROSSLISTED** as HORT 430/HORT 530. **PREREQS:** One year of biology and chemistry.

**CSS 431. PLANT GENETICS RECITATION (1).** Review and demonstration of plant genetics principles. **CROSSLISTED** as HORT 431.

**CSS 438. EXPLORING WORLD AGRICULTURE (2).** Survey of crop and livestock production in a designated section of the world, including history, culture, and political situation. Course is designed to prepare students for a tour of study area. **CROSSLISTED** as ANS 438, AREC 438, HORT 438. Graded P/N.

**CSS 440. WEED MANAGEMENT (4).** Principles of weed control by cultural, biological, and chemical means; weed identification; introduction to herbicides and factors influencing their use. Lec/lab/rec. **PREREQS:** One year biological science and one course in organic chemistry.

**CSS 450. PLANT BREEDING (4).** An introduction to the genetic improvement of self-pollinated, cross-pollinated, and asexually propagated species and the genetic principles on which breeding methods are based. Examples are drawn from a wide range of crops, including cereal grains, grasses, fruits, nuts, and vegetables; guest lecturers discuss their breeding programs. Additional topics include crop evaluation, germplasm preservation, disease resistance, and biotechnology. Lec/lab. **CROSSLISTED** as HORT 450/HORT 550. **PREREQS:** BI 311 or CSS 430/ CSS 530.

**CSS 455. BIOLOGY OF SOIL ECOSYSTEMS (4).** A detailed study of the organisms that live in the soil and their activities in the soil ecosystems, soil as a habitat for organisms, taxonomy and biology of soil organisms, fundamentals of nutrient cycles special topics in soil biology, review basis of soil microbial and ecological principles. **PREREQS:** CSS 305. Courses in chemistry, physics, and microbiology are recommended.

**CSS 460. SEED PRODUCTION (3).** An introduction to principles and practices of seed-based genetic delivery systems. Fundamentals of seed crop biology, cultivar maintenance and production methods are stressed. Concepts are illustrated using Pacific Northwest seed crops. **PREREQS:** CSS 200 or equivalent.

**CSS 466. SOIL MORPHOLOGY AND CLASSIFICATION (4).** Observation and description of soil properties in the field; writing soil profile descriptions; evaluating criteria that define features used to classify soils; using soil classification keys. Lec/lab. **PREREQS:** CSS 305

**CSS 468. SOIL LANDSCAPE ANALYSIS (4).** Principles of soil geomorphology, soil stratigraphy, and surficial processes as applied to understanding the soil system at landscape scales. Emphasis on field observations of soils, geomorphic surfaces, and environment. Field project entails design of soil survey map units, field mapping and GIS cartographic techniques. **PREREQS:** CSS 466\*

**CSS 470. SEED QUALITY MANAGEMENT (3).** Theory, principles and procedures of seed quality management as a component of variety design, multiplication, conditioning, storage, testing, delivery and final utilization. Offered alternate years. **PREREQS:** One year of biology or botany.

**CSS 480. CASE STUDIES IN CROPPING SYSTEMS MANAGEMENT (4).** Decision cases involving the production of field and horticultural crops; individual and group activities; discussion of the decision-making process. Multiple field trips required. **CROSSLISTED** as HORT 480/HORT 580. **PREREQS:** HORT 300 or CSS 300, senior standing in agriculture.

**CSS 499. SPECIAL TOPICS IN CROP SCIENCE AND SOIL SCIENCE (1-16).** Technical knowledge and skills development courses offered in a wide array of course formats. Topics vary from term to term and year to year. May be repeated for credit when topics differ.

**CSS 499H. SPECIAL TOPICS (1-16).** Technical knowledge and skills development courses offered in a wide array of course formats. Topics vary from term to term and year to year. May be repeated for credit when topics differ. **PREREQS:** Instructor approval required, Honors College approval required.

**CSS 501. RESEARCH (1-16).**

**CSS 503. THESIS (1-16).** **PREREQS:** Masters-level graduate students.

**CSS 505. READING AND CONFERENCE (1-16).**

**CSS 506. PROJECTS (1-16).**

**CSS 507. SEMINAR (1).** Graded P/N.

**CSS 508. WORKSHOP (1-16).** Evaluation and judging of soils in Oregon and other states; directed studies of soil morphology, soil survey, soil fertility, soil physics, soil chemistry, soil biology, and soil information systems.

**CSS 509. PRACTICUM IN TEACHING (1-3).** Developing skills and competence in teaching soil science under staff supervision; organization and presentation of instructional material by assisting in laboratory, recitation, and lectures.

**CSS 513. PROPERTIES, PROCESSES, AND FUNCTIONS OF SOILS (4).** Physical, chemical, biological, and landscape properties; processes of fluid retention and movement, weathering and cation exchange, decomposition and C-N dynamics, erosion and sedimentation; functions of hydrologic regulation, nutrient cycling, environmental protection, ecological habitat. **PREREQS:** CH 223 or equivalent.

**CSS 515. SOIL FERTILITY MANAGEMENT (3).** Management of plant nutrients in agronomic systems; diagnosis of nutrient availability and prediction of crop response to fertilizers; interactions between nutrient response and chemical, physical and biological properties of soils. **PREREQS:** CSS 315, courses in statistics, chemistry and plant physiology.

**CSS 520. SEED TESTING TECHNOLOGIES (3).** Principles of seed quality testing including mechanical purity, genetic trait identification, viability, vigor, and seed pathology. Laboratory will provide practical application of lecture topics.

**PREREQS:** CSS 300 or equivalent. CSS 363 is recommended.

**CSS 523. PRINCIPLES OF STABLE ISOTOPES (3).** An introduction to the theory and use of stable isotopes. Applications of stable isotopes to soil science, plant physiology, hydrology, and ecosystem studies.

**CSS 525X. MINERAL-ORGANIC MATTER INTERACTIONS (3).** Studies the fundamental properties of the mineral-organic interface and the mechanisms of interaction between mineral and organic soil properties. **PREREQS:** CSS 305 or equivalent.

**CSS 530. PLANT GENETICS (3).** Introduction to the principles of plant genetics with an emphasis on the structure and function of economically important plant genomes. **CROSSLISTED** as HORT 430/HORT 530. **PREREQS:** One year of biology and chemistry.

**CSS 535. SOIL PHYSICS (3).** Theoretical elements of soil physical properties and processes related to agricultural, hydrological and environmental problems. Requires concurrent weekly laboratory: CSS 536. **PREREQS:** CSS 305. REC: MTH 241, CH 123, PH 201 or equivalent. **COREQS:** CSS 536

**CSS 536. VADOSE ZONE HYDROLOGY LABORATORY (1).** Experimental elements of soil physical properties and processes allowing practical experience in the measurement and analysis of soil physical processes related to agricultural, hydrological and environmental problems. Weekly laboratory. **PREREQS:** CH 123, PH 201 or equivalent.

**CSS 540. WEED MANAGEMENT (4).** Principles of weed control by cultural, biological, and chemical means; weed identification; introduction to herbicides and factors influencing their use. Lec/lab/rec. **PREREQS:** One year biological science and one course in organic chemistry.

**CSS 545. GEOCHEMISTRY OF SOIL ECOSYSTEMS (4).** Structural chemistry of clay minerals and organic matter, cation and anion exchange, soil solution equilibria, solubility, redox reactions, biogeochemical weathering, acidity, soil salinity, and chemical reactions affecting the transport of reactive solutes through soils. Optional lab is available. **PREREQS:** CH 123, PH 201. CSS 305 is recommended.

**CSS 546. SOIL GEOCHEMISTRY LABORATORY (1).** Measurement of soil properties and processes that influence the transport of nutrients and organic compounds through the soil environment. **PREREQS:** CH 123, PH 201.

**CSS 550. PLANT BREEDING (4).** An introduction to the genetic improvement of self-pollinated, cross-pollinated, and asexually propagated species and the genetic principles on which breeding methods are based. Examples are drawn from a wide range of crops, including cereal grains, grasses, fruits, nuts, and vegetables; guest lecturers discuss their breeding programs. Additional topics include crop evolution, germplasm preservation, disease resistance, and biotechnology. Lec/lab. **CROSSLISTED** as HORT 450/HORT 550. **PREREQS:** BI 311 or CSS 430/ CSS 530.

**CSS 555. BIOLOGY OF SOIL ECOSYSTEMS (4).** A detailed study of the organisms that live in the soil and their activities in the soil ecosystems, soil as a habitat for organisms, taxonomy and biology of soil organisms, fundamentals of nutrient cycles special topics in soil biology, review basis of soil microbial and ecological principles. **PREREQS:** CSS 305. Courses in chemistry, physics, and microbiology are recommended.

**CSS 560. SEED PRODUCTION (3).** An introduction to principles and practices of seed-based genetic delivery systems. Fundamentals of seed crop biology, cultivar maintenance and production methods are stressed. Concepts are illustrated using Pacific Northwest seed crops. **PREREQS:** CSS 200 or equivalent.

**CSS 566. SOIL MORPHOLOGY AND CLASSIFICATION (4).** Observation and description of soil properties in the field; writing soil profile descriptions; evaluating criteria that define features used to classify soils; using soil classification keys. Lec/lab.

**CSS 568. SOIL LANDSCAPE ANALYSIS (4).** Principles of soil geomorphology, soil stratigraphy, and surficial processes as applied to understanding the soil system at landscape scales. Emphasis on field observations of soils, geomorphic surfaces, and environment. Field project entails design of soil survey map units, field mapping and GIS cartographic techniques. **PREREQS:** CSS 566\*

**CSS 570. SEED QUALITY MANAGEMENT (3).** Theory, principles and procedures of seed quality management as a component of variety design, multiplication, conditioning, storage, testing, delivery and final utilization. Offered alternate years. **PREREQS:** One year of biology or botany.

**CSS 580. CASE STUDIES IN CROPPING SYSTEMS MANAGEMENT (4).** Decision cases involving the production of field and horticultural crops; individual and group activities; discussion of the decision-making process. Multiple field trips required. **CROSSLISTED** as HORT 480/HORT 580. **PREREQS:** HORT 300 or CSS 300, senior standing in agriculture.

**CSS 590. EXPERIMENTAL DESIGN IN AGRICULTURE (4).** Field layout, analysis, and interpretation of basic experimental designs used in agronomy and plant breeding, and including field plot techniques such as optimum plot size and shape, factorial arrangement, replication, sub-sampling, randomization, and blocking. Recitation provides practical experience with SAS. **PREREQS:** ST 351 or equivalent.

**CSS 598. PLANT CHROMOSOME BIOLOGY (3).** Exploration of the relationship between chromosome number, structure, and behavior to gene inheritance, organization, and expression. Discussion of chromosome manipulation strategies for genomics research, genetic analysis, and plant breeding. **PREREQS:** 6 credits of genetics or equivalent.

**CSS 599. SPECIAL TOPICS IN CROP SCIENCE AND SOIL SCIENCE (1-16).** Technical knowledge and skills development courses offered in a wide array of course formats. Topics vary from term to term and year to year. May be repeated for credit when topics differ.

**CSS 601. RESEARCH (1-16).**

**CSS 603. THESIS (1-16).** **PREREQS:** PhD-level graduate students.

**CSS 605. READING AND CONFERENCE (1-16).**

**CSS 606. PROJECTS (1-16).**

**CSS 607. SEMINAR (1).** Graded P/N.

**CSS 608. WORKSHOP (1-16).**

**CSS 620. DNA FINGERPRINTING (1).** Principles and methods for producing and analyzing DNA fingerprints. Offered alternate years. **CROSSLISTED** as GEN 620, MCB 620. **PREREQS:** BI 311 or CSS 430/CSS 530 or equivalent.

**CSS 621. GENETIC MAPPING (1).** Principles and methods for constructing genetic maps comprised of molecular and other genetic markers. Offered alternate years. **CROSSLISTED** as GEN 621, MCB 621. **PREREQS:** BI 311 or CSS 430/CSS 530 or equivalent.

**CSS 622. MAPPING QUANTITATIVE TRAIT LOCI (1).** Principles and methods for mapping genes underlying phenotypically complex traits. Offered alternate years. **CROSSLISTED** as GEN 622, MCB 622. **PREREQS:** CSS 590 or ST 513 or equivalent.

**CSS 635. CHEMICAL PROCESSES IN SOIL SYSTEMS (3).** Application of equilibrium thermodynamics and chemical kinetics to reactions in soil systems; solubilities, complexation, cation exchange equilibria, surface chemistry, chemical modeling, and chemical transport as applied to weathering, genesis, nutrient availability, and the nature of soil acidity. Offered alternate years. **PREREQS:** CSS 445; CH 442 or equivalent.

**CSS 645. SOIL BIOLOGY AND BIOCHEMISTRY (3).** Biogeochemical cycling of N, P, and S; soil microbial biomass; soil enzymes; rhizosphere biology; applications of stable isotopes in soil science; biodegradation of organic wastes; applications of molecular biology to soil microbiology; models of microbial activity in soil. Offered alternate years. **PREREQS:** CSS 445, MB 448; biochemistry.

**CSS 650. ADVANCED PLANT BREEDING AND QUANTITATIVE GENETICS (3).** Pedigree, bulk, single-seed-descent, doubled haploid, backcross, testcross, mass, and half-sib, S~1~, and S~2~ family breeding methods; breeding hybrids and selecting sources of alleles for developing superior hybrids; the nature and consequences of genotype by environment interactions; marker-assisted backcross and inbred line breeding; quantitative trait locus mapping; random linear models; designing and analyzing cultivar, line, and family selection experiments. Offered alternate years. **PREREQS:** GEN 311 or CSS 430/CSS 530, CSS 450/CSS 550, ST 411/ST 511, ST 412/ST 512, and ST 413/ST 513.

**CSS 660. HERBICIDE SCIENCE (4).** Absorption, movement, and mechanism of action of herbicides in plants; behavior of herbicides in soil. Offered alternate years. **PREREQS:** CSS 440/CSS 540, BOT 331.

**CSS 665. SOIL GENESIS AND CLASSIFICATION (3).** Soil development; soil forming factors and processes as related to soil landscape formation and soil classification; interpretation of X-ray data for soil genesis. Offered alternate years.

**CSS 670. PHYSIOLOGY OF CROP YIELD (3).** Concepts of crop growth and production in relation to environmental and physiological factors and their interactions; current literature. Offered alternate years. **PREREQS:** BOT 331 or equivalent.

**CSS 699. SPECIAL TOPICS (1-16).**

## ENVIRONMENTAL AND MOLECULAR TOXICOLOGY

**Nancy I. Kerkvliet, Interim Head**  
1007 Agricultural and Life Sciences  
Oregon State University  
Corvallis, OR 97331-7301  
541-737-1808  
Website: <http://emt.oregonstate.edu>

### FACULTY

**Professors** Bailey, Baird, Dashwood, Field, Hays, Jenkins, Jepson, Kerkvliet, Miller, Riedl, Williams  
**Associate Professors** Anderson, Buermeyer, Simonich, Sudakin, Tanguay  
**Assistant Professors** Bennett, Kolluri, Stone, Wang  
**Senior Research Assistants** Hoffman, Johnson, Siddens, Steppan

### ADJUNCT/COURTESY/ AFFILIATE FACULTY

Allen, Collier, Fairbrother, Gold, Ho, Iversen, Kisby, Koop, Lein, Proteau, Simon, Stubblefield, Turker

### Undergraduate Minor

#### Toxicology

#### Graduate Major

#### Toxicology (MS, PhD)

#### Graduate Areas of Concentration

*Environmental Chemistry and Ecotoxicology*

*Mechanistic Toxicology*

*Molecular and Cellular Toxicology*

*Neurotoxicology*

#### Graduate Minor

#### Toxicology

The Department of Environmental and Molecular Toxicology offers courses leading to MS and PhD degrees in toxicology.

Training in toxicology prepares students for careers in toxicology in industry, government, and academic institutions. Biochemical, chemical, and molecular research approaches are emphasized, focusing on the following areas: analytical and exposure assessment, aquatic, biochemical, comparative, environmental, food, immuno- and neurotoxicology.

Research is promoted by the faculty's close ties to the National Institute of Environmental Health Sciences (NIEHS), which supports the Environmental Health Sciences Center and Marine/Freshwater Biomedical Sciences Center at OSU. The centers contribute additional research and training opportunities for students. Opportunities in the area of neurotoxicology are provided by scientists of The Center for Occupational and Environmental Toxicology (CROET) at Oregon Health and Sciences University.

Financial support is available to most students in the program through graduate research assistantships or from an NIEHS environmental health predoctoral training program. Completing the application by the end of January assures full consideration for funding for fall of that year.

Students who wish to enter the program should have a BS degree (or equivalent) in a science related field and are expected to select an MS or PhD curriculum related to their own area of specialization. Students will take a core set of courses and will attend and participate in the toxicology seminar class. Courses in toxicology also may be taken by students in engineering or the basic sciences.

### PHD PRELIMINARY EXAM GUIDELINES

#### Objective

The overall objective of the preliminary examination for advancement to PhD candidacy should assess whether a graduate student has the capacity and promise to:

1. understand the basic science of environmental and molecular toxicology;
2. be a creative and critical thinker;
3. understand the scientific literature;
4. conduct original and independent research; and
5. communicate the ideas and results of experiments.

Thus, the ideal examination format would select from these characteristics and prepare the student for the selective pressures that will be encountered upon completing the Environmental and Molecular Toxicology PhD degree program. In order to maintain high standards and produce quality graduate students, the examination must be rigorous and challenging. In addition, the exam format should set specific limits on the amount of time that the student dedicates to this process.

#### EXAM FORMAT

The preliminary examination format outlined below consists of both oral and written elements. This examination must be completed no later than the end of the 8th academic term (not including summer terms) after entering the program. In most cases, the student would schedule the exam in the fall term of the third year of residence, although students may take the exam earlier, after completing at least one year in the program. The examination consists of a written and oral presentation of a research proposal that cannot be closely related to the student's thesis project. As outlined, the student's ability to develop, research, and defend original scientific ideas would be evaluated. The student is

expected to demonstrate a capacity for critical thinking and a command of the specific field of focus. In addition, the student's general knowledge of environmental and molecular toxicology would be evaluated.

#### PROCEDURAL OUTLINE

##### Research Proposal (written/oral)

1. Student submits outline descriptions (required elements listed below) of two potential research projects. The subject of each project must be chosen by the student based on their knowledge and review of the literature, and must describe original, hypothesis-driven research. The proposed projects cannot have been defined previously in published or unpublished form (i.e. manuscript, abstract, database of funded projects, submitted grant application, etc.), or cannot be known to be in progress. Proposed research also must not be closely related to the thesis research of the student. "Closely related" is defined as any research that conceivably could be part of the student's thesis or that conceivably might be initiated by the student's major professor.

##### Project outlines (limited to 1 page each) must include:

- a. Description of an unresolved question relevant to the field of environmental and molecular toxicology. (1–3 sentences)
  - b. Statement of specific hypothesis to be tested. (1–2 sentences)
  - c. Description of an experimental approach designed to test the hypothesis, including a minimum of two specific aims, and a statement of the rationale (justification) for the proposed approach. (2–6 sentences)
  - d. Statement of the significance of the proposed research. (1–2 sentences)
2. The student's graduate committee reviews both outlines and approves one topic to be developed into a written proposal. The research topic is chosen based on originality, quality, potential significance, and likelihood of expanding the student's education and training. Approval of the topic would occur within one week after the outlines are submitted. During this period the outlines would be returned to the student, and the student would receive feedback from the committee concerning the quality and design of the outlined projects. Major strengths and weaknesses in the experimental design or rationale would be identified.
  3. Student develops a written research proposal using the format and topic guidelines of application for the EPA, NIH, NSF, or other appropriate granting agency. The written proposal must be completed and returned to the committee within 4 weeks after the topic was approved. The scope of the project will be equivalent to that of a "pilot project" proposal and if conducted would be expected to take approximately 1 year of research time. The proposal is limited in length to ten pages of double-spaced text (12 point font with 0.5 inch margins), and must include the following elements:
    - a. **Specific Aims.** State concisely and realistically what the research described in this application is intended to accomplish and what hypothesis is to be tested. Do not exceed one page.
    - b. **Background and Significance.** Briefly describe the background to the present proposal, critically evaluating the existing literature and specifically identifying gaps, which the project is intended to fill. State concisely the importance of the research described in this application, and relate the specific aims to the long-term objectives. Limit to two pages.
    - c. **Research Design and Methods.** Discuss in detail the experimental design and procedures to be used to accomplish the specific aims of the project. Describe the protocols to be used and the tentative sequence of investigation. Include the means by which the data will be analyzed and interpreted. Discuss the potential difficulties and limitations of the proposed research and alternative approaches to achieve the aims. Point out any procedures, situations, or materials that may be hazardous to personnel and the precautions to be exercised. Limit to seven pages.
    - d. **Literature Cited.** Do not scatter literature citations throughout the text. List them at the end of the proposal. All papers cited in the text must be listed in the reference list and vice versa. The list of literature citations at the end of the proposal do not count toward the 10-page limit.
    - e. **Appendix.** Students may include additional figures in an appendix, limited to 5 pages. The appendix may not be used to circumvent the page limits of the proposal.

4. The oral exam should be scheduled within 2 weeks of completion of the written proposal. This deadline can be extended with the approval of the student's graduate committee.
5. During the exam the student would present the research plan and defend the experimental approach. Presentation would involve a seminar format with slides/overheads and would be expected to last no longer than 30 minutes. Following the presentation, the student would be judged on the soundness of the hypothesis, their understanding of the subject matter, their ability to defend the proposed experimental design, and their general knowledge of the field of environmental and molecular toxicology. The exam is expected to last approximately 2 hours, and is limited in length to 3 hours.

#### Examination Committee

The examination committee is the graduate student's doctoral committee. The doctoral committee consists of a minimum of five members of the graduate faculty, including at least two members from the major department and a representative of the Graduate Council. If a minor is declared, the committee must include a member from the minor department. All committee members must be on the graduate faculty with appropriate authorization to serve on the student's committee. The major professor would serve as the chairperson of the committee to oversee the exam. The decision concerning whether the student merits advancement to PhD candidacy would be the responsibility of the examination committee.

#### Evaluation

The basic question for the committee is whether or not they believe the student is adequately prepared to conduct doctoral level research and has a good chance of successfully completing such research. Following a discussion of the student's performance on the examination, each committee member is then asked to vote on the basic question. It is appropriate for secret ballots to be used, and secret ballots must be used if requested by any committee member.

If there is one negative vote on this question, the student will have **passed**. If there are two or more negative votes on this question, the student has **not passed**.

If the committee decision is that the student has not passed the examination, the committee must then decide whether or not to allow the student to take a **re-examination**. If the majority of the committee votes in favor of a re-examination, the recommendation for re-examination should be recorded.

In addition, the committee must set a time interval that must elapse before the re-examination is permitted. If the majority of the committee votes against a re-examination, the recommendation to terminate the student's work toward this degree should be recorded.

#### TOXICOLOGY MINOR

The Toxicology minor provides basic and applied science majors sufficient background for technical work in toxicology.

##### Required

BB 450. General Biochemistry (4)  
or BB 490. Biochemistry (3)  
CH 334. Organic Chemistry (3)  
ST 351. Intro to Statistical Methods (4)  
TOX 411. Fundamentals of Toxicology (3)

##### Select five courses from the following or two courses plus undergraduate research:

BI 314. Cell and Molecular Biology (4)  
TOX 401. Research (9)  
TOX 413. Environmental Toxicology and Risk Assessment (3)  
TOX 429. Toxic Substances in Food (3)  
TOX 430. Chemical Behavior in the Environment (3)  
TOX 455. Ecotoxicology: Aquatic Ecosystems (3)  
TOX 490. Environmental Forensic Chemistry (3)

Total=28

#### TOXICOLOGY (MAG, MS, PhD)

##### Graduate Areas of Concentration

*Environmental chemistry and ecotoxicology, mechanistic toxicology, molecular and cellular toxicology, neurotoxicology*

The Department of Environmental and Molecular Toxicology provides students with a fundamental knowledge of toxicology that prepares them for responsible positions in research and development, academia, government, professional services, or research foundations.

The graduate faculty includes scientists with special interest in application of chemistry, biochemistry, molecular biology, pharmacology, pathology, neuroscience, immunology and ecology to problems in toxicology. The concentration in neurotoxicology is an interinstitutional alliance with Oregon Health and Science University (OHSU). Students will be affiliated with and advised by associated faculty.

For the MS and PhD degrees, students are required to take a core curriculum plus elective courses connected with their particular area of specialization. In addition to completing appropriate course work, students will undertake a thesis research project related to some aspect of toxicology. Participation in the seminar program (a one-hour per week seminar) is mandatory.

Minimal prerequisites for admission include one year each of biology,

organic chemistry, physics, and statistics. Students who do not meet all of these requirements may be admitted if their academic record is otherwise outstanding.

#### TOXICOLOGY GRADUATE MINOR

For more details, see the departmental advisor.

#### COURSES

**TOX 360. \*THE WORLD OF POISONS (3).** Provides a basic understanding of how we are exposed and respond to chemicals, examples of human diseases associated with toxic insult, the role of technology and the interface of society and toxicology in risk perception and legislation. (Bacc Core Course) **PREREQS:** One 3-credit course in chemistry or one 3-credit course in biology.

**TOX 401. RESEARCH (1-16).**

**TOX 405. READING AND CONFERENCE (1-16).**

**TOX 411. FUNDAMENTALS OF TOXICOLOGY (3).** Introduction to the discipline of toxicology. Examination of the basic concepts that define how chemicals are absorbed, distributed, metabolized, and eliminated by the body. Overview of associated dose/response relations. **PREREQS:** BB 350\* or BB 450\* or BB 490\*

**TOX 413. ENVIRONMENTAL TOXICOLOGY AND RISK ASSESSMENT (3).** Procedures for defining exposure and the use of toxicological data in defining risk assessment. Recent application of mechanistic concepts are reviewed. **PREREQS:** TOX 411

**TOX 429. TOXIC SUBSTANCES IN FOOD (3).** Toxicology and epidemiology of human exposures to pesticides and food toxicants. **PREREQS:** BB 350\* or BB 450\* or BB 490\*

**TOX 429H. TOXIC SUBSTANCES IN FOOD (3).** Toxicology and epidemiology of human exposures to pesticides and food toxicants. **PREREQS:** BB 350\* or BB 450\* or BB 490\*, Honors College approval required.

**TOX 430. CHEMICAL BEHAVIOR IN THE ENVIRONMENT (3).** Applications of chemical concepts for assessing the movement and fate of organic contaminants in natural and engineered systems including equilibrium partitioning to predict the movement of organic chemicals between environmental compartments and chemical transformations occurring in the environment. **PREREQS:** CH 331 or CH 123, Senior standing.

**TOX 435. \*GENES AND CHEMICALS IN AGRICULTURE: VALUE AND RISK (3).** A multidisciplinary course that examines the scientific, social, political, economic, environmental, and ethical controversies surrounding agricultural and natural resource biotechnologies. (Bacc Core Course).

**TOX 455. ECOTOXICOLOGY: AQUATIC ECOSYSTEMS (3).** Focuses on transport, fate, and effects of toxic substances in freshwater ecosystems. There is special emphasis on impacts on fish. **PREREQS:** CH 331

**TOX 490. ENVIRONMENTAL FORENSIC CHEMISTRY (3).** Principles of Good Laboratory Practice Standards, methodology, utility and limitations of chemical forensic methods as applied to real investigations. **PREREQS:** One year of college chemistry and one term of organic chemistry.

**TOX 499. SPECIAL TOPICS (1-16).**

**TOX 501. RESEARCH (1-16).**

**TOX 503. THESIS (1-16).**

**TOX 505. READING AND CONFERENCE (1-16).**

**TOX 507. SEMINAR (1-16).**

**TOX 511. FUNDAMENTALS OF TOXICOLOGY (3).** Introduction to the discipline of toxicology. Examination of the basic concepts that define how chemicals are absorbed, distributed, metabolized, and eliminated by the body. Overview of associated dose/response relations. Must be taken in order. **PREREQS:** BB 550\* or BB 590\*

**TOX 512. TARGET ORGAN TOXICOLOGY (3).** Examination of toxicological effects of chemicals at organ level. Normal physiology of the organ system is reviewed. **PREREQS:** TOX 511

**TOX 513. ENVIRONMENTAL TOXICOLOGY AND RISK ASSESSMENT (3).** Procedures for defining exposure and the use of toxicological data in defining risk assessment. Recent application of mechanistic concepts are reviewed. **PREREQS:** TOX 511

**TOX 514. MOLECULAR AND CELLULAR TOXICOLOGY (3).** Mechanisms of toxicant-induced cell proliferation, differentiation, or death. Emphasis is on metabolism, cell cycle regulation, mutagenesis, and initiation of cancer. **PREREQS:** BB 590 and BB 591 and BB 592 and TOX 511

**TOX 529. TOXIC SUBSTANCES IN FOOD (3).** Toxicology and epidemiology of human exposures to pesticides and food toxicants. **PREREQS:** BB 350 or BB 450 or BB 490.

**TOX 530. CHEMICAL BEHAVIOR IN THE ENVIRONMENT (3).** Applications of chemical concepts for assessing the movement and fate of organic contaminants in natural and engineered systems including equilibrium partitioning to predict the movement of organic chemicals between environmental compartments and chemical transformations occurring in the environment. **PREREQS:** CH 106, CH 331, graduate standing.

**TOX 554. GENOME ORGANIZATION, STRUCTURE, AND MAINTENANCE (4).** How diverse organisms store their individual sets of genetic information (genomes). Evolution of genomes and gene families. Structures of DNA and chromosomes. Biochemical and regulatory pathways that protect cellular genomes against environmental and endogenous damage and ensure transmission of faithful copies to progeny. Remodeling of genomes by recombination and transposition. **CROSSLISTED** as GEN 554 and MCB 554. **PREREQS:** BI 311 (genetics or equivalent), BB 450, BB 451, BB 452 or BB 490, BB 491, BB 492 (biochemistry) or equivalent.

**TOX 555. ECOTOXICOLOGY: AQUATIC ECOSYSTEMS (3).** Focuses on transport, fate, and effects of toxic substances in freshwater ecosystems. There is special emphasis on impacts on fish. **PREREQS:** CH 331.

**TOX 575. ADVANCED XENOBIOTIC METABOLISM (3).** Familiarizes students with basic principles of drug/xenobiotic metabolism. Concepts addressed include: how foreign chemicals or xenobiotics are absorbed, distributed, and metabolized; induction and inhibition of metabolism; effect of age, species, hormones, and disease on metabolism; genetic polymorphisms; effect of diet and environment; experimental techniques in xenobiotic metabolism; and regulatory issues (FDA and EPA). **PREREQS:** Graduate or professional pharmacy student standing.

**TOX 590. ENVIRONMENTAL FORENSIC CHEMISTRY (3).** Principles of Good Laboratory Practice Standards, methodology, utility and limitations of chemical forensic methods as applied to real investigations. **PREREQS:** One year of college chemistry and one term of organic chemistry.

**TOX 599. SPECIAL TOPICS (1-16).**

**TOX 601. RESEARCH (1-16).**

**TOX 603. THESIS (1-16).**

**TOX 605. READING AND CONFERENCE (1-16).**

**TOX 607. SEMINAR (1-16).**

**TOX 611. TESTING FOR GENOTOXICITY (4).** A lab-based course geared toward toxicology, biochemistry, biology, food science, nutrition, and pharmacy students. Introduces principles and methods of several key assays used to screen for DNA damage and mutation. These tests will include the following: (i) Salmonella mutagenicity assay ('Ames test'), (ii) single cell gel electrophoresis ('comet') assay, (iii) micronucleus assay, and (iv) PCR-based single strand conformation polymorphism (SSCP) screening for oncogene/tumor suppressor gene mutation in cancers. This short-duration, intensive lab/lecture class runs Mon-Fri, two weeks prior to the start of fall term. Each day includes laboratory work starting at 8 a.m., and a 2-hour lecture covering basic principles of the assays, as well as technical details of the experiment for the day. **PREREQS:** TOX 514, BB 400 series, prior course work on DNA repair and mutagenesis, and/or instructor approval.

**TOX 656. DNA REPAIR AND MUTAGENESIS (3).** Biochemical pathways by which cells maintain genomic stability by avoiding DNA mutation and breakage, including repair of DNA damage, DNA replication fidelity and replication error-correction processes, and bypass replication of damaged DNA. **CROSSLISTED** as BB 656. **PREREQS:** MCB 554 and MCB 555, BB 492 or equivalent.

**TOX 675. HUMAN CARCINOGENESIS (3).** Familiarizes students with the basic principles of molecular carcinogenesis with an emphasis on the current molecular understanding of cancer development in humans, and how such understanding influences diagnosis, treatment, and prevention strategies. **PREREQS:** TOX 514 and (MCB 555 or GEN 555) or BB 592, Graduate or professional pharmacy standing.

**TOX 699. SPECIAL TOPICS (1-16).**

**TOX 808. WORKSHOP (1-16).**

## ENTOMOLOGY

See College of Science

**FISHERIES AND WILDLIFE****W. Daniel Edge, Head**

104 Nash Hall  
Oregon State University  
Corvallis, OR 97331-3803  
541-737-4531

E-mail: daniel.edge@oregonstate.edu  
Website: <http://fw.oregonstate.edu/>

**FACULTY**

**Professors** Boehlert, Edge, Gregory, Kennedy, Herlihy, Hughes, Langdon, Malouf, Markle, Mate, Noakes, Rossignol, Sampson

**Associate Professors** Baker, Banks, Bartholomew, Burris, Ford, Giannico, Heikkila, S. Heppell, J. Li, Robinson, Webster

**Assistant Professors** Bowman, Debano, B. Dugger, K. Dugger, Epps, Garcia, Gertseva, S. Heppell, Horning, Miller, Rosenberg, Theberge, Wooster

**Senior Instructors** Hanschumaker

**Instructors** Allen, Duplax, Goggans, Snyder, Whitney

**COURTESY FACULTY**

**Professors** Anthony, Haig, Kauffman, Lackey, H. Li, Power, Roby, Schreck

**Associate Professors** Kaufmann, Landers, Larson, Stein, Thompson

**Assistant Professors** Brodeur, Burnett, Camarra, Chapman, Dumbauld, Dunham, Ebersole, Fitzpatrick, Forsman, Gervais, Jackson, Johnson, McIntosh, Orme-Zavaleta, Reeves, Rogers, Ryer, Schumaker

**Instructors** Ball, Boyer, Martin, Mortenson

**ADJUNCT FACULTY**

**Professors** Buhler (Agricultural Chemistry), Kent (Microbiology), Larson (Forest Resources), Smith (Anthropology), Sylvia (Agricultural and Resource Economics)

**Associate Professors** Hendrichs (Environmental and Molecular Toxicology)

**Assistant Professors** Betts, Suryan

**Undergraduate Major**

**Fisheries and Wildlife Science (BS)**

See specializations section.

**Minor**

**Fisheries and Wildlife**

**Graduate Majors**

**Fisheries Science (MS, PhD)**

**Graduate Areas of Concentration**

*Aquaculture*  
*Conservation Biology*  
*Fish Genetics*  
*Ichthyology*  
*Limnology*  
*Parasites and Diseases*

*Physiology and Ecology of Marine and Freshwater Fishes*

*Stream Ecology*

*Toxicology*

*Water Pollution Biology*

**Wildlife Science (MS, PhD)**

**Graduate Areas of Concentration**

*Animal-Habitat Relationships*

*Behavior*

*Biology of Big Game and Small Mammals*

*Conservation Biology*

*Community Studies*

*Ecology of Avian and Mammalian Predators*

*Ecology of Waterfowl and Upland Gamebirds*

*Effects of Parasites, Diseases, and Environmental Contaminants*

*Nutrition*

*Population*

*Population Dynamics*

*Reproductive Biology*

*Toxicology of Pesticides*

*Wildlife Ecology*

*Wildlife-Forestry Interactions*

*Wildlife Science*

**Graduate Minors**

**Fisheries Science**

**Wildlife Science**

This department prepares students for professional careers in fisheries and wildlife as biologists, managers, consultants, and administrators. Course work leading to the BS, MAg, MS, MAIS, and PhD degrees is offered.

The undergraduate curriculum is based upon the belief that students in fisheries and wildlife should be provided with a good education in biology and ecology as the basis for careers in resource science, conservation and management. But fisheries and wildlife science is not simply a biological discipline. Educated professionals must be aware of the inherent social considerations and must operate with a perspective that is integrative. Toward this end, biological, social, economic, and political knowledge is integrated within the curriculum to provide students with a broad framework for understanding and resolving resource problems.

The undergraduate curriculum is composed of core courses as well as specializations of 42–53 credits. The core represents the educational foundation of fish and wildlife conservation, and the specializations provide the student with an opportunity to build his or her curriculum to meet specific goals. Working with faculty in formal and informal settings, students are encouraged to become engaged in designing their own education. Sample specializations might include forest wildlife management, stream ecology, fish and wildlife law en-

forcement, marine fisheries, aquaculture, conservation education and extension, fisheries business, human dimensions of resource management, conservative biology, and many others. Specializations may include typical on-campus courses, special field courses, a full term of course work at the Hatfield Marine Science Center in Newport, Oregon, or one or more terms of international exchange. Combined with required internships and a capstone group project, fisheries and wildlife science graduates will be well-prepared to begin professional careers in fish and wildlife conservation, or to continue their education in graduate school. For those students unsure of their professional goals or seeking diversity in course work, broad specializations are available.

Students planning to transfer to this department should focus on courses in general biology, general chemistry, physical science, and mathematics during their freshman and sophomore years.

Strategically located for the study of fisheries and wildlife, Oregon State University is within easy reach of state fish hatcheries; lakes, streams and public lands; refuges; experimental streams and ponds; and the Hatfield Marine Science Center at Newport. Research by the Oregon Department of Fish and Wildlife, several federal research centers, and the Cooperative Fishery and Wildlife Research Unit is of basic value to the instructional program.

Graduate programs leading to the MAg, MS, MAIS, or PhD permit intensive study in special areas of interest under the guidance of nationally known scientists. Advanced study in fisheries science may be pursued in water pollution biology, stream ecology, aquaculture, ecology of marine and freshwater fishes, taxonomy and systematics, genetics, toxicology, and parasites and diseases of fish. Advanced study in wildlife science is oriented toward resource management and can involve almost any vertebrate species, biotic community or habitat. Research emphasis may be placed on population dynamics and utilization, life history and ecology, conservative biology, habitats, food habits and nutrition, behavior, and organization of animal communities. Opportunities exist for work in terrestrial and aquatic systems.

**SPECIALIZATIONS**

Undergraduate students consult with faculty to define their career and life goals and develop a course of study to achieve those goals. Specialization plans should be developed prior to the junior year and will be presented to the faculty for review and comment. The focus of the review will be on delineation of the goals and how the proposed academic program will help the student achieve those goals.

Individual plans and titles are subject to approval by the department head. A 1-credit P/N graded course (FW 207, Specialization Development) is offered to help students define their professional goals and develop an appropriate academic plan. The following guidelines are provided to assist students in preparing a specialization.

Specializations must contain 42 to 53 credits of which a maximum of two courses may be lower division. Specializations should contain at least three 400-level fisheries and wildlife courses. A maximum of 10 credits may be taken before formulation and review of the plan. All courses in the specialization are in addition to the courses in the fisheries and wildlife core. Specializations may be given titles to reflect their content, but titles must not substantially duplicate titles of existing degree programs.

Specializations that include "fish," "fishery," or "fisheries" in the title should contain at least 12 credits of aquatic sciences. Specializations that include "wildlife" in the title should have at least 12 credits of terrestrial sciences. Specializations that include "marine" in the title should include a term of full-time enrollment (at least 12 credits) at a marine field station.

Examples of general specializations in fishery science, wildlife science, and marine resources are available in the departmental advising office.

### **FISHERIES AND WILDLIFE (BS, CRED, HBS)**

The Fisheries and Wildlife Science BS degree (180) undergraduate curriculum is composed of core courses as well as specializations of 42–53 credits. The core represents the educational foundation of fish and wildlife conservation, and the specializations provide the student with an opportunity to build his or her curriculum to meet specific goals. Working with faculty in formal and informal settings, students are encouraged to become engaged in designing their own education. The core courses required of all students seeking the BS degree are listed below.

For further information, see the Fisheries and Wildlife Website at <http://fw.oregonstate.edu/>.

### **Baccalaureate Core (48)**

#### **Communication**

COMM 111. \*Public Speaking (3)  
WR 121. \*English Composition (3)  
PHL 121. \*Reasoning and Writing (3)  
or WR 222. \*English Composition (3)

#### **Science**

BI 211, BI 212, BI 213. \*Principles of Biology (4,4,4)  
CH 121, CH 122, CH 123. General Chemistry (5,5,5)  
or CH 221, CH 222, CH 223. \*General Chemistry (5,5,5)

MTH 241. \*Calculus for Management and Social Science (4)

or MTH 251. \*Differential Calculus (4)  
**Select three additional courses from chemistry, physics, and/or geosciences (from an approved list) (9–12)**

BI 370. Ecology (3)  
ST 351, ST 352. Intro to Statistical Methods (4,4)

### **Fisheries and Wildlife Core**

FW 107. Orientation to Fisheries and Wildlife (1)  
FW 207. Specialization Development (1)  
FW 251. Principles of Fish and Wildlife Conservation (3)  
FW 255. Field Sampling of Fish and Wildlife (3)  
FW 320. Introductory Population Dynamics (3)  
FW 321. Fisheries and Wildlife Resource Ecology (3)  
FW 322. Investigations in Population Dynamics (2)

#### **Select one of the following (3):**

FW 311. Biology of Birds (3)  
FW 315. Biology of Fishes (3)  
FW 317. Biology of Mammals (3)  
Z 473. Biology of Amphibians and Reptiles (3)

#### **Select one of the following (2):**

FW 312. Systematics of Birds (2)  
FW 316. Systematics of Fishes (2)  
FW 318. Systematics of Mammals (2)  
Z 474. Systematic Herpetology (2)

#### **Select one additional course from the preceding two lists (2–3)**

#### **Select one of the following (system/application courses):**

FW 425. Field Studies in Riparian Biodiversity (5)  
FW 435. ^Wildlife in Agricultural Ecosystems (3)  
FW 453. Forest Management and Wildlife Conservation (3)  
FW 454. Fishery Biology (5)  
FW 456. Limnology (5)  
FW 458. Management of Big Game Animals (4)  
FW 473. Fish Ecology (4)  
FW 475. Wildlife Behavior (4)  
FW 479. Wetlands and Riparian Ecology (3)  
FW 481. Wildlife Ecology (4)

#### **Select three courses in the Human Dimension of Natural Resources from an approved list (9–12):**

FW 410. Internship (2 required) (4–6)  
FW 441. Intro to Group Problem Solving (1)  
FW 442. Problem Definition and Analysis in Fisheries and Wildlife (2)  
FW 443. Problem Analysis and Resolution in Fisheries and Wildlife (3)  
or FW 444. ^Problem Analysis and Resolution in Fisheries and Wildlife (3)

### **FISHERIES AND WILDLIFE MINOR**

A sequence in general zoology or general biology is a prerequisite to the Fisheries and Wildlife minor (27).

#### **Required**

BI 370. Ecology (3) EC

FW 251. Principles of Fish and Wildlife Conservation (3) EC

#### **Select a minimum of 7 credits from the following (7–9):**

FW 311. Biology of Birds (3) EC  
FW 312. Systematics of Birds (2) EC  
FW 315. Biology of Fishes (3) EC  
FW 316. Systematics of Fishes (2)  
FW 317. Biology of Mammals (3) EC  
FW 318. Systematics of Mammals (2)  
Z 473. Biology of Amphibians and Reptiles (3)  
Z 474. Systematic Herpetology (2)

#### **Select 12–14 credits from the following:**

FW 303. Survey of Geographic Information Systems in Natural Resources (3) EC only  
FW 320. Introductory Population Dynamics (3) EC  
FW 321. Fisheries and Wildlife Resource Ecology (3) EC  
FW 323. Management Principles of Pacific Salmon in the Northwest (3) EC only  
FW 326. Integrated Watershed Management (3) EC only  
FW 328. Wildlife Capture and Immobilization (2)  
FW 340. \*Multicultural Perspectives in Natural Resources (3) EC  
FW 350. \*Endangered Species, Society and Sustainability (3)  
FW 420. Ecology and Management of Marine Fishes (3) HMSC  
FW 426. Coastal Ecology and Resource Management (5) HMSC  
FW 427. Principles of Wildlife Diseases (4)  
FW 431. Dynamics of Marine Biological Resources (4) HMSC  
FW 435. ^Wildlife in Agricultural Ecosystems (3) EC  
FW 445. Ecological Restoration (4)  
FW 446. Wildland Fire Ecology (3) EC  
FW 451. Avian Conservation and Management (5)  
FW 453. Managed Forest and Wildlife Conservation (3)  
FW 454. Fishery Biology (5) HMSC  
FW 456. Limnology (5)  
FW 458. Management of Big Game Animals (4)  
FW 465. Marine Fisheries (4) HMSC  
FW 470. \*Ecology and History: Landscapes of the Columbia Basin (3) EC only  
FW 473. Fish Ecology (4)  
FW 475. Wildlife Behavior (4)  
FW 479. Wetland and Riparian Ecology (3) EC  
FW 481. Wildlife Ecology (3) EC  
FW 485. \*Consensus and Natural Resources (3) EC only  
FW 494. Parasites and Diseases of Marine and Anadromous Fishes (5) HMSC  
FW 499. Special Topics/Fisheries and Wildlife (1–6)

#### **Footnotes:**

^ Writing intensive course

\* Baccalaureate core course

EC=Extended Campus format

EC only=Available only through Extended Campus

HMSC=Offered at Hatfield Marine Science Center, Newport

**FISHERIES SCIENCE  
(MAG, MS, PhD)**

**Graduate Areas of Concentration**  
*Aquaculture, conservation biology, fish genetics, ichthyology, limnology, parasites and diseases, physiology and ecology of marine and freshwater fishes, stream ecology, toxicology, water pollution biology*

The Department of Fisheries and Wildlife offers graduate work leading to the Master of Science and Doctor of Philosophy degrees with majors in fisheries science. The department participates in the Master of Agriculture and the Master of Arts in Interdisciplinary Studies degree in its natural resources management program. Students who cannot be admitted to the department graduate programs because of space limitation and who may wish to improve their background for future admission must confer with the Graduate School for special student consideration.

Fisheries research in graduate studies involves quantitative analyses of marine and freshwater fish populations, water quality, fish systematics, fish and invertebrate physiology, stream ecology, modeling of aquatic ecosystems, land use interactions, endangered species, conservation biology, and aquaculture.

The Oregon Cooperative Fish and Wildlife Research Unit has active research programs funded in part by the Oregon Department of Fish and Wildlife and the Biological Resources Division of the U.S. Geological Survey. The Agricultural Experiment Station, the Sea Grant program, Forest Science Laboratory and other organizations fund major research projects. The department maintains extensive collections of vertebrate species, which are curated by Doctors Markle (fish), Coblentz (mammals), and Dugger (birds).

**WILDLIFE SCIENCE  
(MAG, MS, PhD)**

Graduate Areas of Concentration  
Animal-habitat relationships; behavior; biology of big game and small mammals; conservation biology; community studies; ecology of avian and mammalian predators; ecology of waterfowl and upland gamebirds; effects of parasites, diseases, and environmental contaminants; nutrition; population; population dynamics; reproductive biology; toxicology of pesticides; wildlife ecology; wildlife-forestry interactions; wildlife science

The Department of Fisheries and Wildlife offers graduate work leading to the Master of Science and Doctor of Philosophy degrees with majors in wildlife science. The department participates in the Master of Agriculture and the Master of Arts in Interdisciplinary Studies degree in its natural resources management program. Students who cannot be admitted

to the department graduate programs because of space limitation and who may wish to improve their background for future admission must confer with the Graduate School for special student consideration.

The wildlife graduate program in the Department of Fisheries and Wildlife includes wildlife research concerning interaction of wildlife with land uses, migratory waterfowl, upland game birds, forest bird communities, endangered species, population dynamics, and conservation biology.

The Oregon Cooperative Fish and Wildlife Research Unit has active research programs funded in part by the Oregon Department of Fish and Wildlife and the Biological Resources Division of the U.S. Geological Survey. The Agricultural Experiment Station, the Sea Grant program, Forest Science Laboratory and other organizations fund major research projects. The department maintains extensive collections of vertebrate species, which are curated by Doctors Markle (fish), Coblentz (mammals), and Dugger (birds).

**FISHERIES SCIENCE  
GRADUATE MINOR**

For more details, see the departmental advisor.

**WILDLIFE SCIENCE  
GRADUATE MINOR**

For more details, see the departmental advisor.

**COURSES**

**FW 107. ORIENTATION TO FISHERIES AND WILDLIFE (1).** Information relevant to academic pathways and career planning in the fields of fisheries and wildlife. Graded P/N.

**FW 111. INTRODUCTION TO MARINE LIFE IN THE SEA (1).** A field-focused learning experience, this inquiry-based course is a basic overview of the marine life and environment on the Oregon coast, including rocky shores, sandy beaches, mud flats, bays, estuaries, and watersheds. Through lectures, lab and field experiences, students will examine important marine organisms in their habitat, exploring their ecological niches and adaptations to their environment along the Oregon coast. Graded P/N. **CROSSLISTED** as BI 111. **PREREQS:** High school biology and chemistry.

**FW 199. SPECIAL STUDIES (1-16).** Graded P/N.

**FW 199H. SPECIAL STUDIES (1-16).** Graded P/N. **PREREQS:** Honors College approval required.

**FW 207. SPECIALIZATION DEVELOPMENT (1).** Students will examine career alternatives, develop career goals, learn what knowledge, skills, and abilities are important for diverse careers in fisheries and wildlife conservation, and develop an academic and lifelong plan for achieving their career goals. This course is intended to assist students in developing a specialization in fisheries and wildlife science. Graded P/N.

**FW 251. PRINCIPLES OF FISH AND WILDLIFE CONSERVATION (3).** History of conservation and natural resource use; ecological principles, and social and economic limitations of conservation;

principles and practices of wildlife and fisheries management; role of research in management.

**FW 255. FIELD SAMPLING OF FISH AND WILDLIFE (3).** Introduction to sampling populations and communities of vertebrate animals emphasizing sampling design, collection and management of data, and communication of results. Weekend field trips. Laboratory fee assessed. **PREREQS:** WR 121, familiarity with personal computers.

**FW 268. MATHEMATICAL IDEAS IN BIOLOGY (4).** Mathematical models of biological systems, with emphasis on population dynamics and ecology. Integral calculus with applications to biology. **CROSSLISTED** as MTH 268. **PREREQS:** MTH 251.

**FW 302. BIOLOGY AND CONSERVATION OF MARINE MAMMALS (4).** An examination of the biology of whales, pinnipeds, and other marine mammals, including general adaptations to a marine existence; systematics and biogeography; reproduction; diving physiology; communication and echolocation; feeding and migratory behavior; and marine mammal/human interactions; including conservation issues. **CROSSLISTED** as BI 302. Taught at Hatfield Marine Science Center. **PREREQS:** One year of introductory biology is mandatory.

**FW 303. SURVEY OF GEOGRAPHIC INFORMATION SYSTEMS IN NATURAL RESOURCE (3).** Concepts underlying geographic information systems, global positioning system, and remote sensing; application to management and research, data quality issues, and case studies. Not a lab/skills class.

**FW 311. BIOLOGY OF BIRDS (3).** Survey of the adaptations of birds to a diverse array of habitats. Topics include origins, anatomy, reproductive strategies, migration, flight, behavior, physiology, nutrition, and conservation. **PREREQS:** One year introductory biology.

**FW 312. SYSTEMATICS OF BIRDS (2).** External anatomy, classification of birds of the world, and field identification of birds by sight and song. Field trips required. **PREREQS:** One year introductory biology.

**FW 315. BIOLOGY OF FISHES (3).** A survey of the diversity of biological adaptations of fishes. Topics include physiological and zoogeographical adaptations, reproduction, evolution, cladogenesis, morphology, behavior, and genetics. **PREREQS:** One year introductory biology.

**FW 316. SYSTEMATICS OF FISHES (2).** Phylogenetic diversity of fishes, especially Oregon fishes. Includes identification, anatomy, use of keys, taxonomy, and field collections. **PREREQS:** One year introductory biology.

**FW 317. BIOLOGY OF MAMMALS (3).** A survey of the origins, evolution, diversity, and adaptations of mammals to diverse environments. Topics include taxonomy, reproduction, sensory perception, herbivory, population cycles and behavior. **PREREQS:** One year introductory biology.

**FW 318. SYSTEMATICS OF MAMMALS (2).** A survey of the phylogenetic diversity of the mammals in Oregon from a habitat/community perspective. Identifying, using keys, and measuring specimens will be stressed. **PREREQS:** One year introductory biology.

**FW 320. INTRODUCTORY POPULATION DYNAMICS (3).** Principles and concepts of population dynamics related to fish and wildlife populations; methods of estimating abundance and mortality; models for population and yield analysis. **PREREQS:** (BI 370 or BI 370H or BI 371) and MTH 111, Concurrent enrollment in FW 322 is required for fisheries and wildlife majors.

**FW 321. FISHERIES AND WILDLIFE RESOURCE ECOLOGY (3).** Perspectives in community and ecosystem ecology, including ecosystem classification, and their use in

management of fisheries and wildlife resource systems. **PREREQS:** FW 320.

**FW 322. INVESTIGATIONS IN POPULATION DYNAMICS (2).** Combined laboratory, recitation, and lecture designed to explore concepts of the dynamics of real and simulated populations. **PREREQS:** FW 320\*, BI 370 or BI 371 and MTH 111. (Concurrent enrollment in FW 320 is required for all FW majors, others by instructor approval.)

**FW 323. MANAGEMENT PRINCIPLES OF PACIFIC SALMON IN THE NORTHWEST (3).** A 28-session video course exploring the nature of the salmon problem in the Northwest. Experts from diverse disciplines describe principles of salmon biology, habitat ecology and management, socioeconomics of direct and indirect users, and government policies.

**FW 325. \*GLOBAL CRISES IN RESOURCE ECOLOGY (3).** Historical and contemporary implications of the impacts of burgeoning human populations on rates and patterns of global ecological change. Changes in ecosystem processes and crises of species extinction in the context of cultural and political institutions. (Bacc Core Course).

**FW 326. INTEGRATED WATERSHED MANAGEMENT (3).** A comprehensive approach to watershed management, one that includes biophysical, socioeconomic, planning and education related topics. Intended for students interested in the sustainable management of natural resources. **PREREQS:** FW 251.

**FW 328. WILDLIFE CAPTURE AND IMMOBILIZATION (2).** Manual and chemical restraint methods are covered with an emphasis on darting equipment, animal and human safety, drug pharmacology and species specific recommendations. Lec/lab.

**FW 340. \*MULTICULTURAL PERSPECTIVES IN NATURAL RESOURCES (3).** Explores multicultural influences on development of natural resources in the American West. Effects of diverse social values on changes in the physical landscape and biodiversity. (Bacc Core Course)

**FW 341. FISH AND WILDLIFE LAW ENFORCEMENT (2).** Introduction to the philosophy, purposes, and methods of enforcing natural resource laws, emphasizing fish and wildlife laws.

**FW 346. TOPICS IN WILDLAND FIRE (3).** An interdisciplinary survey of concepts relating to fire science, ecology, management, and policy. Includes case studies of several representative ecosystems, ranging from west- and eastside forests of the Pacific Northwest to shrub steppe ecosystems of the Intermountain West and chaparral ecosystems of southern California. Distance and campus-based delivery using videos, Website, and discussion. **CROSSLISTED** as FOR 346, RNG 346. **PREREQS:** Course work in forest biology or ecology (e.g. FOR 240, FOR 341) or equivalent.

**FW 350. \*ENDANGERED SPECIES, SOCIETY AND SUSTAINABILITY (3).** Provides a general background to endangered species biology, and the social and economic implications of the legislation enacted to conserve endangered species (Endangered Species Act, CITES Treaty). (Bacc Core Course) **PREREQS:** FW 251.

**FW 401. RESEARCH (1-16).**

**FW 403. THESIS (1-16).** **PREREQS:** Departmental approval required.

**FW 405. READING AND CONFERENCE (1-16).**

**FW 407. SEMINAR (1-16).** Graded P/N. Taught at Hatfield Marine Science Center.

**FW 408. WORKSHOP (1-16).**

**FW 410. INTERNSHIP (1-6).**

**FW 415. FISHERIES AND WILDLIFE LAW AND POLICY (3).** Provides students with an

understanding of the key legal frameworks within which they will work to conserve fish and wildlife resources. Examines federal law and policy relating to allocation and conservation of fish and wildlife resources. **PREREQS:** PS 201 or other introductory political science course.

**FW 417. MEDICAL AND PUBLIC HEALTH ENTOMOLOGY (3).** Arthropod pests of man and domestic animals, including biology of pests, disease transmission mechanisms, epidemiology of important arthropod-borne diseases, and prevention and control of pest-related problems. **CROSSLISTED** as ENT 417/ENT 517 and H 417/H 517. **PREREQS:** Two terms of biology or general zoology.

**FW 420. ECOLOGY AND MANAGEMENT OF MARINE FISHES (3).** A lecture and lab course that covers the ecology of marine fishes and important ecological principles that guide conservation and management. Life history, behavior, habitat, community dynamics and ecosystem processes are emphasized, along with alternative management strategies. Taught at Hatfield Marine Science Center. **PREREQS:** FW 320 or equivalent population dynamics class and ichthyology is recommended.

**FW 421. AQUATIC BIOLOGICAL INVASIONS (4).** An overview of the background, theory, evolution, ecology, politics and conservation of invasions by introduced species in aquatic environments. **CROSSLISTED** as BI 421. Taught at Hatfield Marine Science Center. **PREREQS:** One year of university-level biology.

**FW 425. FIELD STUDIES IN RIPARIAN BIODIVERSITY (5).** Field investigations of invertebrate and vertebrate diversity in a forested ecosystem. Biodiversity and issues of scaling in stream, riparian and upslope habitats. Skills in study design, observation, sampling, analysis, and written presentation will be developed. Lec/lab. **PREREQS:** FW 255 or instructor approval, field trip with fee required.

**FW 426. COASTAL ECOLOGY AND RESOURCE MANAGEMENT (5).** Study of the ecology and management of coastal marine and freshwater ecosystems as well as natural resources, emphasizing experimental (participatory) learning in a field station setting. Lec/lab. Taught at Hatfield Marine Science Center.

**FW 427. PRINCIPLES OF WILDLIFE DISEASES (4).** Ecological aspects of important diseases affecting North American wildlife will be discussed. Demonstrations will mainly cover migratory birds, carnivores and ruminants. Lec/lab. Ecampus sections do not use lab demonstrations. **PREREQS:** Junior standing or instructor approval required.

**FW 431. DYNAMICS OF MARINE BIOLOGICAL RESOURCES (4).** Strategies of marine fishery management. A synthesis of the principles of population dynamics for single- and multi-species systems from the viewpoint of a marine resource manager. Offered alternate years. Taught at Hatfield Marine Science Center. **PREREQS:** BI 370 or BI 371.

**FW 433X. MARINE AQUACULTURE AND AQUARIUM SCIENCES (MAAS) (6).** Concepts and practices of marine aquaculture and aquarium science will be taught through lectures, laboratories, group projects and field trips during an intensive 4-week period at the Hatfield Marine Science Center. Emphasis will be placed on "hands-on" experience and working closely with professionals. **PREREQS:** One upper-division course on the biology of aquatic or marine organisms.

**FW 435. ^WILDLIFE IN AGRICULTURAL ECOSYSTEMS (3).** Examines the relationships between agricultural production and fish and wildlife populations and communities. Explores the impacts of agricultural practices on fish and wildlife. Field trips required; transportation fee charged. OSU Ecampus students are not required

to attend field trips. (Writing Intensive Course) **PREREQS:** BI 370 and FW 251.

**FW 441. INTRODUCTION TO GROUP PROBLEM SOLVING (1).** Introduction to group dynamics, problem analysis and problem solving paradigms. Students will form groups, select problem area and faculty/resource professional mentors, and develop an initial work plan to follow in FW 442 and FW 443. Each group will make an oral presentation of their problem and initial plan on a fisheries and/or wildlife topic. Taught at Hatfield Marine Science Center and Corvallis campus. **PREREQS:** FW 441, FW 442, and FW 443 must be taken in sequence.

**FW 442. PROBLEM DEFINITION AND ANALYSIS IN FISHERIES AND WILDLIFE (2).** Student groups working with mentors will define the problem selected in FW 441, collect and review relevant information, and develop a problem analysis plan on a fisheries and/or wildlife topic. Finalized plans will be presented at an open forum at the end of the term. Taught at Hatfield Marine Science Center and Corvallis campus. **PREREQS:** FW 441.

**FW 443. PROBLEM ANALYSIS AND RESOLUTION IN FISHERIES AND WILDLIFE (3).** Student groups will collect additional information as needed, analyze the information, and synthesize a resolution for the problem on a fisheries and/or wildlife topic. Groups will prepare a final written report and a poster to be presented at a senior project fair. Taught at Hatfield Marine Science Center and Corvallis campus. **PREREQS:** FW 442.

**FW 444. ^PROBLEM ANALYSIS AND RESOLUTION IN FISHERIES AND WILDLIFE (3).** Student groups will collect information, analyze the information, and synthesize a resolution to a problem on a fisheries and/or wildlife topic. Groups will prepare a final written report and a poster to be presented at a Senior Project Fair. (Writing Intensive Course). **PREREQS:** FW 441, FW 442.

**FW 445. ECOLOGICAL RESTORATION (4).** Fundamentals of restoring and reclaiming disturbed landscapes and ecosystems. Topics to be covered include types and assessment of site conditions; determining restoration goals and feasibility; hydrologic, biotic, and soil functions and their importance in restoration; and measures of successful restoration. **CROSSLISTED** as FOR 445/FOR 545. **PREREQS:** BI 370 or instructor approval required.

**FW 446. WILDLAND FIRE ECOLOGY (3).** Coverage of fire histories and ecology of major forest, rangeland and wetland ecosystems. Includes fire interactions with physical and biotic components of ecosystems, role of fire in ecological processes, and utilization in natural resource management. **CROSSLISTED** as FOR 446/FOR 546 and RNG 446/RNG 546. **PREREQS:** Course work in ecology and natural resource management.

**FW 451. AVIAN CONSERVATION AND MANAGEMENT (5).** Identification, classification, life history strategies, ecology and management of upland and migratory gamebirds. **PREREQS:** FW 311.

**FW 453. FOREST MANAGEMENT AND WILDLIFE CONSERVATION (3).** The ecology and conservation of wildlife in managed forests, the influences of forest management on wildlife and their habitats, and management of forests to achieve wildlife objectives. **CROSSLISTED** as FS 453. **PREREQS:** FOR 240\* or FOR 341\* or (BI 370\* or BI 370H\*) or equivalent course in ecology.

**FW 454. FISHERY BIOLOGY (5).** Principles and methods used in studying the biology of fishes; ecological requirements of freshwater and anadromous fishes; principles and practices in sport fishery management. Taught at Hatfield Marine Science Center. **PREREQS:** FW 320 and FW 315

**FW 455. SAMPLING AND ANALYSIS OF MARINE FISH STOCKS (3).** Field sampling of economically relevant marine fish stocks. Laboratory analysis of biological samples and computer modeling of data using general stock assessment techniques. Lec/lab. Taught at Hatfield Marine Science Center. **PREREQS:** FM 315 and FW 316 is recommended.

**FW 456. LIMNOLOGY (5).** Physical, chemical, and biological concepts in limnology and techniques related to aquatic resources and their management. Lec/lab. **PREREQS:** Senior standing.

**FW 458. MANAGEMENT OF BIG GAME ANIMALS (4).** A thorough understanding of ecology of herbivorous big game mammals. Techniques used to determine their abundance, diets, reproduction, and the cultural and political variables that contribute to formulation of management programs. **PREREQS:** 9 credits of upper-division biological sciences.

**FW 464. MARINE CONSERVATION BIOLOGY (3).** Lectures, group library research, and class debates on current issues regarding the conservation of biodiversity in the sea. Topics include overfishing, invasive species, eutrophication, marine pollution, and global warming, as well as means of addressing these threats. **CROSSLISTED** as Z 464/Z 564. **PREREQS:** BI 370 or BI 370H or equivalent; senior, postbacs, and graduate students only.

**FW 465. MARINE FISHERIES (4).** A global perspective on commercial fish and shellfish harvesting with emphasis on fishing technology and policy issues. Offered alternate years. Taught at Hatfield Marine Science Center. **PREREQS:** FW 315.

**FW 470. \*ECOLOGY AND HISTORY: LANDSCAPES OF THE COLUMBIA BASIN (3).** Integrates environmental history and landscape ecology of the Columbia River Basin from geologic origins to the present, to create an understanding of change caused by natural processes and human activities. **CROSSLISTED** as HSTS 470/HSTS 570. (Bacc Core Course) **PREREQS:** HST 201, HST 202, HST 203 or BI 370.

**FW 471. ENVIRONMENTAL PHYSIOLOGY OF FISHES (4).** Principles of the functional biology of fishes with emphasis on environmental interactions and management implications. **PREREQS:** FW 315, BI 370 or BI 371.

**FW 472. ADVANCED ICHTHYOLOGY (3).** Evolution of fishes with emphasis on the role of ontogeny; cladistic methodology and classification contrasted with traditional taxonomic approaches. **PREREQS:** Two years upper-division fisheries or zoology.

**FW 473. FISH ECOLOGY (4).** Behavior of fishes as a mode of accommodation to various ecological and evolutionary constraints. Importance of heritable and learned patterns to population and community dynamics. Application of behavioral studies to the solution of management problems. Lec/lab/rec. **PREREQS:** (BI 370 or BI 370H) and FW 315

**FW 474. EARLY LIFE HISTORY OF FISHES (4).** Overview of diversity of development patterns in fishes; emphasis on morphology, life history, and evolution. Offered alternate years. **PREREQS:** FW 315 or equivalent.

**FW 475. WILDLIFE BEHAVIOR (4).** Adaptive significance of egocentric and social behavior of wildlife species. Implications of behavior in sound management practice. **PREREQS:** 9 credits of upper-division biology.

**FW 476. FISH PHYSIOLOGY (4).** Physiological specializations and adaptations of major groups of fishes. **PREREQS:** FW 315, (CH 123 or CH 223).

**FW 479. WETLANDS AND RIPARIAN ECOLOGY (3).** Ecology of riparian freshwater and estuarine wetlands of the Pacific Northwest. Effects of land

use on ecosystem structure, function, biodiversity, and restoration will be explored. **PREREQS:** BI 370 or BI 371.

**FW 481. WILDLIFE ECOLOGY (4).** Interrelationships of wildlife, environment and humans. Evaluation of properties and habitats of wildlife populations. **PREREQS:** BI 370 or BI 370H or BI 371, FW 311, FW 320, ST 351.

**FW 482. SENIOR PROJECT (2).** Independent research project designed and conducted by student. **PREREQS:** Senior standing, ST 351.

**FW 485. \*CONSENSUS AND NATURAL RESOURCES (3).** Students will use a working group approach. They will select a natural resource topic, study the team process and interaction as a method of learning, explore the issue using systems practice, and strive for consensus on solutions to their issue. **CROSSLISTED** as ANS 485/ANS 585, FOR 485, SOC 485/SOC 585. (Bacc Core Course)

**FW 494. DISEASES AND PARASITES OF MARINE AND ANADROMOUS FISHES (3).** Emphasis on interactions between marine/anadromous fishes, disease-causing agents, and ecological conditions under which disease agents may limit populations in the marine environment. Taught at Hatfield Marine Science Center. **PREREQS:** 6 credits of upper-division biology.

**FW 497. ^AQUACULTURE (3).** Principles and practices for the aquaculture of fish, shellfish, and algae. Taught at Hatfield Marine Science Center. (Writing Intensive Course.) **PREREQS:** 9 credits of upper-division biology.

**FW 498. AQUACULTURE LABORATORY (3).** Biology and culture requirements of fish, shellfish, and algae. Emphasis on laboratory culture techniques and practical experience in handling organisms. Taught at Hatfield Marine Science Center. **PREREQS:** 9 credits of upper-division biology.

**FW 499. SPECIAL TOPICS IN FISHERIES AND WILDLIFE (1-6).** Various topics in fisheries science and wildlife science. May be repeated for up to 12 credits. **CROSSLISTED** as ENT 499. Taught at Hatfield Marine Science Center and Corvallis campus.

**FW 501. RESEARCH (1-16).**

**FW 503. THESIS (1-16).**

**FW 505. READING AND CONFERENCE (1-16).**

**FW 507. SEMINAR (1-16).** Selected Topics. Taught at Hatfield Marine Science Center and Corvallis campus.

**FW 508. WORKSHOP (1-16).**

**FW 511. CONSERVATION AND MANAGEMENT OF MARINE MAMMALS (4).** Ecology, conservation and management of marine mammals. Topics include natural history, ecology, taxonomy and conservation. Intended primarily for science teachers. Taught summer term at Hatfield Marine Science Center.

**FW 515. FISHERIES AND WILDLIFE LAW AND POLICY (3).** Provides students with an understanding of the key legal frameworks within which they will work to conserve fish and wildlife resources. Examines federal law and policy relating to allocation and conservation of fish and wildlife resources. **PREREQS:** PS 201 or other introductory political science course.

**FW 517. MEDICAL AND PUBLIC HEALTH ENTOMOLOGY (3).** Arthropod pests of man and domestic animals, including biology of pests, disease transmission mechanisms, epidemiology of important arthropod-borne diseases, and prevention and control of pest-related problems. **CROSSLISTED** as ENT 417/ENT 517 and H 417/H 517. **PREREQS:** Two terms of biology or general zoology.

**FW 518X. ANIMAL POPULATION DYNAMICS (3).** Designed for students who wish to develop

a solid understanding of basic animal population dynamics. Serves as useful background to FW 661, Analysis of Animal Populations, and is designed to complement FW 586, Genetics and Demography of Small Populations, and FW 599, Essential Models of Ecology.

**FW 520. ECOLOGY AND MANAGEMENT OF MARINE FISHES (3).** A lecture and lab course that covers the ecology of marine fishes and important ecological principles that guide conservation and management. Life history, behavior, habitat, community dynamics and ecosystem processes are emphasized, along with alternative management strategies. Taught at Hatfield Marine Science Center. **PREREQS:** FW 320 or equivalent population dynamics class, ichthyology.

**FW 521. AQUATIC BIOLOGICAL INVASIONS (4).** An overview of the background, theory, evolution, ecology, politics and conservation of invasions by introduced species in aquatic environments. **CROSSLISTED** as BI 421. Taught at Hatfield Marine Science Center. **PREREQS:** One year of university-level biology.

**FW 525. FIELD STUDIES IN RIPARIAN BIODIVERSITY (5).** Field investigations of invertebrate and vertebrate diversity in a forested ecosystem. Biodiversity and issues of scaling in stream, riparian and upslope habitats. Skills in study design, observation, sampling, analysis, and written presentation will be developed. Lec/lab. Field trip with fee required. **PREREQS:** FW 255 or instructor approval.

**FW 526. COASTAL ECOLOGY AND RESOURCE MANAGEMENT (5).** Study of the ecology and management of coastal marine and freshwater ecosystems as well as natural resources, emphasizing experimental (participatory) learning in a field station setting. Lec/lab. Taught at Hatfield Marine Science Center.

**FW 527. PRINCIPLES OF WILDLIFE DISEASES (4).** Ecological aspects of important diseases affecting North American wildlife will be discussed. Demonstrations will mainly cover migratory birds, carnivores and ruminants. Lec/lab. Ecampus sections do not use lab demonstrations. **PREREQS:** Junior standing or instructor approval required.

**FW 531. DYNAMICS OF MARINE BIOLOGICAL RESOURCES (4).** Strategies of marine fishery management. A synthesis of the principles of population dynamics for single- and multi-species systems from the viewpoint of a marine resource manager. Offered alternate years. Taught at Hatfield Marine Science Center. **PREREQS:** BI 370 or BI 371.

**FW 533X. MARINE AQUACULTURE AND AQUARIUM SCIENCE (6).** Concepts and practices of marine aquaculture and aquarium science will be taught through lectures, laboratories, group projects and field trips during an intensive 4-week period at the Hatfield Marine Science Center. Emphasis will be placed on "hands-on" experience and working with professionals. **PREREQS:** One upper-division course on the biology of aquatic or marine organisms.

**FW 535. WILDLIFE IN AGRICULTURAL ECOSYSTEMS (3).** Examines the relationships between agricultural production and fish and wildlife populations and communities. Explores the impacts of agricultural practices on fish and wildlife. Field trips required; transportation fee charged. OSU Ecampus students are not required to attend field trips. **PREREQS:** BI 370 and FW 251.

**FW 545. ECOLOGICAL RESTORATION (4).** Fundamentals of restoring and reclaiming disturbed landscapes and ecosystems. Topics to be covered include types and assessment of site conditions; determining restoration goals and feasibility; hydrologic, biotic, and soil functions and their importance in restoration; and measures of successful restoration. **CROSSLISTED** as FOR

445/FOR 545. **PREREQS:** BI 370 or instructor approval required.

**FW 546. WILDLAND FIRE ECOLOGY (3).** Coverage of fire histories and ecology of major forest, rangeland and wetland ecosystems. Includes fire interactions with physical and biotic components of ecosystems, role of fire in ecological processes, and utilization in natural resource management. **CROSSLISTED** as FOR 446/FOR 546 and RNG 446/RNG 546. **PREREQS:** Course work in ecology and natural resource management.

**FW 551. AVIAN CONSERVATION & MANAGEMENT (5).** Identification, classification, life history strategies, ecology and management of upland and migratory gamebirds. **PREREQS:** FW 311.

**FW 553. FOREST WILDLIFE HABITAT MANAGEMENT (4).** Management of terrestrial vertebrates in forest ecosystems. Effects on silvicultural practices and landscape pattern on habitats and populations. **CROSSLISTED** as FS 553. **PREREQS:** FOR 341 or equivalent course in ecology.

**FW 554. FISHERY BIOLOGY (5).** Principles and methods used in studying the biology of fishes; ecological requirements of freshwater and anadromous fishes; principles and practices in sport fishery management. Taught at Hatfield Marine Science Center. **PREREQS:** FW 315, FW 320.

**FW 555. SAMPLING AND ANALYSIS OF MARINE FISH STOCKS (3).** Field sampling of economically relevant marine fish stocks. Laboratory analysis of biological samples and computer modeling of data using general stock assessment techniques. Lec/lab. Taught at Hatfield Marine Science Center. **PREREQS:** FW 316 and FW 316 are recommended.

**FW 556. LIMNOLOGY (5).** Physical, chemical, and biological concepts in limnology and techniques related to aquatic resources and their management. Lec/lab. **PREREQS:** Senior standing.

**FW 558. MANAGEMENT OF BIG GAME ANIMALS (4).** A thorough understanding of ecology of herbivorous big game mammals. Techniques used to determine their abundance, diets, reproduction, and the cultural and political variables that contribute to formulation of management programs. **PREREQS:** 9 credits of upper-division biological sciences.

**FW 563. CONSERVATION BIOLOGY OF WILDLIFE (3).** Overview of the field of conservation biology with emphasis on the relationship to conservation and management of wildlife.

**FW 564. MARINE CONSERVATION BIOLOGY (3).** Lectures, group library research, and class debates on current issues regarding the conservation of biodiversity in the sea. Topics include overfishing, invasive species, eutrophication, marine pollution, and global warming, as well as means of addressing these threats. **CROSSLISTED** as Z 464/Z 564. **PREREQS:** BI 370 or BI 370H or equivalent; senior, postbacs, and graduate students only.

**FW 565. MARINE FISHERIES (4).** A global perspective on commercial fish and shellfish harvesting with emphasis on fishing technology and policy issues. Offered alternate years. Taught at Hatfield Marine Science Center. **PREREQS:** FW 315.

**FW 570. ECOLOGY AND HISTORY: LANDSCAPES OF THE COLUMBIA BASIN (3).** Integrates environmental history and landscape ecology of the Columbia River Basin from geologic origins to the present, to create an understanding of change caused by natural processes and human activities. **CROSSLISTED** as HSTS 470/HSTS 570. **PREREQS:** HST 201, HST 202, HST 203 or BI 370.

**FW 571. ENVIRONMENTAL PHYSIOLOGY OF FISHES (4).** Principles of the functional biology of fishes with emphasis on environmental interactions and management implications. **PREREQS:** FW 315, BI 370 or BI 371.

**FW 572. ADVANCED ICHTHYOLOGY (3).** Evolution of fishes with emphasis on the role of ontogeny; cladistic methodology and classification contrasted with traditional taxonomic approaches. **PREREQS:** Two years upper-division fisheries or zoology.

**FW 573. FISH ECOLOGY (4).** Behavior of fishes as a mode of accommodation to various ecological and evolutionary constraints. Importance of heritable and learned patterns to population and community dynamics. Application of behavioral studies to the solution of management problems. Lec/lab/rec. **PREREQS:** BI 370, FW 315.

**FW 574. EARLY LIFE HISTORY OF FISHES (4).** Overview of diversity of development patterns in fishes; emphasis on morphology, life history, and evolution. Offered alternate years. **CROSSLISTED** as OC 574. **PREREQS:** FW 315 or equivalent.

**FW 575. WILDLIFE BEHAVIOR (4).** Adaptive significance of egocentric and social behavior of wildlife species. Implications of behavior in sound management practice. **PREREQS:** 9 credits of upper-division biology.

**FW 576. FISH PHYSIOLOGY (4).** Physiological specializations and adaptations of major groups of fishes. **PREREQS:** FW 315, (CH 123 or CH 223).

**FW 579. WETLANDS AND RIPARIAN ECOLOGY (3).** Ecology of riparian freshwater and estuarine wetlands of the Pacific Northwest. Effects of land use on ecosystem structure, function, biodiversity, and restoration will be explored. **PREREQS:** BI 370 or BI 371.

**FW 580. STREAM ECOLOGY (3).** Structure and function of stream ecosystems, with emphasis on biological processes; physical and chemical relations; riparian influences and landscape perspectives. **PREREQS:** 9 credits of upper-division science.

**FW 581. WILDLIFE ECOLOGY (4).** Interrelationships of wildlife, environment and humans. Evaluation of properties and habitats of wildlife populations. **PREREQS:** BI 370 or BI 371; FW 311, FW 320, ST 351.

**FW 585. CONSENSUS AND NATURAL RESOURCES (3).** Students will use a working group approach. They will select a natural resource topic, study the team process and interaction as a method of learning, explore the issue using systems practice, and strive for consensus on solutions to their issue. **CROSSLISTED** as ANS 485/ANS 585, FOR 485, SOC 485/SOC 585.

**FW 586. GENETICS AND DEMOGRAPHY OF SMALL POPULATIONS (3).** Factors affecting species persistence, viability models, and implications for conservation. Offered alternate years. **PREREQS:** Ecology, genetics.

**FW 590. COASTAL POPULATION GENETICS AND CONSERVATION (6).** Hands-on application of molecular population genetics in coastal fishery management and conservation, study design, DNA extraction, PCR, analysis techniques, paper review and write-up. Taught at Hatfield Marine Science Center. **PREREQS:** BI 311 or equivalent introductory genetics course.

**FW 594. DISEASES AND PARASITES OF MARINE FISHES AND INVERTEBRATES (3).** Emphasis on interactions between marine/anadromous fishes, disease-causing agents, and ecological conditions under which disease agents may limit populations in the marine environment. Taught at Hatfield Marine Science Center. **PREREQS:** 6 credits of upper-division biology.

**FW 597. AQUACULTURE (3).** Principles and practices for the aquaculture of fish, shellfish, and algae. Taught at Hatfield Marine Science Center. **PREREQS:** 9 credits of upper-division biology.

**FW 598. AQUACULTURE LABORATORY (3).** Biology and culture requirements of fish, shellfish, and algae. Emphasis on laboratory culture techniques and practical experience in handling organisms. Taught at Hatfield Marine Science Center. **PREREQS:** 9 credits of upper-division biology.

**FW 599. SPECIAL TOPICS IN FISHERIES AND WILDLIFE (1-6).** Various topics in fisheries science and wildlife science. May be repeated for up to 12 credits. **CROSSLISTED** as ENT 499. Taught at Hatfield Marine Science Center and Corvallis campus.

**FW 601. RESEARCH (1-16).**

**FW 603. THESIS (1-16).**

**FW 605. READING AND CONFERENCE (1-16).**

**FW 606. PROJECTS (1-16).**

**FW 607. SEMINAR (1-16).**

**FW 620. ECOLOGICAL POLICY (3).** Policy issues associated with ecosystem management, risk assessment, biological diversity, ecosystem health, sustainability, invasive species, bioregionalism, globalization and transnational factors, and rights, ethics, and morals. **PREREQS:** Background in natural resources, environmental sciences, ecological sciences, ecological economics, political science, or similar discipline.

**FW 661. ANALYSIS OF ANIMAL POPULATIONS (5).** Quantitative methods for estimating parameters (abundance, survival, population stability) of animal populations. Emphasis is on vertebrate animals and statistical methods of hypothesis testing, parameter estimation, and inference testing. Offered odd-numbered years. **PREREQS:** ST 511, ST 512 or equivalent.

**FW 667. RESEARCH PERSPECTIVES (4).** Critical evaluation of philosophical perspectives in resource science and management. The aim of the course is to help students develop their own philosophical views through discussion of dominant perspectives and their problems and suggestion of potentially more adequate views. **PREREQS:** 9 credits of upper-division science, philosophy or natural resources.

**FW 699. SPECIAL TOPICS IN FISHERIES AND WILDLIFE (1-4).** Various topics in fisheries science and wildlife science. May be repeated for up to 6 credits. Taught at Hatfield Marine Science Center and Corvallis campus.

**FW 808. WORKSHOP (1-16).**

## FOOD SCIENCE AND TECHNOLOGY

### Robert J. McGorrin, *Head*

100 Wiegand Hall  
Oregon State University  
Corvallis, OR 97331-6602  
541-737-3131  
E-mail: robert.mcgorrin@oregonstate.edu  
Website: <http://oregonstate.edu/dept/foodsci/>

### FACULTY

**Professors** Daeschel, Dutson, McDaniel, McGorrin, Morrissey, Park, Zhao

**Associate Professors** Bakalinsky, Goddik, Kennedy, Penner, Qian, Ross, Shellhammer, Su, Torres

**Assistant Professors** Lim, Osborne  
**Instructor** Smith

### Undergraduate Major

#### Food Science and Technology (BS)

##### Options

*Food Science*  
*Fermentation Science*  
*Enology and Viticulture*

### Minors

Fermentation Science

Food Science

Food Technology

### Graduate Major

#### Food Science and Technology (MS, PhD)

##### Graduate Areas of Concentration

*Brewing*  
*Enology*  
*Flavor Chemistry*  
*Food Chemistry/Biochemistry*  
*Food Engineering*  
*Food Microbiology/Biotechnology*  
*Food and Seafood Processing*  
*Sensory Evaluation*

### Graduate Minor

#### Food Science and Technology

Food science and technology concerns the chemistry and engineering necessary to deliver safe, convenient food products from the farm gate to the food marketer. The academic program integrates principles and concepts in the physical, biological, and engineering sciences, and applies them to the scientific and technological aspects of food processing. The role of the food scientist is to successfully integrate these disciplines to assure an abundant, high quality, and nutritious food supply.

The core curriculum is approved and certified by the education committee of the Institute of Food Technologists, the professional society of international

food scientists. This curriculum allows students to select elective credits to gain added expertise in special areas such as biology, business, chemistry, or nutrition. Faculty advisors provide one-on-one guidance, undergraduate research projects, and assistance in career decisions, summer job selection, scholarship opportunities, and job selection among the many placement opportunities in the food industry.

Food science and technology majors must earn an overall GPA of 2.00 in those courses specified for the FST degree. Students should consult with their advisor prior to exercising the S/U grading option. S/U grading is permitted only for elective courses and courses in specified baccalaureate core areas.

Graduate programs leading to the MS or PhD degree in food science permit intensified study in subject areas of special interest. Research areas in the department include both basic and applied aspects of chemistry/biochemistry, microbiology/biotechnology, sensory analysis, and food engineering. Research in food processing operations covers a number of food commodities such as cereal products, dairy products, fruits, vegetables, meats, seafoods, wines and beers.

Departmental facilities include well-equipped laboratories, a pilot plant, a winery, and a micro-brewery for instruction and research. Research facilities also are available at the Coastal Oregon Marine Experiment Station Seafood Laboratory at Astoria and the Food Innovation Center in Portland, Oregon.

### WORK EXPERIENCE AND INTERSHIPS

Because of the educational value of professional work experience, the department strongly encourages students to gain practical work experience during summer and fall terms. Students typically work in brewing, dairy processing, and seasonal fruit and vegetable processing. Students may earn internship credit with prior approval of the department and of the employer. OSU students may also participate in Alaska and international internship programs.

### SCHOLARSHIPS

The College of Agricultural Sciences, the department, the food industry, and the Institute of Food Technologists offer over 25 merit and financial need scholarships to encourage students preparing for careers in the food industry. For more information, contact the department, 737-3131, and the Office of Financial Aid and Scholarships, 737-2241.

### CAREER OPPORTUNITIES

Career opportunities in the food, brewing, and enology industries include

management, research and development, process and production supervision, quality assurance, distribution, sales, marketing, consulting, and trade associations. Food science and technology graduates hold teaching, research and extension positions with colleges and universities. Governmental agencies employ food scientists for work in regulatory control, research, and the development of food standards.

### FST GRADE POLICY AND REQUIREMENTS

1. All courses in FST, science and mathematics that are required for the major, including option requirements, must be passed on the A-F grading scale.
2. Within the Baccalaureate Core, writing courses that are specified by the Department of Food Science, namely WR 121 and WR 222 and WR 327, are to be taken for a grade (A/F).
3. Any other courses, including Baccalaureate Core courses (except for those included in items 1 and 2 above), may be taken on an S/U graded basis, to the maximum allowable (36 credits) by the university. To remain in good standing, and be eligible for graduation, a student must maintain a cumulative GPA of at least 2.00 for all OSU course work.
4. Further, to ensure students and future employers of competence in this discipline, FST has an additional grade point average requirement in order to fulfill the major. The cumulative GPA for food and related science courses required in the major must also be at least 2.00.

### FOOD SCIENCE AND TECHNOLOGY (BS, CRED, HBS)

#### Food Science and Technology Core (75)

##### Food Science and Technology Courses

BEE 452. Intro to Process Engineering (4)  
BEE 453. Intro to Process  
Engineering Design (4)  
FST 360. Food Safety and Sanitation (3)  
FST 407. Senior Seminar (1)  
FST 421. \*Food Law (3)  
FST 422. Food Chemistry (5)  
FST 479. Fermentation Microbiology (3)

##### Chemistry/Biochemistry Courses

CH 221, CH 222, CH 223. \*General  
Chemistry (5,5,5)  
CH 324. Quantitative Analysis (4)  
CH 331, CH 332. Organic Chemistry (4,4)  
CH 337. Organic Chemistry Lab (4)

##### Physics/Mathematics Courses

PH 201. \*General Physics (5)  
ST 351. Intro to Statistical Methods (4)

##### Biological Science Courses

BI 212. \*Principles of Biology (4)

MB 302. General Microbiology (3)  
 MB 303. General Microbiology Lab (2)

**Footnote:**

\* Bacc Core Course  
 ^ Writing Intensive Course

**ENOLOGY AND VITICULTURE OPTION**

The wine industry in the United States is a west coast-centered industry, with about 95% of our nation's wines produced on the west coast. Oregon is second in the nation in terms of number of wineries and fourth in the nation in total volume of wine produced. The Oregon wine industry is a rapidly growing industry, and is becoming increasingly important to the larger Oregon economy.

The Enology and Viticulture option within the Department of Food Science and Technology prepares students to become successful winemakers. Courses in enology, taught by food science faculty, provide a scientifically-based understanding of wine production. Supporting course work in horticulture, botany and crop and soil science, helps students develop an understanding of the interaction between grape production and wine-making. Graduates in this option will possess the necessary breadth and depth of knowledge and associated practical skills to become independently thinking and successful winemakers.

**Food Science and Technology Courses:**

FST 251. Introduction to Wines, Beers, and Spirits (3)  
 or HORT 251. Temperate Tree Fruit, Berries, Grapes and Nuts (2)  
 FST 424. ^Food Formulation Chemistry (3)  
 FST 466. Wine Production Principles (3)  
 FST 467. Wine Production and Analysis (2)  
 FST 468. Sensory Evaluation of Wines (2)  
 FST 480. Topics in Fermentation (1-2)

**Mathematics Course:**

MTH 241. \*Calculus for Management and Social Science (4)

**Biological Science Courses:**

BI 211. \*Principles of Biology (4)  
 BI 213. \*Principles of Biology (4)  
 BOT 331. Plant Physiology (4)  
 HORT 301. Principles of Horticultural Technology (4)  
 HORT 316. M/Plant Nutrition (4)  
 HORT 453. Viticulture I (3)  
 HORT 454. Viticulture II (3)

**Choose one course from the following:**

BOT 350. Introductory Plant Pathology (4)  
 CSS 311. Introduction to Insect Pest Management (5)  
 CSS 440. Weed Management (4)

**Choose one course from the following:**

BB 350. Elementary Biochemistry (4)  
 BI 314. Cell and Molecular Biology (4)

**Crop and Soil Science Course:**

CSS 305. Principles of Soil Science (4)

**FERMENTATION SCIENCE OPTION**

The Fermentation Science option is approved by the Institute of Food Technologists.

**Physics/Mathematics Courses:**

PH 202. \*General Physics (5)

**Choose one of the following course pairs:**

MTH 251. \*Differential Calculus (4)  
 MTH 252. Integral Calculus (4)  
 or  
 MTH 112. \*Elementary Functions (4)  
 MTH 241. \*Calculus for Management and Social Science (4)

**Nutrition,**

**Biology/Biochemistry Courses:**

**Choose one of the following:**

NFM 225. Human Nutrition (3)  
 NFM 240. Human Nutrition (3)

**Choose one of the following:**

BI 314. Cell and Molecular Biology (4)  
 BB 350. Elementary Biochemistry (4)

**Food Science**

**and Technology Courses:**

FST 423. Food Analysis (4)  
 FST 460. Brewing Science (3)  
 FST 461. ^Brewing Analysis (3)  
 FST 466. Wine Production Principles (3)  
 FST 467. Wine Production and Analysis (2)  
 FST 468. Sensory Evaluation of Wines (2)  
 FST 480. Topics in Fermentation (1-2) *to be taken for a total of 2 credits*  
 FST 490. Food Processing Calculations (2)  
 FST 491. Food Processing Calculations Laboratory (1)  
 FST 495. Food Packaging (2)  
 MB 440. Food Microbiology (3)  
 MB 441. Food Microbiology Lab (2)

**FOOD SCIENCE OPTION**

The Food Science option is approved by the Institute of Food Technologists.

**Physics/Mathematics Courses**

MTH 251. \*Differential Calculus (4)  
 MTH 252. Integral Calculus (4)  
 PH 202. \*General Physics (5)  
 ST 352. Intro to Statistical Methods (4)

**Nutrition and**

**Biochemistry Courses**

**Choose one of the following:**

NFM 225. Human Nutrition (3)  
 NFM 240. Human Nutrition (3)

**Choose one of the following:**

BB 350. Elementary Biochemistry (4)  
 BB 450. General Biochemistry (4)  
 Food Science and Technology Courses  
 FST 210. Fruit and Vegetable Processing (3)  
 FST 212. Dairy Processing (2)  
 FST 213. Dairy Processing Lab (1)  
 FST 420. Sensory Evaluation of Food (3)  
 FST 423. Food Analysis (4)  
 FST 424. ^Food Formulation Chemistry (3)  
 FST 490. Food Processing Calculations (2)  
 FST 491. Food Processing Calculations Lab (1)  
 FST 495. Food Packaging (2)  
 MB 440. Food Microbiology (3)  
 MB 441. Food Microbiology Lab (2)  
 TOX 429. Toxic Substances in Food (3)

**FERMENTATION SCIENCE MINOR**

**Required Courses (12)**

FST 251. Intro to Wines, Beers and Spirits (3)  
 MB 302. General Microbiology (3)  
 MB 303. General Microbiology Lab (2)

**Select one of the following two:**

BB 350. Elementary Biochemistry (4)  
 BI 314. Cell and Molecular Biology (4)

**Elective Courses (15)**

**Select 15 credits from the following:**

BIOE 457. Bioreactors I (3)  
 BIOE 460. Metabolic Engineering (3)  
 FST 360. Food Safety and Sanitation (3)  
 FST 460. Brewing Science (3)  
 FST 466. Wine Production Principles (3)  
 FST 467. Wine Production and Analysis (2)  
 FST 468. Sensory Evaluation of Wines (2)  
 FST 479. Fermentation Microbiology (3)  
 FST 480. Topics in Fermentation (1-2 credits per class)\*\*  
 MB 440. Food Microbiology (3)  
 MB 441. Food Microbiology Lab (2)  
 \*\*May take up to 4 credits.

**Total=27**

**FOOD SCIENCE MINOR**

**Required Courses (13 credits)**

FST 360. Food Safety and Sanitation (3)  
 FST 422. Food Chemistry (5)  
 MB 440. Food Microbiology (3)  
 MB 441. Food Microbiology Lab (2)  
 Elective Courses

**Select 14 credits from the following:**

BEE 452. Intro to Process Engineering (4)  
 BEE 453. Intro to Process Engineering Design (4)  
 FST 102. Maraschino Cherry (1)  
 FST 210. Fruit and Vegetable Processing (3)  
 FST 212/FST 213. Dairy Processing/Lab (2,1)  
 FST 251. Introduction to Wines, Beers, Spirits (3)  
 FST 260. Food Science and Technology in Western Culture (3)  
 FST 420. Sensory Evaluation of Food (3)  
 FST 421. \*Food Law (3)  
 FST 423. Food Analysis (4)  
 FST 424. ^Food Formulation Chemistry (3)  
 FST 460. Brewing Science (3)  
 FST 466. Wine Production Principles (3)  
 FST 467. Wine Production Practices and Analysis (2)  
 FST 468. Wine Sensory Evaluation (2)  
 FST 479. Fermentation Microbiology (3)  
 FST 480. Topics in Fermentation (1-2)  
 FST 490. Food Processing Calculations (2)  
 FST 491. Food Processing Calculations Laboratory (1)  
 FST 495. Food Packaging (2)  
 TOX 429. Toxic Substances in Food (3)

**Total=27**

**Footnotes:**

\* Bacc Core Course  
 ^ WIC Course

**FOOD TECHNOLOGY MINOR****Required Courses (17)**

FST 102. Maraschino Cherry (1)  
 FST 210. Fruit and Vegetable Processing (3)  
 FST 212. Dairy Processing (2)  
 FST 213. Dairy Processing Lab (1)  
 FST 360. Food Safety and Sanitation (3)  
 FST 421. \*Food Law (3)  
 MB 230. \*Introductory Microbiology (4)

**Elective Courses:**

**Select 10 credits from the following, 6 must be upper division:**

ANS 251. Principles of Animal Foods Technology (3)  
 ANS 351. Advanced Principles of Animal Foods Technology (4)  
 FST 251. Intro to Wines, Beers, and Spirits (3)  
 FST 260. Food Science and Technology in Western Culture (3)  
 FST 420. Sensory Evaluation of Food (3)  
 FST 480. Topics in Fermentation (1–2 credits per class, can take up to 2 credits)  
 FST 495. Food Packaging (2)  
 NFM 225. Human Nutrition (3)  
 NFM 235. Science of Foods (4)

**Total=27**

**FOOD SCIENCE AND TECHNOLOGY (MAG, MS, PHD)****Graduate Areas of Concentration**

*Brewing, enology, flavor chemistry, food chemistry/biochemistry, food engineering, food microbiology/biotechnology, food and seafood processing, sensory evaluation*

The Department of Food Science and Technology offers graduate programs leading toward the Master of Science and Doctor of Philosophy degrees. A variety of research specializations are available covering the chemical, physical, microbiological and biotechnological, and sensory properties of foods.

Food engineering research concerns measurement and modeling of thermophysical properties of foods, and modeling of heat and mass transfer phenomena. Studies in food microbiology focus on food safety and the characterization and improvement of wine yeasts. Flavor chemistry and sensory evaluation studies are ongoing with a wide variety of foods and beverages.

Food chemistry research concerns the occurrence, role, formation, stability and analysis of various food constituents. Biomass conversion processes involve chemical treatments, enzymatic treatments and microbial fermentations. The work focuses primarily on lignocellulosic residues, and involves mechanistic studies of chemical and enzymatic reactions, modeling for process optimization and metabolic studies of fermentation efficiency. Adulteration in fruit juice concentrates is being determined through compositional analyses. Other studies are directed toward an understanding of

the mechanism of anthocyanin pigment degradation in foods.

Food processing research deals with the use of high pressure as a means of food preservation and use of edible food coatings to enhance the nutritional quality of fresh fruits and vegetables. Enological research emphasizes the effects of wine processing and vineyard practices on wine quality. Research in brewing focuses on the effects of processing on beer quality and stability. Dairy research concerns characterization and use of processing by-products. Investigations on seafood processing and by-product utilization are being conducted on campus, and at the Coastal Oregon Marine Experiment Station Seafood Laboratory in Astoria, Oregon. Packaging and sensory evaluation of value-added food products occurs at the Food Innovation Center in Portland, Oregon.

Students desiring to pursue graduate study must have a BS degree or equivalent. Students from related fields of study (chemistry, microbiology, biology, etc.) should have a strong background in the basic sciences and must have earned at least a "B" (3.0) average during their last two years of undergraduate study.

**FOOD SCIENCE AND TECHNOLOGY GRADUATE MINOR**

For more details, see the departmental advisor.

**COURSES****FST 101. FOOD SCIENCE ORIENTATION**

(1). For food science majors. Orientation and academic guidance toward career planning in food science and technology. Graded P/N.

**FST 102. MARASCHINO CHERRY (1).** The interdisciplinary nature of food science and technology is demonstrated by examining historical, technological, and scientific aspects of maraschino cherry production.

**FST 199. SPECIAL STUDIES (1-16).** Graded P/N.

**FST 210. FRUIT AND VEGETABLE PROCESSING (3).** Lectures, lab activities and plant tours to help majors and non-majors understand traditional and modern fruit and vegetable processing technologies. **PREREQS:** CH 123 or CH 223.

**FST 212. DAIRY PROCESSING (2).** Methods of processing and preserving milk and milk products and related unit operations. **PREREQS:** CH 123 or CH 223.

**FST 213. DAIRY PROCESSING LABORATORY (1).** Laboratory and field work to accompany FST 212. Field trip required. **PREREQS:** Concurrent enrollment in FST 212.

**FST 251. INTRODUCTION TO WINES, BEERS, AND SPIRITS (3).** A descriptive introduction to the history, science, sensory, economics, and societal aspects of alcoholic beverages. **PREREQS:** High school biology and chemistry. Open to any major.

**FST 260. \*FOOD SCIENCE AND TECHNOLOGY IN WESTERN CULTURE (3).** Exploring the sciences and technologies of food processing and preservation within the context of their historical, current, and possible future influences on what we eat, the structure of our society, and our day-to-day lives. (Bacc Core Course)

**FST 360. FOOD SAFETY AND SANITATION (3).** Principles, practices, and regulations governing and ensuring the microbiological safety of our food supply through risk assessment, surveillance, and intervention.

**FST 399. SPECIAL TOPICS (1-16).**

**FST 399H. SPECIAL TOPICS (1-16). PREREQS:** Honors College approval required.

**FST 401. RESEARCH (1-16). PREREQS:** Departmental approval required.

**FST 403. THESIS (1-16). PREREQS:** Departmental approval required.

**FST 405. READING AND CONFERENCE (1-16). PREREQS:** Departmental approval required.

**FST 407. SENIOR SEMINAR (1).**

**FST 410. INTERNSHIP (1-16).** A work internship to give students practical on-the-job training in the food processing or related industries. Graded P/N. **PREREQS:** Junior standing. Departmental approval, submission of employer and employee evaluation forms, and written reports.

**FST 420. SENSORY EVALUATION OF FOOD (3).** For FST majors and nonmajors. Procedures and test methods used to evaluate the sensory properties of foods. Lec/lab. **PREREQS:** ST 352 or ST 412.

**FST 421. \*FOOD LAW (3).** Concepts, statutes, regulations, and agencies controlling the production, processing, and distribution and promotion of food. (Bacc Core Course)

**FST 422. FOOD CHEMISTRY (5).** An integrated lecture/lab course in food chemistry. The lecture portion of the course focuses on the theoretical basis of common food phenomena related to the macromolecules of foods (water, proteins, carbohydrates and lipids). The laboratory component provides opportunities for students to manipulate food/model systems to gain a better understanding of the functional properties, and related reactivity, of food macromolecules. **PREREQS:** CH 332 or CH 335, BB 350 or equivalent.

**FST 423. FOOD ANALYSIS (4).** An integrated laboratory/lecture course covering methods used for the quantitative analysis of the chemical composition of foods and agricultural products. **PREREQS:** CH 324, CH 337, BB 350.

**FST 424. ^FOOD FORMULATION CHEMISTRY (3).** Application of principles of food chemistry and analysis to product formulation. Student teams determine the composition of a commercial food product with the objective of formulating a replica from standard ingredients. Includes preparation of a technical project report with revision. (Writing Intensive Course) **PREREQS:** FST 423, WR 222 or WR 327.

**FST 460. BREWING SCIENCE (3).** Chemistry, microbiology and engineering of malting and brewing operations for the production of beer, including the compositional analysis of barley, malt, hops, water, and beer and their effects on beer quality. **PREREQS:** MB 302 and BEE 452.

**FST 461. ^BREWING ANALYSIS (3).** Compositional analysis, laboratory techniques and sensory evaluation of barley, malt, hops, water, yeast and beer. Lec/lab. (Writing Intensive Course) **PREREQS:** FST 460 and MB 440 and MB 441 and (BEE 452 or BRE 452) and WR 121, must be 21 years of age. WR 222 or WR 327 recommended.

**FST 466. WINE PRODUCTION PRINCIPLES (3).** Principles of wine production technology from grape berry development through bottling, covering the microbiology and chemistry of fermentation, aging and production practices of red and white table wines, as well as sparkling and dessert wines. **PREREQS:** BB 350 and MB 302.

**FST 467. WINE PRODUCTION AND ANALYSIS (2).** Fundamentals of commercial red and white label table wine processing practices from harvest to bottling and related quality control analytical procedures for juice and wine analysis. **PREREQS:** FST 466/FST 566.

**FST 468. SENSORY EVALUATION OF WINES (2).** Fundamentals of sensory evaluation of wines including character descriptions, defects, and sensory evaluation techniques. **PREREQS:** FST 467

**FST 479. FERMENTATION MICROBIOLOGY (3).** An introduction to industrial microbiology with a focus on the physiology of fermentation and use of microorganisms for the production of food ingredients, fermented foods, and beverages. **CROSSLISTED** as MB 479/MB 579. **PREREQS:** (BB 350 or BI 314) and MB 302.

**FST 480. TOPICS IN FERMENTATION (1-2).** Selected topics in fermentation science will be presented by department faculty and invited outside experts. Topics and format will change each quarter. Students may take the course for 1 or 2 credits as the topics change. Lec/lab.

**FST 490. FOOD PROCESSING CALCULATIONS LABORATORY (2).** Application of engineering principles to produce safe processed foods meeting consumer expectations for quality. Experiments in a pilot plant supported by a computer laboratory. **COREQ:** FST 491. **PREREQS:** BEE 452 and MB 440, Microsoft Excel skills.

**FST 491. FOOD PROCESSING CALCULATIONS LABORATORY (1).** Experiments in a pilot plant supported by a computer laboratory. **COREQ:** FST 490. **PREREQS:** Microsoft Excel skills.

**FST 495. FOOD PACKAGING (2).** Fundamentals of food packaging covering the major packaging solutions with a focus on plastic, paper, and paperboard. **PREREQS:** Junior standing in a physical or biological science-based major.

**FST 499. SPECIAL STUDIES (1-16).**

**FST 501. RESEARCH (1-16).** **PREREQS:** Departmental approval required.

**FST 503. THESIS (1-16).**

**FST 505. READING AND CONFERENCE (1-16).** **PREREQS:** Departmental approval required.

**FST 507. SEMINAR (1).**

**FST 510. INTERNSHIP (1-16).**

**FST 514. HEALTH BENEFITS OF FUNCT FOODS, NUTRACEUT, DIETARY SUPPLEMEN (3).** Functional foods, nutraceuticals and dietary supplements represent a rapidly expanding segment of domestic and international markets. This course will overview the principles and procedures necessary to evaluate and market these products. The chemistry and mechanisms of major nutraceutical ingredient categories and current scientific information supporting their biochemical and physiological efficacy will be addressed. Special dietary products, such as medical, weight control, sport, and herbal supplements, will be addressed. Regulatory aspects of labeling and structure-function claims will be covered. **CROSSLISTED** as NFM 514. **PREREQS:** CH 332, BB 350.

**FST 520. SENSORY EVALUATION OF FOOD (3).** For FST majors and nonmajors. Procedures and test methods used to evaluate the sensory properties of foods. Lec/lab. **PREREQS:** ST 352 or ST 412.

**FST 521. FOOD LAW (3).** Concepts, statutes, regulations, and agencies controlling the production, processing, and distribution and promotion of food.

**FST 522. FOOD CHEMISTRY (5).** An integrated lecture/lab course in food chemistry. The lecture portion of the course focuses on the theoretical basis of common food phenomena related to the macromolecules of foods (water, proteins, carbohydrates and lipids). The laboratory component provides opportunities for students to manipulate food/model systems to gain a better understanding of the functional properties, and related reactivity, of food macromolecules. **PREREQS:** (CH 332 or CH 335) and BB 350 or equivalent.

**FST 523. FOOD ANALYSIS (4).** An integrated laboratory/lecture course covering methods used for the quantitative analysis of the chemical composition of foods and agricultural products. **PREREQS:** CH 324, CH 337, BB 350.

**FST 524. FOOD FORMULATION CHEMISTRY (3).** Application of principles of food chemistry and analysis to product formulation. Student teams determine the composition of a commercial food product with the objective of formulating a replica from standard ingredients. Includes preparation of a technical project report with revision. **PREREQS:** FST 423/FST 523, WR 222 or WR 327.

**FST 560. BREWING SCIENCE (3).** Chemistry, microbiology and engineering of malting and brewing operations for the production of beer, including the compositional analysis of barley, malt, hops, water, and beer and their effects on beer quality. **PREREQS:** MB 302 and BEE 452.

**FST 561. BREWING ANALYSIS (3).** Compositional analysis, laboratory techniques and sensory evaluation of barley, malt, hops, water, yeast and beer. Lec/lab. **PREREQS:** Must be 21 years of age. WR 222 or WR 327 recommended.

**FST 566. WINE PRODUCTION PRINCIPLES (3).** Principles of wine production technology from grape berry development through bottling, covering the microbiology and chemistry of fermentation, aging and production practices of red and white table wines, as well as sparkling and dessert wines. **PREREQS:** BB 350 and MB 302.

**FST 567. WINE PRODUCTION AND ANALYSIS (2).** Fundamentals of commercial red and white label table wine processing practices from harvest to bottling and related quality control analytical procedures for juice and wine analysis. **PREREQS:** FST 466/FST 566.

**FST 568. SENSORY EVALUATION OF WINES (2).** Fundamentals of sensory evaluation of wines including character descriptions, defects, and sensory evaluation techniques. **PREREQS:** FST 567

**FST 579. FERMENTATION MICROBIOLOGY (3).** An introduction to industrial microbiology with a focus on the physiology of fermentation and use of microorganisms for the production of food ingredients, fermented foods, and beverages. **CROSSLISTED** as MB 479/MB 579. **PREREQS:** (BB 350 or BI 314) and MB 302.

**FST 590. PILOT PLANT EXPERIENCES IN FOOD PROCESSING (2).** Application of engineering principles to produce safe processed foods meeting consumer expectations for quality. Experiments in a pilot plant supported by a computer laboratory. **COREQ:** FST 591. **PREREQS:** BEE 552 and MB 540, Microsoft Excel skills.

**FST 591. FOOD PROCESSING CALCULATIONS LABORATORY (1).** Experiments in a pilot plant supported by a computer laboratory. **COREQ:** FST 590. **PREREQ:** Microsoft Excel skills.

**FST 595. FOOD PACKAGING (2).** Fundamentals of food packaging covering the major packaging solutions with a focus on plastic, paper, and paperboard. **PREREQS:** Junior standing in a physical or biological science-based major.

**FST 599. SPECIAL STUDIES (1-16).**

**FST 601. RESEARCH (1-16).** **PREREQS:** Departmental approval required.

**FST 603. THESIS (1-16).**

**FST 605. READING AND CONFERENCE (1-16).** **PREREQS:** Departmental approval required.

**FST 607. SEMINAR (1).**

**FST 628. FLAVOR CHEMISTRY (3).** The definition of flavor, analytical methods in flavor chemistry, and mechanisms of odor interaction in food system will be discussed. In addition, an integrated approach will be used to study the flavor chemistry of economically-important agricultural products in the Pacific Northwest such as dairy products, fruits, and alcoholic beverages. **PREREQS:** FST 522, FST 523.

**FST 639. FOOD POLYMER SCIENCE (3).** Investigates the theoretical principles and structure-function relationships of food macromolecules. The theoretical principles are related, where possible, to observable phenomena during thermal processing and storage of foods. **PREREQS:** FST 422 or FST 522.

**GENETICS****Walt Ream, Director**

3021 Agricultural and Life Sciences Building  
Oregon State University  
Corvallis, OR 97331-7303  
541-737-3799

E-mail: millimag@cgrb.oregonstate.edu  
Website: <http://agsci.oregonstate.edu/genetics/>

**ADJUNCT FACULTY**

**Professors** Adams, Buhler, Carrington, Chen, Ciuffetti, Dolja, Dreher, Forsberg, Frei, Giovannoni, Haig, Hayes, Hays, Hruby, Leid, Liston, Mehlenbacher, Merrill, Meyer, D. Mok, M. Mok, Moore, Myers, Ream, Rohrmann, Savage, Strauss, Taylor, Wolpert, Zabriskie

**Associate Professors** Bakalinsky, Blouin, Buermeyer, Field, Fowler, Greenwood, Mahmud, Riera-Lizarazu, Rivin, Rockey, Vales

**Assistant Professors** Bakker, Bennett, Chang, Denver, Freitag, Indra, Jin, Kioussi, Mockler, Pастey

**Senior Instructor** Ahern

**Graduate Major**

Genetics (MA, MS, PhD)

**Graduate Areas of Concentration**

*Molecular, developmental, and quantitative genetics of microbes, plants, animals, and their viruses*

**Graduate Minor**

Genetics

The Genetics Program provides a comprehensive course of study, taught by faculty drawn from throughout the university, leading to Master of Science and Doctor of Philosophy degrees. Although there is no undergraduate degree in genetics, pre-baccalaureate students may select the Genetics option in the biology degree program, Bioresource Research, or Crop and Soil Science.

**GENETICS (MA, MAG, MS, PhD)****Graduate Areas of Concentration**

*Molecular, developmental, and quantitative genetics of microbes, plants, animals, and their viruses*

A student enrolling in the Genetics Program should have completed one year of physics and biology, two years of chemistry, an introductory genetics course, and mathematics through calculus. For the MS and PhD degrees in genetics, students take the core genetics courses:

BB 550/BB 551. General Biochemistry (4,3)  
or BB 590/BB 591/BB 592. Biochemistry (3,3,3)

GEN 530. Intro to Population Genetics (3)

GEN 554. Genome Organization, Structure, and Maintenance (4)

GEN 555. Genome Expression and Regulation (4)

ST 511. Methods of Data Analysis (4)

A graduate seminar (507 or 607 level) offered by any biological science department (1 credit minimum)

And four graduate-level courses approved by the student's committee.

The program of study must include 36 credits of graduate course work (excluding seminar, research, or thesis credits). The MS degree requires 45 graduate credits, and the PhD requires 108 graduate credits, including 36 credits devoted to thesis preparation. Students participate in research designed to prepare them for careers in genetics.

For additional information, contact Walt Ream, Director, Genetics Program, 3021 Agricultural and Life Sciences Building, OSU, Corvallis, OR 97331-7303.

**GENETICS GRADUATE MINOR****Graduate Areas of Concentration**

*Molecular, developmental, and quantitative genetics of microbes, plants, animals, and their viruses*

For more details, see the departmental advisor.

**COURSES****GEN 430. INTRODUCTION TO POPULATION**

**GENETICS (3).** Genetic polymorphisms, inbreeding, genetic drift, population subdivision and gene flow, mutation and selection. Emphasis on applied rather than theoretical questions. Offered alternate years. **PREREQS:** BI 311 and ST 351/ST 352.

**GEN 501. RESEARCH (1-16).**

**GEN 503. THESIS (1-16).**

**GEN 505. READING AND CONFERENCE (1-16).**

**GEN 507. SEMINAR (1-16).** One-credit sections.

**GEN 530. INTRODUCTION TO POPULATION**

**GENETICS (3).** Genetic polymorphisms, inbreeding, genetic drift, population subdivision and gene flow, mutation and selection. Emphasis on applied rather than theoretical questions. Offered alternate years. **PREREQS:** BI 311 and ST 351/ST 352.

**GEN 554. GENOME ORGANIZATION,**

**STRUCTURE, AND MAINTENANCE (4).** How diverse organisms store their individual sets of genetic information (genomes). Evolution of genomes and gene families. Structures of DNA and chromatin. Biochemical and regulatory pathways that protect cellular genomes against environmental and endogenous damage and ensure transmission of faithful copies to progeny. Remodeling of genomes by recombination and transposition. **CROSSLISTED** as MCB 554 and TOX 554. **PREREQS:** BI 311 (genetics or equivalent), BB 450, BB 451, (BB 452 or BB 490), BB 491, BB 492 (biochemistry) or equivalent.

**GEN 555. GENOME EXPRESSION AND**

**REGULATION (4).** Prokaryotic and eukaryotic systems will be used to describe recent advances in understanding transcriptional and posttranscriptional control mechanisms. Topics include: microbial, yeast and mouse model systems; transcriptional control mechanisms; RNA processing, silencing and microRNAs; protein synthesis and posttranslational modification; microarray- and mass spectrometry-based expression genomics. **CROSSLISTED** as MCB 555. **PREREQS:** BB 451 or equivalent.

**GEN 556. CELL AND DEVELOPMENTAL**

**BIOLOGY (4).** Examination of molecular and structural elements in eukaryotic cells and their relationship to function and development. Topics include nuclear organization, membranes, organelles, intracellular sorting, cell energetics, cell signaling, cell motility, cell division cycle, and developmental processes of selected model organisms. Critical reading and writing skills will be emphasized. **CROSSLISTED** as MCB 556. **PREREQS:** BB 450, BB 451 (biochemistry) or equivalent; BI 311 (genetics) or equivalent. Recommended: BI 460 (cell biology) or equivalent; MCB 554, MCB 555.

**GEN 573. CYTOGENETICS (4).** Effects of variations in chromosome structure and number. Offered alternate years. **CROSSLISTED** as HORT 573, MCB 573. **PREREQS:** BI 311 or equivalent or instructor approval required.

**GEN 601. RESEARCH (1-16).**

**GEN 603. THESIS (1-16).**

**GEN 605. READING AND CONFERENCE (1-16).**

**GEN 620. DNA FINGERPRINTING (1).**

Principles and methods for producing and analyzing DNA fingerprints. Offered alternate years. **CROSSLISTED** as CSS 620, MCB 620. **PREREQS:** BI 311 or CSS 430/CSS 530 or equivalent.

**GEN 621. GENETIC MAPPING (1).** Principles and methods for constructing genetic maps comprised of molecular and other genetic markers. Offered alternate years. **CROSSLISTED** as CSS 621, MCB 621. **PREREQS:** BI 311 or CSS 430/CSS 530 or equivalent.

**GEN 622. MAPPING QUANTITATIVE TRAIT**

**LOCI (1).** Principles and methods for mapping genes underlying phenotypically complex traits. Offered alternate years. **CROSSLISTED** as CSS 622, MCB 622. **PREREQS:** CSS 590 or ST 513 or equivalent.

**GEN 625. PLANT MOLECULAR GENETICS (3).**

Structure, expression, and interactions of the plant nuclear, chloroplast and mitochondrial genomes. Critical examination of the current literature on gene regulation, mobile genetic elements and biotechnology in higher plants. Offered alternate years. **CROSSLISTED** as BOT 625 and MCB 625. **PREREQS:** BB 451 and MCB 555 or equivalents, or instructor approval required.

**HORTICULTURE****Anita Azarenko, Head**

4017 Ag and Life Sciences Building  
Oregon State University  
Corvallis, OR 97331-7304  
541-737-3695

E-mail: azarenka@hort.oregonstate.edu  
Website: <http://oregonstate.edu/dept/hort/>

**FACULTY**

**Professors** Azarenko, Chen, Long, Mehlenbacher, Mallory-Smith, McGrath, Myers, Olsen, Righetti, Strik, Sugar, VanBuskirk

**Associate Professors** Braunworth, Bubl, Castagnoli, Clough, Cook, Detweiler, Kaufman, Luna, McMahan, McReynolds, Nonogaki, Penhalligon, Regan, Renquist, Rosetta, Stang, Stone, Yang

**Assistant Professors** Bakker, DeFrancesco, Kaiser, Lambrinos, Langellotto, Miller, Owen, Peachey, Sandrock, Skinkis, Walton, White

**Instructors** Andrews, Bell, Fick, Matthewson, Reynolds

**COURTESY FACULTY**

Bassil, Bruck, Bryla, Finn, Fisher, Hummer, Martin, Reed, Scagel, Schreiner, Wisniewski

**ADJUNCT FACULTY**

Bondi, Hays, Jensen, Kennedy

**Undergraduate Major****Horticulture (BS)****Options**

*Environmental Landscape*  
*Horticultural Communication*  
*Horticultural Research*  
*Integrated Horticultural Production*  
*Turf Management*  
*Viticulture and Enology*

**Minors**

**General Horticulture**  
**Turf and Landscape Management**

**Graduate Major****Horticulture (MAG, MS, PhD)****Graduate Areas of Concentration**

*Biotechnology/Molecular Biology*  
*Culture and Management of*  
*Horticultural Crop Production*  
*Genetics and Breeding*  
*Physiology and Biochemistry*

**Graduate Minor****Horticulture**

Horticulture involves the production, genetic improvement, storage, and marketing of fruits, nuts, vegetables, flowers, and vegetable crops; and the design, construction, and management of landscape plantings such as parks, gardens, golf courses, restoration projects, and sports fields. It is a science, an art, an avocation, and a business.

Horticultural and other high value specialty crops are the largest component of Oregon's agricultural industry. Landscape horticulture is a rapidly expanding service industry in the urban areas of the Pacific Northwest and throughout the nation. Excellent and varied career opportunities exist for college graduates in both crop and landscape horticulture.

The undergraduate program provides students with a solid background in the fundamental life and physical sciences, as well as an understanding of the technologies and management systems used in the horticultural industry. Problem-solving and decision-making skills are stressed, as is student involvement. Field trips are an important component of many of the courses.

**The program has six options:**

- Environmental Landscape
- Horticultural Communication
- Horticultural Research
- Integrated Horticultural Production

- Turf Management
- Viticulture and Enology

The **Environmental Landscape** option prepares students to be practitioners and leaders in the design, construction, and installation of our green spaces.

The **Horticultural Communication** option enables students to gain expertise in communications between different segments of the horticultural community (business, government, and education/extension) and the general public.

The **Horticultural Research** option prepares students to assist in research or pursue graduate studies.

The **Integrated Horticultural Production** option prepares students for careers dealing directly or indirectly with the production, breeding, post-harvest handling, marketing, and scientific study of horticultural crops.

The **Turf Management option** prepares students for careers in golf course maintenance and park and athletic field maintenance.

The **Viticulture and Enology option** prepares students for careers in Oregon's growing vineyard and winery industry.

All options allow the student considerable flexibility to pursue a minor or to tailor course work to meet individual goals. Qualified students interested in the business aspects of horticulture are encouraged to pursue a minor in business. All undergraduates are required to complete either an approved internship or an undergraduate research project.

A high school student preparing for the program should follow a well-balanced college preparatory curriculum. Course work in biology, chemistry, and mathematics is strongly recommended. Course work in the social sciences, humanities, arts, and foreign languages is also encouraged, and the student should develop public speaking and writing abilities.

The program was designed to facilitate timely completion of degree requirements by transfer and postbaccalaureate students. Students intending to transfer into the program from a two- or four-year institution should complete as many of the lower-division requirements as possible. Some professional-technical courses from community colleges may be equivalent to lower-division horticulture courses. Equivalent credit can be given for such courses. Contact a departmental advisor for further information.

For additional information about the program, contact one of the undergraduate advisors: Kelly Donegan (undergraduate advisor, all options); David Sandrock (Environmental Landscape option); Jack Stang (Integrated Horticultural Production option); Tom Cook (Turf Management option).

**GRADE REQUIREMENTS**

Students pursuing a major or minor in horticulture are required to receive a grade of C- or better in all horticulture courses that are required for completion of their major and option, or minor. If a grade below C- is received in a horticulture course required for their major and option, or minor, a student will need to re-take the course and receive a grade of C- or better. If the grade below a C- was received for a course that is part of a group of courses where the student can select which courses to take (i.e., they do not need to take all of the courses, just a specified number of courses or credits) then it would be acceptable for the student to substitute a course for the one that they had received a grade below a C-. For example, in most of our options, a student needs to complete three of four plant identification courses. If a student received a grade lower than a C- in one of the classes, they could either re-take the same course or complete the other three courses with a grade of C- or better.

**HORTICULTURE (BS, CRED, HBS)****BS Degree Baccalaureate Core Requirements (33)**

All students must complete an option and its corresponding core to complete the major.

**ENVIRONMENTAL LANDSCAPE OPTION**

The landscape industry is a large (\$72 billion annual output in the U.S.), diverse profession offering careers in landscape design, landscape construction, landscape management, landscape restoration, conservation, park management, botanical and public gardens, urban forestry, research, consulting, and interiorscaping. Landscape professionals design, build, and manage aesthetic, functional, and environmentally responsible spaces where we all live, work, and play. In recent years, the industry has expanded and rapidly become more sophisticated to meet the challenges of today's urban environment. Consequently, there is great demand for creative, motivated individuals who love the outdoors and enjoy working with plants, soil, water, nature, and people.

The Environmental Landscape option curriculum is built on science-based information and provides students with the latest technology and trends in the field. Hands-on labs, fieldtrips, and internships are important steps in experiencing and choosing from the many career options available. In addition, the activities conducted through the OSU Landscape Club supplement the option's curriculum.

**Option Requirements**

AG 312. Engine Theory and Operation (3)

BA 215. Money and Investment Management: Manager, Lender and Investor Viewpoint (4)  
or BA 260. Introduction to Entrepreneurship (4)  
CSS 335. \*Intro to Water Science and Policy (3)  
HORT 280. Intro to Landscape Design (3)  
HORT 314. Principles of Turfgrass Maintenance (4)  
HORT 315. Principles and Practices of Landscape Management (4)  
HORT 316. M/Plant Nutrition (4)  
HORT 318. Applied Ecology of Managed Ecosystems (3)  
HORT 358. ^Landscape Construction Techniques (4)  
HORT 360. Landscape Construction: Irrigation and Drainage (4)  
HORT 380. Advanced Landscape Design Studio (3)  
HORT 385. ^Landscape Operations (3)

### Horticulture Core

#### Preparatory Science Classes

BI 211, BI 212, BI 213. Principles of Biology (4,4,4)  
CH 121. General Chemistry (5)  
CH 122, CH 123. \*General Chemistry (5,5)  
MTH 112. \*Elementary Functions (4)

#### Plant Materials (select 3 of the following 4 classes):

HORT 226. Landscape Plant Materials (3)  
HORT 227. Landscape Plant Materials (3)  
HORT 228. Landscape Plant Materials (3)  
HORT 255. Herbaceous Ornamental Plant Materials (3)

#### Agricultural Sciences

BOT 350. Introductory Plant Pathology (4)  
CSS 305. Principles of Soil Science (4)  
CSS 306. Problem Solving: Soil Science Applications (1)  
CSS/ENT 311. Intro to Insect Pest Management (5)  
CSS 440. Weed Management (4)

#### Horticulture

HORT 112. Introduction to Turf and Landscape Management (2)  
HORT 301. Principles of Horticultural Technology (4)  
HORT 302. Principles of Horticultural Technology (4)  
HORT 407. Seminar (1)  
HORT 410. Internship (1–12)  
or Hort 403. Thesis (6–16)  
HORT 412. Career Exploration: Internships and Research Projects (1)

### HORTICULTURAL COMMUNICATION OPTION

Effective communication skills are crucial to the success of many sectors of modern, professional horticulture: Horticultural companies and commodity groups market their products to the general public; horticultural professionals communicate the needs of their industries to government policy makers; educators and researchers share research results with those who could benefit from them; public information officers of public/private agricultural organizations

alert donors and stakeholders to issues of mutual interest. The Horticultural Communication option was developed to meet these needs in the field.

The option serves to produce graduates with expertise in communications between different segments of the horticultural community (business, government, and education/extension) and the general public. Graduates will possess two subsets of skills:

- Horticultural skills to actively investigate horticultural problems and situations, the acquisition of a broad, deep foundation of horticultural knowledge, and the ability to actively synthesize and apply that knowledge to real world issues.
- Communication skills with emphases on the business, education or political arenas, and knowledge from course work that includes print, broadcast, and digital modes of delivery.

### Option Requirements (67–68)

#### Horticulture (30)

##### Upper-division HORT courses (18)

HORT 300. Introduction to Crop Production (4)  
HORT 302. Principles of Horticultural Technology (4)  
HORT 311. ^Plant Propagation (4)

#### Communication Core (7 credits not in Bacc Core)

COMM 111. \*Public Speaking (3) (Wr III)  
WR 201. \*Writing for Media (3) (Wr II)

#### Choose one of the three areas of concentration from below:

##### Marketing Area (31 credits of non-Bacc Core courses)

BA 390. Marketing (4)  
ECON 201. \*Intro to Microeconomics (4)  
WR 214. \*Writing in Business (3)  
WR 414. Advertising and Public Relations Writing (3)

##### Choose 18 credits from the following:

BA 492. Consumer Behavior (4)  
or BA 493. Advertising Management (4)  
COMM 316. Advanced Persuasion (3)  
CS 195. Introduction to Web Authoring (4)  
CS 295. Intermediate Web Authoring (4)  
NMC 383. Field Production (4)  
NMC 481. Post Production (4)

##### Media/Education Area (30)

NMC 302. Reporting (3)  
NMC 305. Copyediting (3)  
WR 327. \*Technical Writing (3)

##### Choose 21 credits from the following:

COMM 412. Topics in Communication (3)  
FOR 391. Natural Resource Communications (3)  
FOR 493. Environmental Interpretation (4)  
FOR 495. Interpretive Projects (2)  
NMC 383. Field Production (4)  
NMC 481. Post Production (4)  
NMC 482. Documentary (4)  
WR 448. Magazine Article Writing (3)

### Agricultural Issues Area (30)

AREC 475. M/Negotiation in Business and Resource Management (1)  
COMM 114. \*Argument and Critical Discourse (3) (Wr III)  
COMM 218. \*Interpersonal Communication (3) (Wr III)  
PS 414. Interest Groups (4)  
PS 415. Politics and the Media (4)

#### Choose 4 credits from the following:

PS 474. Natural Resource Policy and Bureaucratic Politics (4)  
PS 475. Environmental Politics and Policy (4)

#### Choose 12 credits from the following:

COMM 314. Argumentation (3)  
COMM 316. Advanced Persuasion (3)  
COMM 321. Intro to Communication Theory (3)  
COMM 322. Small-Group Problem Solving (3)  
COMM 440. Theories of Conflict and Conflict Management (3)  
COMM 442. Bargaining and Negotiation Processes (3)  
COMM 444. Third Parties in Dispute Resolution: Mediation (3)

### Horticulture Core (70–75 )

#### General Science (30)

BI 211, BI 212, BI 213. \*Principles of Biology (4,4,4)  
CH 121. General Chemistry (5)  
CH 122. \*General Chemistry (5)  
CH 130. General Chemistry of Living Systems (4)  
MTH 112. \*Elementary Functions (4)

#### Plant Materials (5–7)

##### Choose 2 courses from the following:

FOR 141. Tree and Shrub Identification (3)  
HORT 226. Landscape Plant Materials (3)  
HORT 227. Landscape Plant Materials (3)  
HORT 228. Landscape Plant Materials (3)  
HORT 233. Vegetable Crops (4)  
HORT 251. Temperate Tree Fruit, Berries, Grapes, and Nuts (2)  
HORT 255. Herbaceous Ornamental Plant Materials (3)

#### Agricultural Sciences (18)

BOT 350. Introductory Plant Pathology (4)  
CSS 305. Principles of Soil Science (4)  
CSS 306. Problem Solving: Soil Science Applications (1)  
CSS 440. Weed Management (4)  
ENT 311. Introduction to Insect Pest Management (5)

#### Horticulture (17–20)

HORT 111. Introduction to Horticultural Crop Production (2)  
or HORT 112. Introduction to Turf and Landscape Management (2)  
HORT 301. Principles of Horticultural Technology (4)  
HORT 407. Seminar (1)  
HORT 410. Internship (1–12)  
or HORT 403. Thesis (1–16)  
HORT 412. Career Exploration (1)  
HORT 495. Horticultural Management Plans (3)

#### Footnotes:

\* Baccalaureate core course

^ Writing intensive course

## HORTICULTURAL RESEARCH OPTION

The Horticultural Research option is designed for students interested in graduate school and a career in academic or industrial research. It provides an excellent foundation in the natural sciences and horticulture, and accommodates the specific interests of each student. Graduates of this program will be critical thinkers, and experienced technical communicators. They will be skilled in finding and using information, as well as synthesizing information from many sources to analyze novel situations and solve problems.

The relationship between the student and the research mentor is a key feature of this program. The mentor will assist the student in choosing upper-division classes that match the student's interests. Each student also completes a two-year research project under the guidance of his/her mentor, and writes an undergraduate thesis. Students can work with Horticulture researchers on the OSU campus or at research institutions of their choosing. Our undergraduates have been welcomed at local research institutions including the United States Department of Agriculture-Agricultural Research Service laboratories, the National Clonal Germplasm Repository in Corvallis, the Corvallis Plant Materials Center of the National Resources Conservation Service, and the North Willamette Research and Extension Center.

### Option Requirements

#### Research (11)

HORT 403. Thesis (6)  
 HORT/BRR 406. Projects: Data Presentations (1)  
 HORT 407. Seminar (1)  
 PHL 547. \*Research Ethics (3)

#### Horticulture and specialized life science courses (39)

CSS 305. Principles of Soil Science (4)  
 CSS 306. Problem Solving: Soil Science Applications (1)  
 HORT 311. ^Plant Propagation (4)  
 HORT 316. M/Plant Nutrition (Modules a and b) (2,1)  
 HORT 430. Plant Genetics (3)

#### Horticulture and Life Sciences

##### Select upper-division courses with approval of research mentor (24)

##### Foundation courses to prepare for specialized study (26)

BB 350. Elementary Biochemistry (4)  
 BOT 331. Plant Physiology (4)  
 BOT 341. Plant Ecology (4)  
   or BI 370. Ecology (3)  
   or HORT 318. Applied Ecology of Managed Ecosystems (3)  
 CH 331, CH 332. Organic Chemistry (4, 4)  
 CH 337. Organic Chemistry Lab (4)  
 MB 230. \*Introductory Microbiology (4)

##### Foundation sciences not covered by the Horticulture Core (18)

MTH 252. Integral Calculus (4)

PH 201, PH 202. \*General Physics (5,5)  
 ST 351. Intro to Statistical Methods (4)

#### Communication

COMM 111. \*Public Speaking (3)  
 WR 121. \*English Composition (3)  
 WR 327. \*Technical Writing (3)

#### Horticulture Core (39-41)

##### General Science (31)

BI 211, BI 212, BI 213. \*Principles of Biology (4,4,4)  
 CH 221, CH 222, CH 223. \*General Chemistry (5,5,5)  
 MTH 251. \*Differential Calculus (4)

##### Plant Materials (2-4)

##### Select one of the following courses:

FOR 141. Tree and Shrub Identification (3)  
 HORT 226. Landscape Plant Materials (3)  
 HORT 227. Landscape Plant Materials (3)  
 HORT 228. Landscape Plant Materials (3)  
 HORT 233. Vegetable Crops (4)  
 HORT 251. Temperate Tree Fruit, Berries, Grapes, and Nuts (2)  
 HORT 255. Herbaceous Ornamental Plant Materials (3)

##### Horticulture (7)

HORT 111. Introduction to Horticultural Crop Production (2)  
 HORT 301. Principles of Horticultural Technology (4)  
 HORT 412. Career Exploration: Internships and Research Projects (1)

#### Total=99

## INTEGRATED HORTICULTURAL PRODUCTION OPTION

Students in the Integrated Horticultural Production option gain the knowledge and skills necessary to plan and manage horticultural production systems for nursery, greenhouse, fruit, and vegetable crops. They come to see horticulture as an activity that is connected to our larger society and which includes issues of ecology, economics, and politics.

The Integrated Horticultural Production option involves a set of required courses, but more importantly, it stresses active learning, case studies about real-world situations, and integrating ideas and facts from many different subjects. Integrated Horticultural Production graduates will be active learners, and possess skills prized by employers. They will have a broad and thorough knowledge of horticulture and related topics. They will be able to think critically. They will be skilled in finding and using information, as well as synthesizing information from many sources to analyze novel situations and solve problems in the field.

### Option Requirements

#### Horticultural Science and Technology Core

BEE 439. Irrigation Principles and Practices (4)  
 BOT 331. Plant Physiology (4)  
 Ecology elective (3-4)  
 HORT 311. ^Plant Propagation (4)

HORT 316. M/Plant Nutrition (4)  
 HORT 414. M/Information Systems in Agriculture (4)  
 HORT 430. Plant Genetics (3)

#### Advanced Horticultural Production and Technology

##### Select 3 of the following courses:

HORT 303. Horticultural Projects (2)  
 HORT 351. Greenhouse Environments (2)  
 HORT 361. M/Greenhouse and Nursery Production and Management I (1-4)  
 HORT 363. Seed Biology (3)  
 HORT 441. Plant Tissue Culture (4)  
 HORT 450. Plant Breeding (4)  
 HORT 451. Tree Fruit Physiology and Culture (4)  
 HORT 452. Berry and Grape Physiology and Culture (4)  
 HORT 453. Viticulture I (3)  
 HORT 454. Viticulture II (3)

##### Horticultural Synthesis

HORT 300. Introduction to Crop Production (4)  
 HORT 411. Horticulture Book Club (1)

##### Select two of the following courses:

HORT 451. Tree Fruit Physiology and Culture (4)  
 HORT 480. Case Studies in Cropping Systems Management (4)  
 HORT 481. Case Studies in Horticultural Systems Management (4)

##### Business Management

AREC 211. Management in Agriculture (4)

##### Select one of the following courses:

AREC 468. M/Crop Enterprise Budgeting (1)  
 AREC 470. M/Farm Budgeting and Planning (1)  
 AREC 476. M/Agricultural Personnel Management (2)

##### Government and Policy

PS 201. Intro to U.S. Government and Politics (4)

##### Select one of the following courses:

PS 331. State and Local Government and Politics (4)  
 PS 474. Natural Resource Policy and Bureaucratic Politics (4)  
 PS 475. Environmental Politics and Policy (4)

#### Horticulture Core (70-81 credits)

##### Preparatory Science Classes

BI 211, BI 212, BI 213. \*Principles of Biology (4,4,4)  
 CH 121. General Chemistry (5)  
 CH 122. \*General Chemistry (5)  
 CH 130. General Chemistry of Living Systems (4)  
 MTH 112. \*Elementary Functions (4)

##### Plant Materials (5-7 credits)

##### Select two of the following courses:

FOR 141. Tree and Shrub Identification (3)  
 HORT 226. Landscape Plant Materials (3)  
 HORT 227. Landscape Plant Materials (3)  
 HORT 228. Landscape Plant Materials (3)  
 HORT 233. Vegetable Crops (4)  
 HORT 251. Temperate Tree Fruit, Berries, Grapes, and Nuts (2)  
 HORT 255. Herbaceous Ornamental Plant Materials (3)

**Agricultural Sciences**

BOT 350. Introductory Plant Pathology (4)  
 CSS 305. Principles of Soil Science (4)  
 CSS 306. Problem Solving: Soil Science Applications (1)  
 CSS 440. Weed Management (4)  
 ENT 311. Intro to Pest Management (5)

**Horticulture**

HORT 111. Introduction to Horticultural Crop Production (2)  
 HORT 301. Principles of Horticultural Technology (4)  
 HORT 407. Seminar (1)  
 HORT 410. Internship (1–12) or HORT 403. Thesis (1–16)  
 HORT 495. Horticultural Management Plans (3)

**Total=61–67****TURF MANAGEMENT OPTION**

The turf industry offers professional opportunities in golf course maintenance, park and athletic field maintenance, and landscape maintenance. This continually growing industry offers more career track jobs than any other area in horticulture. Golf course maintenance, leading to positions such as golf course superintendent, historically has drawn the most students and is the largest component of the curriculum. Graduates in this option compete well for top jobs throughout the West, with most finding work in Oregon, Washington, and California. Athletic field maintenance is emerging as a strong career track opportunity as well.

Students in this curriculum must have a passion for the outdoors, for turf maintenance, and for working with other people in a team context. Prior practical work experience and a willingness to work summers and/or extended internships while at OSU is a characteristic shared by our students. The curriculum focuses on science, technology, 'in field' hands-on experience, and decision making in real world settings. Active participation in student clubs, class field labs and out-of-class internship work experiences is critical to success. Activities stress networking and exposure to multiple work environments to help students integrate into the industry.

**Option Requirements**

AG 312. Engine Theory and Operation (3)  
 BA 215. Money and Investment Management: Manager, Lender, Investor Viewpoint (4)  
 CSS 335. \*Intro to Water Science and Policy (3)  
 HORT 311. ^Plant Propagation (4)  
 HORT 314. Principles of Turfgrass Maintenance (4)  
 HORT 316. M/Plant Nutrition: Nutrient Absorption, Plant Composition (Sect. a) (2)  
 HORT 316. M/Plant Nutrition: Diagnosing Nutritional Disorders (Sect. b) (1) and HORT 317. Turf Fertility (1)  
 HORT 318. Applied Ecology of Managed Ecosystems (3) or Ecology Elective (3–4)

HORT 360. Landscape Construction: Irrigation and Drainage (4)  
 HORT 418. Golf Course Maintenance (4)

**Select three of the following:**

BOT 313. Plant Structure (4)  
 CSS 460. Seed Production (3)  
 CSS 466. Soil Morphology/Classification (4)  
 HORT 280. Intro to Landscape Design (3)  
 HORT 315. Principles and Practices of Landscape Maintenance (4)  
 HORT 358. ^Landscape Construction Techniques (4)  
 HORT 360. Landscape Construction: Irrigation and Drainage (4)  
 HORT 380. Advanced Landscape Design Studio (3) *Not required for turf management.*

**Horticulture Core (70–81 credits)****Preparatory Science Classes**

BI 211, BI 212, BI 213. \*Principles of Biology (4,4,4)  
 CH 121. General Chemistry (5)  
 CH 122, CH 123. \*General Chemistry (5,5)  
 MTH 112. \*Elementary Functions (4)

**Plant Materials (9 credits)****Select three of the following four courses:**

HORT 226. Landscape Plant Materials (3)  
 HORT 227. Landscape Plant Materials (3)  
 HORT 228. Landscape Plant Materials (3)  
 HORT 255. Herbaceous Ornamental Plant Materials (3)

**Agricultural Sciences**

BOT 350. Introductory Plant Pathology (4)  
 CSS 305. Principles of Soil Science (4)  
 CSS 306. Problem Solving: Soil Science Applications (1)  
 CSS 440. Weed Management (4)  
 CSS/ENT 311. Intro to Insect Pest Management (5)

**Horticulture**

HORT 112. Introduction to Turf and Landscape Management (2)  
 HORT 301. Principles of Horticultural Technology (4)  
 HORT 407. Seminar (1)  
 HORT 410. Internship (1–12) or HORT 403. Thesis (1–16)  
 HORT 412. Career Exploration: Internship and Research Project (1,1)

**Footnote:**

\* Bacc Core Course  
 ^ Writing Intensive Course

**VITICULTURE AND ENOLOGY OPTION**

The Oregon wine industry has experienced steady growth since wine grape production began in 1961. Oregon now ranks second nationally in number of wineries, and Oregon wine production output is the fourth highest in the United States. Vineyards and wineries have also become an integral part of the Oregon tourism industry.

The Viticulture and Enology curriculum addresses the educational needs of vineyard managers and professionals. The curriculum stresses active learning, case studies about real-world situations,

and integrating ideas and facts from many different subjects. Viticulture and Enology graduates will be active learners, and possess the skills prized by employers. They will have a broad, thorough knowledge of viticulture and related topics, and will understand how their actions in the field affect the quality of the finished wine. They will be able to think critically. They will be skilled in finding and using information, as well as synthesizing information from many sources to analyze novel situations and solve problems in the field.

**Option Requirements****Foundation Sciences**

BI 314. Cell and Molecular Biology (4)  
 BB 350. Elementary Biochemistry (4)  
 BOT 331. Plant Physiology (4)  
 CH 331, CH 332. Organic Chemistry (4, 4)  
 MB 302. General Microbiology (3)

**Horticulture Synthesis**

HORT 300. Introduction to Crop Production (4)  
 HORT 481. Case Studies in Horticultural Systems Management (4)

**Viticulture**

HORT 311. ^Plant Propagation (4)  
 HORT 316. M/Plant Nutrition (4)  
 HORT 452. Berry and Grape Physiology and Culture (4)  
 HORT 453. Viticulture I (3)  
 HORT 454. Viticulture II (3)

**Fermentation Science**

FST 251. Intro to Wines, Beers, and Spirits (3)  
 FST 466. Wine Production Principles (3)  
 FST 467. Wine Production and Analysis (2)  
 FST 468. Sensory Evaluation of Wines (2)

**Business Management****Select one of the following courses:**

AREC 211. Management in Agriculture (4)  
 BA 215. Money and Investment Management: Manager, Lender, Investor Viewpoint (4)  
 BA 260. Intro to Entrepreneurship (4)

**Horticulture Core (70–81 credits)****Preparatory Science Classes**

BI 211, BI 212, BI 213. \*Principles of Biology (4,4,4)  
 CH 121. General Chemistry (5)  
 CH 122, CH 123. \*General Chemistry (5,5)  
 MTH 112. \*Elementary Functions (4)

**Plant Materials**

HORT 251. Temperate Tree Fruit, Berries, Grapes, and Nuts (2)

**Agricultural Sciences**

BOT 350. Introductory Plant Pathology (4)  
 CSS 305. Principles of Soil Science (4)  
 CSS 306. Problem Solving: Soil Science Applications (1)  
 CSS 440. Weed Management (4)  
 ENT 311. Intro to Pest Management (5)

**Horticulture**

HORT 111. Introduction to Horticultural Crop Production (2)  
 HORT 301. Principles of Horticultural Technology (4)  
 HORT 407. Seminar (1)

HORT 410. Internship (1–12)  
or HORT 403. Thesis (6–16)  
HORT 412. Career Exploration: Internships  
and Research Projects (1)  
HORT 495. Horticultural Management  
Plans (3)

**Total=57**

### **HORTICULTURE MINOR**

#### **Requirements**

HORT 111. Intro to Horticultural Crop  
Production (2)  
HORT 301, HORT 302. Principles of  
Horticultural Technology (4,4)  
At least 17 additional credits in horticulture  
including at least 6 upper-division credits.

**Total=27**

### **TURF AND LANDSCAPE MANAGEMENT MINOR**

#### **Requirements**

CSS 305. Principles of Soil Science (4)  
CSS 306. Problem Solving: Soil Science  
Applications (1)

#### **Plus courses listed under Turf Focus or Landscape Focus**

#### **Turf Focus**

HORT 112. Intro to Turf and Landscape  
Management (2)  
HORT 301. Principles of Horticultural  
Technology (4)  
HORT 314. Principles of Turfgrass  
Maintenance (4)  
HORT 315. Principles and Practices of  
Landscape Maintenance (4)  
HORT 360. Landscape Construction:  
Irrigation and Drainage (4)  
HORT 418. Golf Course Maintenance (4)

**Total=27**

#### **Landscape Focus**

HORT 112. Intro to Turf and Landscape  
Management (2)  
HORT 315. Principles and Practices of  
Landscape Maintenance (4)  
HORT 280. Intro to Landscape Design (3)  
HORT 358. Landscape Construction  
Techniques (4)

#### **Select two courses from the following:**

HORT 226. Landscape Plant Materials (3)  
HORT 227. Landscape Plant Materials (3)  
HORT 228. Landscape Plant Materials (3)

#### **And one of the following:**

HORT 314. Principles of Turfgrass  
Maintenance (4)  
HORT 318. Applied Ecology of Managed  
Landscapes (3)  
HORT 360. Landscape Construction:  
Irrigation and Drainage (4)

**Total=27–28**

### **HORTICULTURE (MAG, MS, PhD)**

*Graduate Areas of Concentration  
Biotechnology/molecular biology, culture  
and management of horticultural crop  
production, genetics and breeding,  
physiology and biochemistry*

The Department of Horticulture offers  
Master of Agriculture, Master of Sci-  
ence, and Doctor of Philosophy degree

programs. In consultation with a gradu-  
ate advisor, students in the MS and PhD  
programs select thesis topics that are  
complementary to an ongoing research  
program. Thesis research topics are in  
physiology, biochemistry, biotechnology,  
molecular biology, genetics, breeding,  
or culture and management of fruit,  
vegetable, or ornamental crops.

Since Oregon is a major horticultural  
area, departmental research and gradu-  
ate programs are oriented to basic and  
applied mission-oriented investigations  
with clearly defined objectives.

Research and teaching assistantships  
are available as resources permit, as is  
graduate student office space. Graduate  
students are not required to show pro-  
ficiency in a foreign language, but they  
must participate in graduate seminar  
presentations. A 4-credit teaching experi-  
ence is required of doctoral students  
receiving assistantships.

For more information or to apply,  
contact a member of the graduate faculty  
or Dr. Shawn Mehlenbacher, Graduate  
Coordinator, Department of Horticul-  
ture, Agricultural and Life Sciences 4017,  
OSU, Corvallis, OR 97331-7304, e-mail:  
mehlenbs@hort.oregonstate.edu.

### **HORTICULTURE GRADUATE MINOR**

For more details, see the departmental  
advisor.

#### **COURSES**

**HORT 111. INTRODUCTION TO  
HORTICULTURAL CROP PRODUCTION (2).**  
Characteristics of commercial horticulture; survey  
of commercial horticultural systems with emphasis  
on the Pacific Northwest; career opportunities in  
horticulture. Required field trips.

**HORT 112. INTRODUCTION TO TURF AND  
LANDSCAPE MANAGEMENT (2).** Survey  
of turf and landscape management industry  
with emphasis on the Pacific Northwest; career  
opportunities. Required field trips.

**HORT 199. SPECIAL TOPICS (1-16).**

**HORT 226. LANDSCAPE PLANT MATERIALS  
(3).** Identification of trees, shrubs, vines, and  
ground covers used in landscape horticulture; their  
use in plant composition.

**HORT 227. LANDSCAPE PLANT MATERIALS  
(3).** Identification of trees, shrubs, vines, and  
ground covers used in landscape horticulture; their  
use in plant composition.

**HORT 228. LANDSCAPE PLANT MATERIALS  
(3).** Identification of trees, shrubs, vines, and  
ground covers, used in landscape horticulture;  
their use in plant composition.

**HORT 233. VEGETABLE CROPS (4).**  
Introduction to various vegetable crops grown  
in the PNW. Botanical relationships, breeding  
systems for varietal propagation, and traits  
of importance to growers, processors, and  
consumers are discussed. Fresh material is  
used to illustrate varietal differences and traits of  
importance. Offered alternate years.

**HORT 251. TEMPERATE TREE FRUIT,  
BERRIES, GRAPES, AND NUTS (2).** Covers  
fruit and nut crops for temperate zones. Emphasis  
placed on scientific and common names, plant  
adaptation, basic morphology, major cultivars, and  
markets. Offered alternate years.

**HORT 255. HERBACEOUS ORNAMENTAL  
PLANT MATERIALS (3).** Identification and  
culture of herbaceous plants used in the  
landscape. Offered alternate years.

**HORT 260. ORGANIC FARMING AND  
GARDENING (3).** Organic farming and gardening  
methods are discussed in class and practiced in  
the field. The philosophical background of organic  
farming as well as the biological, environmental  
and social factors involved in organic food  
production are covered. Emphasis is on hands-  
on application of scientific principles to create  
sustainable food production systems. Lec/lab.

**HORT 270. INTRODUCTION TO THERAPEUTIC  
HORTICULTURE (2).** An introduction to the  
history, benefits, and methods of therapeutic  
horticulture. Surveys program models for  
vocational, social/recreational, wellness and  
therapeutic applications of horticulture.

**HORT 271. TECHNIQUES & ADAPTIVE  
STRATEGIES IN THERAPEUTIC  
HORTICULTURE (2).** An introduction to the  
characteristics of therapeutic gardens. Survey  
of year-round, indoor and outdoor therapeutic  
horticultural programming adaptations, strategies  
and techniques for different special populations.  
**PREREQS:** HORT 270.

**HORT 272. BASIC THERAPEUTIC SKILLS I  
(2).** The assessment and evaluation process  
in therapeutic horticulture. Development of  
communication strategies, helping skills, and  
horticultural skills for the therapeutic situations.  
**PREREQS:** HORT 271.

**HORT 273. BASIC THERAPEUTIC SKILLS II  
(2).** Assessment and documentation tools in  
therapeutic horticulture. Treatment issues related  
to different types of physical and mental issues.  
Conduct and evaluate therapeutic horticultural  
activity sessions. **PREREQS:** HORT 272.

**HORT 274. THERAPEUTIC HORTICULTURAL  
PROGRAMS FOR OLDER ADULTS/CHILDREN  
(2).** Benefits and applications of therapeutic  
horticulture to older adults and special needs  
children. **PREREQS:** HORT 273.

**HORT 275. THERAPEUTIC GARDEN DESIGN,  
MAINTENANCE AND PROGRAMMING (2).**  
The history, characteristics and design of the  
therapeutic garden. The use of the garden in  
therapeutic horticultural programming. **PREREQS:**  
HORT 274 and HORT 280

**HORT 280. INTRODUCTION TO LANDSCAPE  
DESIGN (3).** Students will actively discover  
the landscape design process, from initial client  
interview and site assessment to presentation  
of the final plan. Basic design principles, plant  
selection, and drafting skills will be emphasized.  
**PREREQS:** HORT 226, HORT 227, HORT 228.

**HORT 299. SPECIAL TOPICS (1-16).**

**HORT 299H. SPECIAL TOPICS (1-16).**  
**PREREQS:** Honors College approval required.

**HORT 300. INTRODUCTION TO CROP  
PRODUCTION (4).** Principles, practices, and  
issues relating to the production, marketing,  
and improvement of horticultural and agronomic  
crops. Comparison of crop production systems;  
geography of crop production; cropping calendars.  
Lec/rec. **CROSSLISTED** as CSS 300. **PREREQS:**  
One year of general biology or equivalent.

**HORT 301. PRINCIPLES OF HORTICULTURAL  
TECHNOLOGY (4).** Principles and practices  
relating to control of plant growth and  
development; manipulation of growth rate, plant  
form, flowering, fruiting, and dormancy by means  
of environment, chemicals, pruning, and training.  
**PREREQS:** General biology or botany sequence.

**HORT 302. PRINCIPLES OF HORTICULTURAL  
TECHNOLOGY (4).** Analysis of plant-  
environment relationship; principles underlying  
manipulation of aerial and soil environments; site  
evaluations; plant adaptation; diagnosis of plant  
damage. Lec/lab. **PREREQS:** General biology or  
botany sequence.

**HORT 303. HORTICULTURAL PROJECTS**

(2). Student-managed crop production projects with emphasis on container grown, greenhouse crops. Crop scheduling, propagation and planting, selecting temperature and lighting regimes, specifying growth regulator applications, nutrient management, irrigation management, pest monitoring, and problem diagnosis and correction. **PREREQS:** HORT 301.

**HORT 311. ^PLANT PROPAGATION (4).** The regeneration of plants from vegetative and reproductive tissue and organs. Horticultural and physiological principles, methods, and techniques for laboratory, greenhouse nursery, field, and orchard. (Writing Intensive Course) **PREREQS:** HORT 301.

**HORT 314. PRINCIPLES OF TURFGRASS MAINTENANCE (4).**

Identification and adaptation of common turfgrasses. Physiology of turfgrass growth and response to cultural and environmental stresses. Cultural practices including establishment, general maintenance, and pest control. Field trips required. **PREREQS:** CSS 305.

**HORT 315. PRINCIPLES AND PRACTICES OF LANDSCAPE MAINTENANCE (4).**

Maintenance practices related to non-turf landscape areas. Emphasis on pruning, planting, fertilization, and pest control. Plant responses to stress, particularly those encountered in the urban environment. Field trips required. **PREREQS:** HORT 301.

**HORT 316. M/PLANT NUTRITION (4).** Factors influencing nutrient absorption and plant composition are presented. Basic concepts of mineral nutrition and soil management for woody plants and turf are emphasized. Also offered in 3 modules covering: a) Factors influencing nutrient absorption and plant composition (2 credits). b) Diagnosing nutritional disorders (1 credit). c) Physiology of plant nutrition (1 credit). Course can be repeated for credit. **PREREQS:** CSS 305.

**HORT 317. TURF FERTILITY (1).** Factors influencing the nutritional management of turf systems are discussed. The course is intended for students whose primary interest is professional turfgrass management. **PREREQS:** HORT 316, HORT 314.

**HORT 318. APPLIED ECOLOGY OF MANAGED ECOSYSTEMS (3).**

Survey of ecological processes in managed ecosystems emphasizing ecological management techniques. Ecosystem services; biodiversity management; weed dynamics; agroecology; urban ecology; restoration and mitigation; landscape management. Field trip required. **PREREQS:** General biology or botany sequence.

**HORT 330. \*PLAGUES, PESTS, AND POLITICS (3).** Integration and interaction of agricultural and public health aspects of entomology in society and history. **CROSSLISTED** as BI 300 and ENT 300. (Bacc Core Course)

**HORT 351. GREENHOUSE ENVIRONMENTS**

(2). An introduction to the planning and operation of greenhouse facilities for crop production. **PREREQS:** HORT 301.

**HORT 358. ^LANDSCAPE CONSTRUCTION TECHNIQUES (4).**

Study of landscape construction process from initial site analysis to finished landscape. Techniques used in building hardscape and landscape areas. Field trips required. Lec/lab. (Writing Intensive Course)

**HORT 360. LANDSCAPE CONSTRUCTION: IRRIGATION AND DRAINAGE (4).**

Surface grading/drainage techniques and structures; principles and techniques of landscape and turf irrigation. Field trips required. Lec/lab. **PREREQS:** HORT 358, CSS 305.

**HORT 361. M/GREENHOUSE AND NURSERY PRODUCTION AND MANAGEMENT I (1-4).**

Course offered in 3 modules covering: a) overview of greenhouse and nursery industry and decisions to be made in establishing a business (1 credit).

b) plant aerial environment (1 credit). c) plant root environment (2 credits). **PREREQS:** HORT 301.

**HORT 363. SEED BIOLOGY (3).** Biological aspects of seed formation and development, germination, maturation, dormancy, and deterioration. Fundamentals of seed composition and function. Lec/lab. **CROSSLISTED** as CSS 363. **PREREQS:** BI 103 or BI 212.

**HORT 380. ADVANCED LANDSCAPE DESIGN STUDIO (3).**

The assessment of design problems/situations, the development of solutions and the communication of those solutions to the client through the design. Specific topics include designing for ecosystem maintenance/enhancement, introduction to computer-aided design (CAD), using color in landscape designs and rendering section/elevation views. **PREREQS:** HORT 280 and HORT 315 and HORT 358

**HORT 385. ^LANDSCAPE OPERATIONS (3).**

Managing a successful landscape design, construction and/or management company requires significant knowledge beyond the horticulture skills practiced on the job site. Students will learn about the size, nature, and economic status of the landscape industry, contracts, specifications, licensing, certification, environmental issues, safety and personnel management. (Writing Intensive Course)

**HORT 399. SPECIAL TOPICS (1-16).****HORT 401. RESEARCH (1-16).**

**HORT 403. THESIS (1-16).** **PREREQS:** Junior standing. Departmental approval required.

**HORT 405. READING AND CONFERENCE (1-16).**

**HORT 406. PROJECTS: DATA PRESENTATIONS (1).** The design, evaluation, and development of poster and slide presentations containing scientific data. Practice in written and oral communication skills relating to public presentation of data in written and oral form. **CROSSLISTED** as BRR 406. **PREREQS:** Junior or senior standing.

**HORT 407. SEMINAR (1).**

**HORT 410. INTERNSHIP (1-12).** Work internship to acquaint horticulture majors with the practices of the horticulture industry. Under direction of departmental internship committee. Requires approved statement of intent, submission of employer and employee evaluation forms and written report. **PREREQS:** Junior standing.

**HORT 411. HORTICULTURE BOOK CLUB (1).**

Reading and discussion of noteworthy books and associated topics relating to agriculture, society and the environment. **PREREQS:** Sophomore standing.

**HORT 412. CAREER EXPLORATION: INTERNSHIPS AND RESEARCH PROJECTS (1).**

Provides orientation to the horticulture major internship and research project requirement. Covers procedures for selecting, performing, and reporting on an internship or research project. Includes guidance and skill development valuable in the pursuit of horticultural career goals, such as cover letter and resume preparation and interviewing experience.

**HORT 414. INFORMATION SYSTEMS IN AGRICULTURE (4).**

Introduction to precision farming tools (GIS, image processing, GPS, and computer-linked agricultural equipment). Students enrolling in 4 credits also complete a class project.

**HORT 418. GOLF COURSE MAINTENANCE (4).**

Basic aspects of golf course maintenance under temperate zone conditions. Lec/lab. **PREREQS:** HORT 314.

**HORT 430. PLANT GENETICS (3).** Introduction to the principles of plant genetics with an emphasis on the structure and function of economically important plant genomes. **CROSSLISTED** as CSS 430/CSS 530. **PREREQS:** One year of biology and chemistry.

**HORT 431. PLANT GENETICS RECITATION**

(1). Review and demonstration of plant genetics principles. **CROSSLISTED** as CSS 431.

**HORT 438. EXPLORING WORLD AGRICULTURE (2).**

Survey of crop and livestock production in a designated section of the world, including history, culture, and political situation. Course is designed to prepare students for a tour of study area. **CROSSLISTED** as AREC 438, CSS 438, ANS 438. Graded P/N.

**HORT 441. PLANT TISSUE CULTURE (4).**

Principles, methods, and applications of plant tissue culture. Laboratory is important part of course. Topics include callus culture, regeneration, somaclonal variation, micropropagation, anther culture, somatic hybridization, and transformation. **PREREQS:** BOT 331, BI 311, or HORT 430/ HORT 530.

**HORT 450. PLANT BREEDING (4).**

An introduction to the genetic improvement of self-pollinated, cross-pollinated, and asexually propagated species and the genetic principles on which breeding methods are based. Examples are drawn from a wide range of crops, including cereal grains, grasses, fruits, nuts, and vegetables; guest lecturers discuss their breeding programs. Additional topics include crop evolution, germplasm preservation, disease resistance, and biotechnology. Lec/lab. **CROSSLISTED** as CSS 450/CSS 550. **PREREQS:** BI 311 or HORT 430/ HORT 530.

**HORT 451. TREE FRUIT PHYSIOLOGY AND CULTURE (4).**

Plant growth and development in relation to tree fruit production; emphasis on canopy development and pruning theory, flowering and fruit set, and development, dormancy, and cold acclimation. Field trips required. Offered alternate years. **PREREQS:** HORT 301, BOT 331, or concurrent enrollment.

**HORT 452. BERRY AND GRAPE PHYSIOLOGY AND CULTURE (4).**

Production of wine grapes, caneberrys, strawberries, blueberries, and other miscellaneous berry crops. Emphasis on plant growth and development; pruning and training systems; flower and fruit development and cultivars. Field trips required. Offered in alternate years. **PREREQS:** HORT 301.

**HORT 453. VITICULTURE I (3).**

The physiological aspects of grapevine establishment and development, and vegetative/reproductive balance. Effects of vineyard site mesoclimate and soil; site selection. **PREREQS:** HORT 301 or instructor approval.

**HORT 454. VITICULTURE II (3).**

The relationship of vineyard and canopy management to grapevine physiology and fruit quality. Nutrient/water relations within the soil/vine continuum. Vineyard microclimate, floor management, and pests will also be discussed. **PREREQS:** HORT 453 or instructor approval.

**HORT 480. CASE STUDIES IN CROPPING SYSTEMS MANAGEMENT (4).**

Decision cases involving the production of field and horticultural crops; individual and group activities; discussion of the decision-making process. Multiple field trips required. A field trip fee may be charged. **CROSSLISTED** as CSS 480/CSS 580. **PREREQS:** HORT 300 or CSS 300, senior standing in agriculture.

**HORT 481. CASE STUDIES IN HORTICULTURAL SYSTEMS MANAGEMENT (4).**

Field-based decision cases involving problematical situations encountered in horticultural farming systems including nursery production, orchard and vineyard systems, market gardening, Christmas tree, and row crop production. Required field trips may include weekend trips. Course can be repeated for credit. **PREREQS:** HORT/CSS 300, HORT 301, CSS 305.

**HORT 495. HORTICULTURAL MANAGEMENT PLANS (3).**

Develop an integrated management plan for a horticultural enterprise. Course may be repeated once for credit. **PREREQS:** Senior standing.

**HORT 499. SPECIAL TOPICS (1-16).**

**HORT 501. RESEARCH (1-16).**

**HORT 503. THESIS (1-16).**

**HORT 505. READING AND CONFERENCE (1-16).**

**HORT 507. SEMINAR (1-16).**

**HORT 511. RESEARCH AND EDUCATIONAL PERSPECTIVES IN HORTICULTURE (2).**

Introduces beginning graduate students to the faculty in horticulture and provides an in-depth discussion of their research and education programs.

**HORT 512. DISCUSSIONS IN PLANT SCIENCE (1).**

Student presentations dealing with selected topics in the plant sciences and examined in the context of contemporary research. (Students enroll once in each academic year.)

**HORT 513. PLANT GENETIC ENGINEERING (3).**

Principles, methods, and recent developments in the genetic engineering of higher plants. Offered alternate years. **PREREQS:** BOT 331, BI 311 or HORT 430/HORT 530, CSS 430/CSS 530.

**HORT 514. M/INFORMATION SYSTEMS IN AGRICULTURE (4).**

Introduction to precision farming tools (GIS, image processing, GPS, and computer-linked agricultural equipment). Students enrolling in 4 credits also complete a class project, make an educational video, and present results in a computer presentation. Standard classroom, video, and distance versions of the course are available. Also offered in 4 modules covering: a) geographic information systems (GIS) (1 credit), b) image processing (1 credit), c) global positioning systems (GPS) (1 credit). Course can be repeated for credit.

**HORT 516. ADVANCED PLANT NUTRITION (4).**

Factors influencing nutrient absorption and plant composition with an emphasis on plant physiology and soil chemistry. Diagnostic approaches to determining nutritional status are discussed in detail. Current efforts to enhance nutritional efficiency are explained. Offered alternate years. **PREREQS:** BOT 331, CSS 305.

**HORT 517. DIAGNOSIS OF NUTRITIONAL DISORDERS (1).**

Factors influencing the interpretation of soil and plant testing are discussed. Emphasis is placed on horticultural crops. The same information presented in HORT 316 module (b) is available for graduate credit in this course. **PREREQS:** BOT 331, CSS 305.

**HORT 520. TOPICS IN HORTICULTURE RESEARCH (1-16).**

**HORT 521. RESEARCH TECHNIQUES (1-16).**

Separate sections dealing with the theory and practice of various laboratory and field techniques used in horticultural research.

**HORT 530. PLANT GENETICS (3).**

Introduction to the principles of plant genetics with an emphasis on the structure and function of economically important plant genomes. **CROSSLISTED** as CSS 430/CSS 530.

**PREREQS:** One year of biology and chemistry.

**HORT 541. PLANT TISSUE CULTURE (4).**

Principles, methods, and applications of plant tissue culture. Laboratory is important part of course. Topics include callus culture, regeneration, somaclonal variation, micropropagation, anther culture, somatic hybridization, and transformation. **CROSSLISTED** as MCB 541.

**HORT 550. PLANT BREEDING (4).**

An introduction to the genetic improvement of self-pollinated, cross-pollinated, and asexually propagated species and the genetic principles on which breeding methods are based. Examples are drawn from a wide range of crops, including cereal grains, grasses, fruits, nuts, and vegetables; guest lecturers discuss their breeding programs. Additional topics include crop evolution, germplasm preservation, disease resistance, and biotechnology. Lec/lab. **CROSSLISTED** as CSS 450/CSS 550. **PREREQS:** BI 311 or HORT 430.

**HORT 552. BERRY AND GRAPE PHYSIOLOGY AND CULTURE (4).**

Production of wine grapes, caneberries, strawberries, blueberries, and other miscellaneous berry crops. Emphasis on plant growth and development; pruning and training systems; flower and fruit development and cultivars. Field trips required. Offered in alternate years. **PREREQS:** HORT 301.

**HORT 564. ADVANCED SEED BIOLOGY (3).**

Review of seed development, dormancy, and germination. Reading and discussion of advanced seed biology research. Offered in alternate years. **PREREQS:** Graduate or professional students only.

**HORT 573. CYTOGENETICS (4).**

Effects of variation in chromosome structure and number. Offered alternate years. **CROSSLISTED** as GEN 573, MCB 573. **PREREQS:** BI 311 or equivalent.

**HORT 575. AGRICULTURAL MANAGEMENT OF OREGON SOIL RESOURCES (2).**

Field trips to study soil and crop management for agriculture and forestry through the experiences of Oregon farmers, ranchers, and foresters. Trips visit both dryland and irrigated enterprises in eastern Oregon, irrigated and nonirrigated operations in western Oregon, and managed forests and rangelands throughout Oregon. A field trip fee may be charged. **PREREQS:** Graduate standing.

**HORT 580. CASE STUDIES IN CROPPING SYSTEMS MANAGEMENT (4).**

Decision cases involving the production of field and horticultural crops; individual and group activities; discussion of the decision-making process. Multiple field trips required. A field trip fee may be charged. **CROSSLISTED** as CSS 480/CSS 580.

**PREREQS:** HORT 300 or CSS 300, graduate standing in agriculture.

**HORT 601. RESEARCH (1-16).**

**HORT 603. DISSERTATION (1-16).**

**HORT 605. READING AND CONFERENCE (1-16).**

**HORT 606. PROJECTS (1-16).**

**HORT 607. SEMINAR (1-16).**

**HORT 611. PLANT GENETICS (3).** Specific and current topics in genetics of particular relevance to higher plants. Offered alternate years.

## MICROBIOLOGY

See College of Science.

## NATURAL RESOURCES

See the Interdisciplinary Studies section of this catalog for curriculum details.

## RANGELAND ECOLOGY AND MANAGEMENT

**Michael M. Borman**, *Interim Head*  
202 Strand Agriculture Hall  
Oregon State University  
Corvallis, OR 97331-6704  
541-737-3341  
E-mail: rangelands@oregonstate.edu  
Website: <http://oregonstate.edu/dept/range/>

### FACULTY

**Professors** Borman, Buckhouse, Johnson, Larson, McInnis, J. Miller, R. Miller, Peters, Sharrow

**Associate Professors** Deboodt, Schreder, Williams

**Assistant Professors** Delaney, Ehrhart, Johnson, Mata-Gonzalez

**Instructor** Carr

### COURTESY FACULTY

**Associate Professor** Pyke, Stringham  
**Assistant Professors** Bates, Boyd, Davies, Ganskopp, George, James, Mangold, Sheley, Svejar

### Undergraduate Major

#### Rangeland Ecology and Management (BS)

##### Options

*General Rangeland Resources*  
*Range/Forestry*  
*Range Management*  
*Range Science*  
*Range/Soils*  
*Range/Wildlife*  
*Wildland Ecology*

### Minor

#### Rangeland Ecology and Management

### Graduate Major

#### Rangeland Ecology and Management (MS, PhD)

##### Graduate Areas of Concentration

*Agroforestry*  
*Ecology of Rangelands*  
*Physiology of Range Plants*  
*Range Improvement*  
*Range Nutrition*  
*Restoration Ecology*  
*Riparian Zone Management*  
*Watershed Management*

### Graduate Minor

#### Rangeland Ecology and Management

Rangeland resource management is one of the family of natural resources professions important to the social, economic, and political development of Oregon, the nation, and the world. It is based upon ecological principles and is concerned with the restoration, improvement, con-

servation, and use of rangelands. Since range management is practiced on lands producing domestic and wild animals, timber, water, and recreation, concepts of integrated land use are included in the curriculum. A balance among soil, domestic animal, wildlife, ecology, and other biological sciences is realized in the educational program.

The curriculum below includes university and departmental requirements for the BS degree and provides emphasis either in science, management, ecology, or allied disciplines. The BS degree is also offered on the campus of Eastern Oregon University at La Grande through an extension of the OSU Department of Rangeland Ecology and Management. Facilities for study include classroom and field-oriented educational environments both on-campus and at locations throughout Oregon. Field trips are taken in conjunction with specific courses.

Graduate work leading to MAG, MAIS, MS, or PhD degrees may involve research on domestic or wild animals, rangeland nutrition, community ecology, physiology of rangeland plants, rangeland improvement, rangeland watershed and riparian zone management, rangeland restoration, utilization and management, agroforestry and landscape ecology.

Summer employment with private industry, government agencies, and on range research projects makes possible learning experiences while earning a salary. Employment opportunities include resource management, research, Extension, ranch management, college and university teaching, business and industrial activities related to rangeland resources, and foreign agricultural and resource development assistance.

The Department of Rangeland Ecology and Management is accredited by the Society for Range Management. It is recognized throughout the country as one of the leading institutions of rangeland management.

### RANGELAND ECOLOGY AND MANAGEMENT (BS, CRED, HBS)

To earn the Rangeland Ecology and Management BS degree, each student must take the core courses plus additional courses in one of the seven options: general rangeland resources, range management, range science, range/forestry/fire management, range/soils, range/wildlife, wildland ecology.

Course work credit may not be counted twice to satisfy department core, option or minor requirements. Departmental requirements may be utilized to satisfy Baccalaureate Core and non-departmental minor requirements.

#### Baccalaureate Core (48)<sup>6</sup>

**General Sciences and Communications (49)<sup>6</sup>**

ANS 313. Applied Animal Nutrition: Feeds and Ration Formulation (4)  
ANS 436. Sheep Production Systems (3) or ANS 443. Beef Production Systems (3)  
AREC 351. \*Natural Resource Economics and Policy (3)  
or AREC 352. \*Environmental Economics and Policy (3)  
BI 211, BI 212. \*Principles of Biology (4,4)  
BI 370. Ecology (3)  
or BOT 341. Plant Ecology (4)  
BOT 321. Plant Systematics (4)  
BOT 331. Plant Physiology (4)  
or BOT 488. Environmental Physiology of Plants (3)  
BOT 414. Agrostology (4)  
CH 121. General Chemistry (5)  
CH 122. \*General Chemistry (5)  
CH 130. General Chemistry of Living Systems (4)  
CSS 305. Principles of Soil Science (4)  
CSS 306. Solving Problems: Soil Science Applications (1)  
CSS 466. Soil Morphology and Classification (4)  
ECON 201. \*Intro to Microeconomics (4)  
GEO 102. \*The Surface of the Earth (4)  
MTH 241. \*Calculus for Management and Social Science (4)  
ST 351. Intro to Statistical Methods (4) or ST 201. Principles of Statistics (3) plus ST 209. Principles of Hypothesis Testing (1)  
WR 327. \*Technical Writing (3)

#### Natural Resources (11)

CSS 310. Forage Production (4)  
FOR 111. Intro to Forestry (3)  
FOR 251. Recreation Resource Management (4)  
FW 251. Principles of Fish and Wildlife Conservation (3)

#### Rangeland Ecology and Management (30)

**Note:** Majors in rangeland resources are required to achieve a minimum "C" grade in the following courses:  
RNG 241. Rangeland Ecology and Management (3)  
RNG 301. Career Orientation (1)  
RNG 351. Range Ecology I-Grasslands (3)  
RNG 352. Range Ecology II-Shrublands (3)  
RNG 353. Wildland Plant Identification (4)  
RNG 355. Desert Watershed Management (3)  
RNG 403. ^Senior Thesis (1-16)  
RNG 421. Wildland Restoration and Ecology (4)  
RNG 441. Rangeland Analysis (4)  
RNG 442. Rangeland-Animal Relations (4)  
RNG 490. Rangeland Management Planning (4)  
Free electives (3-13)

#### Footnote:

<sup>6</sup> Certain classes may be used to satisfy both the baccalaureate core and the rangeland ecology and management core.

### GENERAL RANGELAND RESOURCES OPTION

Option course work must include a minimum of 15 upper-division credits. The general option is designed to allow

students, with advisor approval, to develop a specialized knowledge emphasis. Select at least 12 credits from the list below, plus electives to total 27 credits:

ANS 420. ^Ethical Issues in Animal Agriculture (3)  
 AREC 211. Management in Agriculture (4)  
 AREC 253. \*Evolution of U.S. Environmental and Natural Resources Law (4)  
 AREC 311. Intermediate Microeconomic Theory I (4)  
 AREC 353. Public Land Statutes and Policy (4)  
 AREC 434. ^Environmental and Resource Economics (3)  
 AREC 441. Agricultural Financial Management (4)  
 AREC 442. Agricultural Business Management (4)  
 AREC 453. Public Land and Resource Law (4)  
 BA 211. Financial Accounting (4)  
 CSS 315. ^Nutrient Management and Cycling (4)  
 CSS 440. Weed Management (4)  
 FW 435. ^Wildlife in Agricultural Ecosystems (3)  
 RNG 477. \*Agroforestry (3)

#### **RANGE SCIENCE OPTION**

**Option course work must include a minimum of 15 upper-division credits. Students must choose one option.**

ANS 378. Animal Genetics (4)  
 Biology, Rangeland Ecology and Management courses (13)  
 Physics (8)  
 Electives (2)

**Total=27**

#### **RANGE/FORESTRY/FIRE MANAGEMENT OPTION**

**Option course work must include a minimum of 15 upper-division credits.**

**Select 27 credits from:**

BOT 415. Forest Insect and Disease Management (5)  
 FOR 220. Aerial Photo Interpretation and Forest Measurements (4)  
 FOR 241. Dendrology (5)  
 FOR 321. Forest Mensuration (5)  
 FOR 341. Forest Ecology (3)<sup>8</sup>  
 FOR 407. Seminar (1–16)  
 FOR 420. Advanced Aerial Photos and Remote Sensing (3)  
 FOR 441. Silviculture Principles (4)  
 RNG 436. Wildland Fire Science and Management (4)  
 RNG 446. Wildland Fire Ecology (3)

**Total=27**

#### **Footnote:**

<sup>8</sup> Offered during Forestry's Spring Intensive Term.

#### **RANGE MANAGEMENT OPTION**

ANS 121. \*Intro to Animal Sciences (4)  
 ANS 436. Sheep Production Systems (3)  
 or ANS 443. Beef Production Systems (3)  
 FW 251. Principles of Fish and Wildlife Conservation (3)  
 RNG 351. Range Ecology I-Grasslands (3)  
 RNG 35X. Range Ecology II-Shrublands (3)  
 RNG 353. Wildland Plant Identification (4)  
 RNG 477. \*Agroforestry (3)

**Total=23**

#### **RANGE/SOILS OPTION**

**Option course work must include a minimum of 15 upper-division credits. Students must choose one option.**

CSS 315. ^Nutrient Management and Cycling (4)  
 CSS 455. Biology of Soil Ecosystems (4)  
 CSS 535. Soil Physics (3)  
 Other soils and rangeland courses (8)

**Total=23**

#### **RANGE/WILDLIFE OPTION**

**Option course work must include a minimum of 15 upper-division credits. Students must choose one option.**

BI 311. Genetics (4)  
 Zoology Courses (6)  
**Select at least 17 credits from below:**  
 FW 311. Biology of Birds (3)  
 or Z 471. Ornithology (4)  
 FW 317. Biology of Mammals (3)  
 FW 318. Systematics of Mammals (2)  
 FW 320. Introduction to Population Dynamics (3)  
 FW 321. Fish and Wildlife Ecology (3)  
 FW 451. Avian Conservation and Management (5)  
 FW 458. Management of Big Game Animals (4)  
 FW 481. Wildlife Ecology (4)  
 FW 485. \*Consensus and Natural Resources (3)  
 or Z 348. \*Human Ecology (3)  
 Z 365. Biology of Insects (4)  
 Z 473. Biology of Amphibians and Reptiles (3)

**Total=27**

#### **WILDLAND ECOLOGY OPTION**

**Option course work must include a minimum of 15 upper-division credits. Students must choose one option.**

**Select two courses from below:**

CSS 535. Soil Physics (3)  
 FW 311. Biology of Birds (3)  
 or FW 317. Biology of Mammals (3)  
 FW 321. Fisheries and Wildlife Resource Ecology (3)  
 FW 458. Management of Big Game Animals (4)  
 RNG 455. Riparian Ecology and Management (3)

**Select three courses from below:**

BI 371. ^Ecological Methods (3)

BOT 442. Plant Population Ecology (3)  
 FOR 341. Forest Ecology (3)  
 GEO 422. Reconstructing Historical Landscapes (3)  
 Electives (6)

**Total=27**

#### **RANGELAND ECOLOGY AND MANAGEMENT MINOR**

##### **Requirements**

RNG 241. Rangeland Ecology and Management (3)  
 RNG 351. Range Ecology I-Grasslands (3)  
 RNG 352. Range Ecology II-Shrublands (3)  
 RNG 421. Wildland Restoration and Ecology (4)  
 RNG 442. Rangeland-Animal Relations (4)  
 RNG 490. Rangeland Management Planning (4)

**Select 9 additional credits from:**

Any other RNG course  
 ANS 436. Sheep Production Systems (3)  
 ANS 443. Beef Production Systems (3)  
 BOT 341. Plant Ecology (4)

**Total=28**

**Note:** Completion of the Rangeland Resources minor alone does not qualify students for rangeland conservationist positions with the U.S. Office of Personnel Management (OPM).

#### **RANGELAND ECOLOGY AND MANAGEMENT (MAG, MS, PhD)**

**Graduate Areas of Concentration**  
*Agroforestry, ecology of rangelands, physiology of range plants, range improvement, range nutrition, restoration ecology, riparian zone management, watershed management,*

The Department of Rangeland Ecology and Management offers the Master of Science, the Master of Agriculture, and the Doctor of Philosophy degrees.

The program integrates plant, soil, and animal sciences to prepare degree candidates for leadership in this professional field. Under the guidance of the rangeland faculty, graduate students study rangeland ecology, physiology of rangeland plants, rangeland nutrition, rangeland improvements, watershed management, restoration ecology, agroforestry, water quality, and riparian zone management. Through the Department of Rangeland Ecology and Management, range management graduate students have access to greenhouse, field plot, pasture, range, and animal facilities on campus, and at the two Eastern Oregon Agricultural Research Center stations at Union and Burns.

Graduate students in rangeland ecology and management may select courses in complementary areas, including agricultural and resource economics, fisheries and wildlife, botany, soils, statistics, biology forestry, crop science, and animal science. The selection of these complementary areas depends on the interest of the students, their aptitude, and the

thesis topic chosen. Minors are commonly elected in botany, soils, forage crops, animal nutrition, fisheries and wildlife, agricultural and resource economics, or in an integrated program of study.

### **RANGELAND ECOLOGY AND MANAGEMENT GRADUATE MINOR**

For more details, see the departmental advisor.

#### **COURSES**

**RNG 241. RANGELAND ECOLOGY AND MANAGEMENT (3).** Nature and management of rangelands. Integrated land use with emphasis on plant-animal-soil interactions. Course can be repeated for credit. **PREREQS:** Sophomore standing.

**RNG 299. SPECIAL TOPICS (1-16).**

**RNG 299H. SPECIAL TOPICS (1-16).** **PREREQS:** Honors College approval required.

**RNG 346. TOPICS IN WILDLAND FIRE (3).** An interdisciplinary survey of concepts relating to fire science, ecology, management, and policy. Includes case studies of several representative ecosystems, ranging from west- and eastside forests of the Pacific Northwest to shrub steppe ecosystems of the Intermountain West and chaparral ecosystems of southern California. Distance and campus-based delivery using videos, Website, and discussion. **CROSSLISTED** as FOR 346, FW 346. **PREREQS:** Course work in forest biology or ecology (e.g. FOR 240, FOR 341) or equivalent.

**RNG 351. RANGE ECOLOGY I - GRASSLANDS (3).** Principles and terminology of grassland ecology. Addresses the spatial-temporal dynamics of structure, function, and process in North American grassland ecosystems. Water, nutrient cycles and energy pathways are explored in the context of the variable driving forces of climate (drought), herbivory, and fire. **PREREQS:** BOT 313, RNG 341.

**RNG 352. RANGE ECOLOGY II-SHRUBLANDS (3).** Introduces the ecology of shrublands using an autecological approach. Explores the effects of stressors such as temperature, drought, fire, and herbivory on plant morphology, physiology, reproduction, and growth. Covers life histories of common shrubs and descriptions of shrubland communities used to promote understanding of autecological principles. **PREREQS:** BOT 313, RNG 341.

**RNG 353. WILDLAND PLANT IDENTIFICATION (4).** Students will learn how to identify approximately 100 plant species found in wildlands of North America and Mexico. Individual plant species ecology, basic plant anatomy and identification characteristics observable only through a microscope or dissecting scope, and how to use a dichotomous key for plant ID will also be covered.

**RNG 355. DESERT WATERSHED MANAGEMENT (3).** Principles and methods in managing rangeland for optimum production and regulation of water yields, as well as maintaining soil stability and on-site productivity. Effects of grazing herbivores and their potential as land use, manipulative tools. Concepts of arid land hydrology, with emphasis on the resultant effects on runoff quantity and quality.

**RNG 399. SPECIAL TOPICS (1-16).** May be repeated for a total of 16 credits.

**RNG 403. SENIOR THESIS (1-16).** **PREREQS:** Departmental approval required.

**RNG 405. READING AND CONFERENCE (1-16).**

**RNG 406. PROJECTS (1-16).**

**RNG 411. ADVANCED PLANT ID (2).** Advanced rangeland plant taxonomy. **PREREQS:** Departmental approval required.

**RNG 421. WILDLAND RESTORATION AND ECOLOGY (4).** Emphasis is placed on understanding the ecology of arid and semi-arid ecosystems through the study of ecological processes responsible for ecosystem function. Range improvement practices for stabilizing and repairing degraded wildlands by directing autogenic recovery mechanisms are discussed. This involves manipulating plants, soil, animals and microenvironments for improved ecosystem function. **PREREQS:** Course work in soils and ecology. Field trip required.

**RNG 436. WILDLAND FIRE SCIENCE AND MANAGEMENT (4).** Principles and applications of fire as a natural resource management tool, the role of fire in conservation management, restoration, and preservation of ecosystems. Focus will center on ecological relationships of fire and natural communities, wildlife habitats, fire influences on air quality and climate change. The course will cover techniques used to describe fire behavior, fuels, and fire effects on the biota. **CROSSLISTED** as FOR 436/FOR 536.

**RNG 441. RANGELAND ANALYSIS (4).** Techniques used to describe vegetation in shrub-lands, grasslands, and forests. Use of measurements in resource management. Course is field-oriented, emphasizing both theory and practice of wildland inventory methods. **PREREQS:** ST 351 or ST 351H

**RNG 442. RANGELAND-ANIMAL RELATIONS (4).** Domestic and wild animal use of rangelands as related to environmental factors, palatability, food habits, nutrition, physiography, and their effects on management of rangeland-animal resources. **PREREQS:** RNG 341

**RNG 446. WILDLAND FIRE ECOLOGY (3).** Coverage of fire histories and ecology of major forest, rangeland and wetland ecosystems. Includes fire interactions with physical and biotic components of ecosystems, role of fire in ecological processes, and utilization in natural resource management. **CROSSLISTED** as FOR 446/FOR 546 and FW 446/FW 546. **PREREQS:** Course work in ecology and natural resource management.

**RNG 450. LANDSCAPE ECOLOGY AND ANALYSIS (3).** Course will introduce students to the principles and terminology of landscape ecology in a rangeland context. We will examine the pattern and distribution of elements across the landscape and seek relationships between element location and environmental parameters. Landscape dynamics through time will be quantified, analyzed, and mapped. **PREREQS:** RNG 341 or equivalent.

**RNG 455. RIPARIAN ECOLOGY AND MANAGEMENT (3).** Study of the ecology of riparian vegetation, including successional processes in riparian zones, productivity, structure and diversity of riparian ecosystems. The class is focused on the terrestrial vegetation, soils and animals of riparian ecosystems. Emphasis is placed on the past abuse associated with riparian ecosystems, methods of rehabilitation, and theories of the proper use of riparian ecosystems under a multiple-use philosophy (i.e. fish, wildlife, livestock, aesthetics, recreation, and silviculture). **PREREQS:** RNG 355

**RNG 477. \*AGROFORESTRY (3).** Theory and worldwide practice of multiple-crop low input sustainable systems involving concurrent production of tree and agricultural products. Biological, economic, social, and political factors that underlie the application of agroforestry technology. (Bacc Core Course) **PREREQS:** Course in basic ecology, any ecology course.

**RNG 490. RANGELAND MANAGEMENT PLANNING (4).** Administration and management of rangelands; planning processes involving goal setting, inventories, personnel management, environment, conflict resolution, and other constraints necessary for decision-making. Use of data collected from field problems to support the execution of class plans. Field trip required. Lec/lab.

**RNG 499. SPECIAL TOPICS (1-16).**

**RNG 501. RESEARCH AND SCHOLARSHIP (1-16).**

**RNG 503. MASTER'S THESIS (1-16).**

**RNG 505. READING AND CONFERENCE (1-16).**

**RNG 506. PROJECTS (1-16).**

**RNG 507. SEMINAR (1-2).**

**RNG 521. WILDLAND RESTORATION AND ECOLOGY (4).** Emphasis is placed on understanding the ecology of arid and semi-arid ecosystems through the study of ecological processes responsible for ecosystem function. Range improvement practices for stabilizing and repairing degraded wildlands by directing autogenic recovery mechanisms are discussed. This involves manipulating plants, soil, animals and microenvironments for improved ecosystem function.

**RNG 536. WILDLAND FIRE SCIENCE AND MANAGEMENT (4).** Principles and applications of fire as a natural resource management tool, the role of fire in conservation management, restoration, and preservation of ecosystems. Focus will center on ecological relationships of fire and natural communities, wildlife habitats, fire influences on air quality and climate change. The course will cover techniques used to describe fire behavior, fuels, and fire effects on biota. **CROSSLISTED** as FOR 436/FOR 536 and FW 436/FW 536.

**RNG 541. RANGELAND ANALYSIS (4).** Techniques used to describe vegetation in shrub-lands, grasslands, and forests. Use of measurements in resource management. Course is field-oriented, emphasizing both theory and practice of wildland inventory methods. **PREREQS:** ST 351.

**RNG 542. RANGELAND-ANIMAL RELATIONS (4).** Domestic and wild animal use of rangelands as related to environmental factors, palatability, food habits, nutrition, physiography, and their effects on management of rangeland-animal resources. **PREREQS:** RNG 341.

**RNG 550. LANDSCAPE ECOLOGY AND ANALYSIS (3).** Course will introduce students to the principles and terminology of landscape ecology in a rangeland context. We will examine the pattern and distribution of elements across the landscape and seek relationships between element location and environmental parameters. Landscape dynamics through time will be quantified, analyzed, and mapped. **PREREQS:** RNG 341 or equivalent.

**RNG 555. RIPARIAN ECOLOGY AND MANAGEMENT (3).** Study of the ecology of riparian vegetation, including successional processes in riparian zones, productivity, structure and diversity of riparian ecosystems. The class is focused on the terrestrial vegetation, soils and animals of riparian ecosystems. Emphasis is placed on the past abuse associated with riparian ecosystems, methods of rehabilitation, and theories of the proper use of riparian ecosystems under a multiple-use philosophy (i.e. fish, wildlife, livestock, aesthetics, recreation, and silviculture). **PREREQS:** RNG 355.

**RNG 563. FOUNDATIONS IN ECOLOGICAL RESEARCH (3).** Classical literature in the fields of plant and animal population and community ecology will serve as the foundation for developing questions regarding the design of research studies that address current issues in the general

field of ecology and the environment, but also of particular relevance to the discipline of rangeland ecology. **PREREQS:** Completion of three or more units of upper-division ecology.

**RNG 577. AGROFORESTRY (3).** Theory and worldwide practice of multiple-crop low input sustainable systems involving concurrent production of tree and agricultural products. Biological, economic, social, and political factors that underlie the application of agroforestry technology. **PREREQS:** Course in basic ecology, any ecology course.

**RNG 590. RANGELAND MANAGEMENT PLANNING (4).** Administration and management of rangelands; planning processes involving goal setting, inventories, personnel management, environment, conflict resolution, and other constraints necessary for decision-making. Use of data collected from field problems to support the execution of class plans. Field trip required. Lec/lab.

**RNG 601. RESEARCH AND SCHOLARSHIP (1-16).**

**RNG 603. DOCTORAL THESIS (1-16).**

**RNG 605. READING AND CONFERENCE (1-16).**

**RNG 606. PROJECTS (1-16).**

**RNG 607. SEMINAR (1-2).**

**RNG 608. WORKSHOP (1-16).**

**RNG 643. WILDLAND PLANT ECOPHYSIOLOGY (4).** Emphasizes the physiological ecology of plants living in arid and semi-arid ecosystems. Primary class emphasis will include photosynthesis, respiration, water stress and water use efficiency, stable isotopes, root structure and function, nutrient uptake and stress, and defoliation. Offered every other fall, even years.

**RNG 661. AGRICULTURAL RESEARCH PERSPECTIVES (3).** Planning and managing agricultural research projects, publishing research results, professional ethics, interactions of science, scientists, and society. Offered on alternate years.

**RNG 662. RANGELAND ECOLOGY (3).** Studies ecological theory in rangeland and related resource management. Population ecology, succession and classification are discussed and evaluated. Offered every other fall, even years. **PREREQS:** RNG 663 is a prerequisite for Rangeland Ecology and Management students taking RNG 662.

**RNG 663. RANGELAND ECOLOGICAL THEORY (2).** Readings and discussions in the history and development of rangeland ecological theory. Plant demography, plant population dynamics, disturbance theory, succession, vegetation classification and range condition assessments are discussed. **PREREQS:** Course in basic ecology recommended. Instructor approval for non-major graduate students. RNG 663 is a prerequisite for Rangeland Ecology and Management students taking RNG 662.

**RNG 670. ECOLOGICAL INVASIVE PLANT MANAGEMENT (2).** Logic of ecologically based invasive plant management. Ecological processes of invasion. Management of plant succession with emphasis on augmentive restoration. Adaptive management of weed invasions into natural ecosystems. Development of ecologically based management plans for natural ecosystems. Offered odd-numbered years only.

## STATISTICS

See the College of Science