Department of

Plants, Soils, and Biometeorology

College of Agriculture

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Professors *Bruce G. Bugbee*, crop physiology; *Steven A. Dewey*, weed science; *Lynn M. Dudley*, soil physical chemistry; *John O. Evans*, weed science; *Donald T. Jensen*, climatology; *Dani Or*, soil physics; *H. Paul Rasmussen*, horticulture; *V. Philip Rasmussen*, sustainable agriculture; *Schuyler D. Seeley*, pomology; *James H. Thomas*, international agronomy; *Ralph E. Whitesides*, agronomy; **Research Professors** *Gail E. Bingham*, micrometeorology; *Stanford A. Young*, seed production; **Adjunct Professors** *Michael C. Amacher*, soil chemistry; *Kay H. Asay*, grass breeding; *N. Jerry Chatterton*, forage/range physiology/biochemistry; *Wilford R. Gardner*, soil physics; *Henry F. Mayland*, soil science; *Charles W. Robbins*, soil science; *Dale R. Westermann*, soil science; *Raymond M. Wheeler*, plant physiology; *James L. Wright*, soil science; **Associate Professors** *Janis L. Boettinger*, soil genesis, classification and mineralogy; *Daniel T. Drost*, vegetable production; *Paul R. Grossl*, biogeochemist; *Lawrence E. Hipps*, biometeorology; *David J. Hole*, cereal breeding; *Roger K. Kjelgren*, urban horticulture; *Richard T. Koenig*, soil fertility; *Jennifer W. MacAdam*, forage production and physiology; *Jeanette M. Norton*, soil microbiology; **Research Associate Professor** *Esmaiel Malek*, biometeorology; **Adjunct Associate Professors** *Kevin B. Jensen*, forage breeding; *John M. Stark*, microbial ecology and biogeochemistry; *Helga Van Miegroet*, forest soils; **Assistant Professors** *David G. Chandler*, surface hydrology; *Robert R. Gillies*, biometeorology; *Thomas C. Griggs*, agronomy; *Paul G. Johnson*, turfgrass science; *Kelly L. Kopp*, water conservation/turfgrass science; *Dominique J. P. Roche*, small grains, breeding/genetics; **Research Assistant Professors** *Raymond L. Cartee*, soils and irrigation; *Scott B. Jones*, soil physics; *Steven R. Larson*, research geneticist; *Blair L. Waldron*, research geneticist; **Adjunct Assistant Professor** *Richard T. Lamar*, environmental microbiology; **Senior Lecturer** *D. Craig Aston*, ornamental horticulture; **Research Associates** *Susan Buffler*, irrigated pasture production; *Shyrl M. Clawson*, plant breeding; *Robert L. Newhall*, soil conservation and sustainable agriculture; **Director, Utah Botanical Gardens** *William A. Varga*, ornamental horticulture; **Assistant Director, Utah Botanical Gardens** *Debbie Amundsen*, horticulture; **Director, Soil Testing Lab** *Janice Kotuby-Amacher*, soil chemistry; **Professors Emeriti** *Rulon S. Albrechtsen*, plant breeding; *Keith R. Allred*, forage physiology; *J. LaMar Anderson*, pomology; *Gaylen L. Ashcroft*, biometeorology; *William F. Campbell*, crop stress physiology; *Paul D. Christensen*, soil science; *Wade G. Dewey*, plant breeding; *Alvin R. Hamson*, horticulture; *R. John Hanks*, soil physics; *Anthony H. Hatch*, horticulture; *David W. James*, soil fertility; *Jerome J. Jurinak*, soil chemistry; *R. Paul Larsen*, horticulture; *DeVere McAllister*, plant breeding; *Frank B. Salisbury*, plant physiology; *John J. Skujins*, soil microbiology; *R. L. Smith*, soil science; *Alvin R. Southard*, soil classification; *H. Grant Vest, Jr.*, vegetable breeding; *David R. Walker*, pomology

Degrees Offered: Bachelor of Science (BS) and Bachelor of Arts (BA) in Crop Science, Horticulture, Environmental Soil/Water Science; Master of Science (MS), and Doctor of Philosophy (PhD) in Biometeorology, Plant Science, Soil Science, and Ecology; Master of Professional Studies in Horticulture (MPSH)

Undergraduate emphases: *Crop Science BS, BA*—Agronomy, Agronomic Research, Biotechnology/Research; *Horticulture BS, BA*—Ornamental Horticulture, Landscape Maintenance and Construction, Business, Science; *Environmental Soil/Water Science BS, BA*—Soil, Water, Plant

Graduate specializations: *Biometeorology MS, PhD*—Agricultural Meteorology, Climatology, Micrometeorology, Remote Sensing, Turbulence in Plant Canopies; *Plant Science MS, PhD*—Crop Physiology, Crop Production and Management, Plant Breeding and Cytology, Plant Biotechnology and Tissue Culture, Plant Nutrition, Space Biology, Weed Science; *Soil Science MS, PhD*—Molecular Biology, Soil and Water Chemistry, Soil Biochemistry and Ecology, Soil Conservation Systems, Soil Fertility and Plant Nutrition, Soil Physics, Soil-Plant-Water Relations, Soil Taxonomy and Genesis, Soils and Irrigation

Certificate and Associate Degree Program: Ornamental Horticulture

Undergraduate Programs

Objectives

The departmental curricula emphasize understanding basic plant functions and environmental impacts on the management of crops, greenhouses, irrigation regimes, and landscapes.

The purpose of the undergraduate teaching program is to train students in their chosen field of study. The program aims to prepare them to serve clientele needs, provide them with an understanding of and an appreciation for diversity, and teach them to be productive citizens of the world and professionals in their vocations.

The department also provides training of undergraduates for graduate school and maintains a strong graduate program in biometeorology, plant science, and soil science. The research that underlies the graduate program is conducted in biometeorology (micro- and meso-scale), crop biotechnology, crop ecology, crop physiology, crop science, horticulture (general and ornamental), plant breeding, soil microbiology, pedology, soil chemistry, soil physics, soil fertility, environmental soil and water science, and arid landscaping.

A major effort is directed at extending research and teaching programs to all citizens of the State of Utah.

Departmental Facilities

To support these objectives, departmental facilities include well-equipped laboratories and greenhouses on campus. The University has significant acreage for field research at strategic locations throughout the state. In addition, the University is developing a botanical garden, which will offer opportunities to a broad spectra of clientele. The department maintains state-of-the-art analytical equipment for the measurement of critical soil, plant, and climatic variables.

Requirements

Departmental Admission Requirements. Persons meeting the admission requirements for the University (see pages 48-51) are admitted to the Department of Plants, Soils, and Biometeorology by listing the department major code on the University admission application form. A change of major form is used when students in good standing wish to transfer from another department to the Department of Plants, Soils, and Biometeorology.

ARCPACS Certification. Students who meet specific requirements are eligible, after five years of work experience, for professional certification as an Agronomist, Crop Scientist, Crop Specialist, Horticulturist, Soil Scientist, Soil Specialist, Soil Classifier, or Weed Scientist through the American Registry of Certified Professionals in Agronomy, Crops, and Soils (ARCPACS). Course requirements for certification are listed below. Students interested in becoming certified should inform their advisor of their intent.

Applied Ornamental Horticulture Certificates and AAS Degree. This program provides practical training in greenhouse and nursery management, turf production, floral design, and maintenance of home and commercial grounds. Coursework encompasses pest control, plant identification, construction of landscapes, small business management, and the operation and maintenance of equipment, including small engines. As an integral part of their training, students are required to complete an internship in the industry. Students may work toward a **one-year certificate** or an **Associate of Applied Science Degree.**

Bachelor of Science Degree. The department offers the Bachelor of Science Degree in three areas: (1) **Crop Science,** which deals with agronomic (commonly called field) crops, such as forages, grains, corn, pasture, etc.; (2) **Horticulture**, which deals with tree fruits, berries, vine fruits, vegetables, and ornamental plants (**ornamental** includes all aspects of floriculture and landscape plant production and use); and (3) **Environmental Soil/Water Science**, which deals with soil and water in relation to plant growth and environmental quality. In all three majors, there are science-oriented emphases intended to prepare students for research or professional studies, and degree emphases that emphasize a practical, applied approach to application of information. All courses used to fill major requirements must be taken on an *A-B-C-D-F* basis. A minimum 2.5 GPA is required for courses used for the major. Transfer students are required to take at least 18 credits of major subject courses in residence at USU. **A minor** may be earned in Agronomy, Crop Biotechnology, Horticulture, Ornamental Horticulture, and Soil Science. A minimum of 16 approved credits are required (see lists below). All courses must be taken on an *A-B-C-D-F* basis and passed with a grade of *C-* or better.

The course requirements for the **Crop Science Major** are designed to prepare students for a career related to the production of agronomic crops. These courses allow students to function well in a rapidly changing technological environment and to acquire new skills and understanding as their career evolves. Each of the emphases within this major has been designed to allow students the flexibility to add courses or a minor to meet their own goals. The **Agronomy Emphasis** is designed for students interested in learning more about the applied aspects of crop production. Some courses emphasize production techniques and systems, while others provide the student with an understanding of the principles underlying crop production. The **Biotechnology/Research Emphasis** is designed for students who wish to participate in the development of plant-oriented technologies at any level of employment, and for those who intend to pursue a career in private or public research or to teach at the university level. The **Agronomic Research Emphasis** is designed for students planning careers in production-oriented agronomic research.

The **Horticulture Major** prepares students for production of fruits, vegetables, turf, or ornamentals and for landscape construction and maintenance. Course topics include biology, chemistry, and control of insects, diseases, and weeds. The **Ornamental Emphasis** adds courses in production management techniques, such as pruning, spraying, and landscaping (materials, design, and maintenance); and greenhouse management. In the **Landscape Maintenance and Construction Emphasis**, students learn design, construction, and maintenance through a joint program with the Landscape Architecture and Environmental Planning Department. The **Science Emphasis** prepares students for graduate study and for employment in technical occupations. The **Business Emphasis** joins courses necessary for a minor in Business with those necessary for obtaining expertise in horticulture.

The **Environmental Soil/Water Science Major** is intended to provide each student with a fundamental understanding of the basic sciences and mathematics, as well as a strong background in both soil and water sciences. Preparatory requirements include chemistry, physics, mathematics, biology, geology, and statistics. The core courses for Environmental Soil/Water Science empha-

size the interactive soil/water processes in the soil's plant-rooting zone—from the microscopic to the landscape perspective. From this base, each student can design his or her own program of specialization in one of the many aspects of soil science, water science, or the integration of both soil and water sciences. Students may choose complementary classes in the **Soil Emphasis**, **Water Emphasis**, **Plant Emphasis**, or a combined emphasis in preparation for a variety of career opportunities. The Environmental Soil/Water Science Major is complementary to existing undergraduate programs at Utah State University in Geology, Environmental Studies, Watershed Science, and Environmental Engineering.

Course Requirements

Crop Science Major

Agronomy Emphasis. Students must complete the following courses: Biol 1210, 1220, 4400, Chem 1110, 1120, 1130, Econ 1500, Math 1050, Phyx 1200, PlSc 2000, PSB 1050, 4890 (two semesters), Soil 3000. Additional plant science requirements include at least 28 credits selected from the following, including at least 6 credits selected from courses identified with an asterisk (*): Biol 4410, 4500*, 5410*, FRWS 5100*, PlSc 2650, 3500, 3700, 3800, 4280, 4300, 4320, 4600, 5200, 5210, 5550*, 5700, 5750, PSB 4250. Additional soil science requirements include at least 11 credits selected from the following: Soil 4000, 4700, 5050, 5130, 5310, 5320, 5550, 5560, 5650.

Students wishing to accumulate the minimum core requirements for **ARCPACS certification** should *replace* the additional plant science requirements (28 credits, listed above) and soil science requirements (11 credits, listed above) as follows. For **Certified Agronomist** or **Certified Weed Scientist** status, take 9 credits from the following: PlSc 3800, 4280, 4300, 4320, 4600, 5200, 5210, 5700; for **Certified Crop Scientist** or **Crop Specialist** status, take 12 credits from the following: PlSc 3800, 4280, 4300, 4320, 4600, 5200, 5210, 5700; for **Certified Agronomist**, **Certified Crop Scientist**, or **Crop Specialist** status, take two of the following four courses: Biol 4500, 5410, FRWS 5100, PlSc 5550; for **Certified Agronomist**, **Certified Crop Scientist**, or **Crop Specialist** status, take ASTE 3050, Spch 3050, CS 1010, Econ 2010, and Stat 1040; for **Certified Weed Scientist** status, take 22 credits from the following, ensuring courses marked with an asterisk are taken: Biol 3400*, 3050, 4410*, 4500, 5410, FRWS 5100, PlSc 2200*, 5550*; for **Certified Agronomist**, **Certified Crop Scientist**, **Crop Specialist**, or **Certified Weed Scientist** status (all ARCPAC categories), take Chem 1210, 1220, and Soil 5550 in place of Chem 1110 and 1130; for **Certified Agronomist** and **Certified Weed Scientist** status, take Soil 5550.

Agronomic Research Emphasis. Students must complete the following courses: Biol 1210, 1220, 3200, 4400, Chem 1210, 1220, 1230, 1240, 2310, 2320, 2330, 2340, 3700, 3710, Econ 1500, Math 1050, 1060, Phyx 1200, PlSc 2000, 5200, 5210, PSB 1050, 4890 (two semesters), Soil 3000, 5550, 5560. In addition, select 14 credits from the following: PlSc 2650, 3700, 4280, 4300, 4320, 4600, 5550, 5700, 5750. Other recommended courses include: Biol 4410, 4500, 5410, Math 1210, Phyx 2110.

Biotechnology/Research Emphasis. Students must complete the following courses: Biol 1210, 1220, 3200, 4200, 4400, 4410, Chem 1210, 1220, 1230, 1240, 2310, 2320, 2330, 2340, 3700, 3710, Econ 1500, Math 1050, 1060, Phyx 1200, PlSc 2000, 4300, 5200, 5210, 5440, 5450, 5750, PSB 1050, 4890 (two semesters), Soil 3000. Select at least two credits from the following courses: PlSc 3700, 4600, 5550, 5700. The following courses are also recommended: Biol 5410, Math 1210, Phyx 2110, PSB 5160, 5240.

Horticulture Major

Core Courses. Chem 1110 or 1210, BIS 1400, FRWS 2200, Math 1050, PlSc 2000, 2250 (or PSB 4250), 2650, PSB 1050, 4890 (two semesters), Soil 3000.

Ornamental Emphasis. In addition to the Core courses, select 36 credits from the following. Those marked with an asterisk (*) are required. ASTE 3080, Biol 1210*, 1220*, PlSc 2600*, 2610*, 2620*, 3050, 3300, 3400, 3410, 3700, 3800, 4100, 4400*, 4500*, Soil 5550*. Select two courses from the following: Biol 4500, 5410, FRWS 5100, PlSc 5550. Select two of the following courses (not including Chem 1130): Biol 4400, 4410, Chem 1120, 1130, PlSc 3500, 5200, 5210.

Landscape Maintenance and Construction Emphasis. In addition to the Core courses, students must complete all of the following: Biol 1010, 1020, LAEP 1200, 2600, 3500, 3610, PlSc 2200, 2600, 2620, 3400, 3410, 3500, 3800, 4100, 4400 or 4500, 5550, Soil 4700. Suggested electives include: ASTE 3200, PlSc 2610, 3700, Soil 5550.

Business Emphasis. In addition to the Core courses, select 24 credits from the following. Those marked with an asterisk (*) are required. Biol 1010*, 1020*, PlSc 2200*, 2600, 2620, 3050, 3300, 3400, 3500*, 3700, 3800, 4100, 4400*, 4500*, 5200, 5210, 5550*, Soil 4700, 5550. The following courses are required for a **Business Minor:** Acct 2010, BA 3460, 3500, Econ 1500, 2010, MHR 2990 or BIS 3100, MHR 3110.

Science Emphasis. In addition to the Core courses, select 41 credits from the following. Those marked with an asterisk (*) are required. Biol 1210*, 1220*, 2220, 4400, 4410, 5400, Chem 1120, 1210, 1220, 1230, 1240, 2310, 2320, 3700, 3710, Math 1060, 1100*, Phyx 1200, PlSc 3700, 4400*, 4500*, any ornamental horticulture class*, PlSc 5200*, 5210, 5760, Soil 5550*, Stat 3000. Select one of the following: Biol 4500, 5410, FRWS 5100, PlSc 5550.

Environmental Soil/Water Science Major

Core Courses. Biol 1210, 1220; Chem 1110, 1120, 1130, *or* Chem 1210, 1220, 1230, 1240, 2300; FRWS 2200 or Biol 2220; Geol 1150; Math 1050, 1060, 1210, *or* Math 1210, 1220; Phyx 2110, 2120, *or* Phyx 2210, 2220; Stat 2000 or 3000.

Professional Core Courses. Soil 3000, 5050, 5130; Soil 5310 or 5550 (Soil 5550 is required for the plant emphasis); Soil 5560, 5650, 5750, PSB 4890 (two semesters). **Emphases:** Students must select 12 credits from one or a combination of the following emphases:

Soil Emphasis. AWER 3900, 5930; Bmet 5250; Chem 3600; Geol 3500, 3550, 3600, 3700, 5600, 5630; Soil 3100, 4000, 5310, 5320, 5350, 5550.

Water Emphasis. ASTE 5260; AWER 3700, 4500, 4510, 4530, 5330, 5660; BIE 5010, 5110, 5150; Bmet 4300, 5250, 5500, 5700; CEE 3430, 3500; Chem 3600; Geol 5510; PlSc 5200, 5210; Soil 4000, 4700.

Plant Emphasis. Biol 3400, 4400; Bmet 5500; FRWS 3220, 4450; PlSc 2600 and 2610, or 2620; PlSc 3300, 3400, 3410, 3800, 4100, 4280, 4300, 4320, 4400, 4500, 5200, 5210, 5430, 5550, 5760; Soil 4700.

Applied Ornamental Horticulture Certificate and AAS Degree

One-Year Certificate (27 credits required). PlSc 2600 and 2620 are required; 18.5-20 additional PlSc credits must be completed from applied core courses emphasizing floriculture or landscape horticulture; and 3-5 credits from approved electives.

Associate of Applied Science degree (64 credits required). Students must complete all applied core courses; 11-19 credits of approved electives; and 14-16 credits of University Studies, including Engl 1010 and 2010; 5-7 credits Breadth Social Sciences (BSS)/Breadth Humanities (BHU) courses; 3-5 credits Breadth Life Sciences (BLS)/Breadth Physical Sciences (BPS) courses.

Applied Core Courses. BIS 1400, PlSc 2200, 2250, 2600, 2610, 2620, 2650, 3050, 3300, 3400, 3700, 3800, PSB 1050.

Approved Electives. Choose any courses that are part of a BS degree in horticulture or PlSc 2900, 3010, 3020 (11-19 credits required).

Minors

Crop Biotechnology Minor (16 credits required). The following courses are required. PlSc 2000, 3700, 5750. Select the balance of credits from the following courses. At least one of the production courses, marked with an asterisk, (*) is required. PlSc 3500, 4280*, 4300*, 4320*, 4400*, 4500*, 5200, 5550, 5700, PSB 5160, 5240, 5260.

Agronomy Minor (16 credits required). A minimum of 6 credits of Soil Science courses must be taken, including Soil 3000. A minimum of 6 credits of Plant Science courses must be taken, including at least two of the following three courses: PlSc 4280, 4300, 4320. Select the balance of credits from the following courses: Soil 4000, 4700, 5130, 5310, 5550, 5560, 5650, PlSc 2200, 3800, 4400, 4500, 5200, 5550, 5700.

Soil Science Minor (16 credits required). The following course is required: Soil 3000. Select 12 credits from the following courses: Soil 4000, 4700, 5050, 5130, 5310, 5350, 5550, 5560, 5650, 5750.

Ornamental Horticulture Minor (16 credits required). The following courses are required: Soil 2000, PlSc 2200, 3200. Select the balance of credits from the following courses: PlSc 2600, 2610, 2620, 3050, 3300, 3400, 3410, 3700, 3800, 4400, 4500.

Horticulture Minor (16 credits required). Soil 2000 is required. Select 6 credits from the following courses: PlSc 2200, 4400, 4500, one ornamental horticulture course. Select the remaining credits from the following: PlSc 2000, 2650, 3050, 3300, 3800.

Additional Information

For more information about Bachelor of Science requirements and the sequence in which courses should be taken, see major requirement sheets available from the Plants, Soils, and Biometeorology Department.

Graduate Programs

Admission Requirements

See general admission requirements, pages 72-73. Departmental admission committees and potential graduate student advisors (major professors) consider previous work experience, undergraduate and graduate records and curriculum, and formal recommendations in their decisions concerning acceptance of applicants. Students without an undergraduate or graduate degree in plants, soils, biometeorology, or a closely related field may be required to complete selected undergraduate courses prior to admission as fully matriculated graduate students in the Plants, Soils, and Biometeorology Department. Qualified applicants are occasionally denied admission because faculty members in the applicant's area of interest do not have the time or funds to advise additional students. The serious applicant is encouraged to discuss his or her goals with appropriate members of the graduate faculty prior to preparing an application.

Graduate student candidates must have scores on the verbal and quantitative portions of the Graduate Record Examination (GRE) at or above the 40th percentile. TOEFL scores of 550 or higher are required for candidates from abroad. International students with a prior degree from an English-speaking university are exempted from the TOEFL exam.

Degree Programs and Specializations

The Master of Science and Doctor of Philosophy degrees are offered as follows: (1) **Plant Science** with specializations in crop production and management, weed science, plant nutrition, crop physiology, plant breeding and cytology, and space biology; (2) **Soil Science** with specializations in soil physics, soil and water chemistry, soils and irrigation, soil fertility and plant nutrition, soil biochemistry and ecology, molecular biology (interdepartmental program), soil conservation systems, soil-plant-water relations, and soil taxonomy and genesis; (3) **Biometeorology** with specializations in agricultural meteorology, climatology, micrometeorology, turbulence in plant canopies, and remote sensing; and (4) **Ecology**. A **Master of Professional Studies in Horticulture (MPSH)** is also offered.

Course Requirements

Course requirements leading to MS or PhD degrees are developed jointly by the student and the student's advisory committee. Course selections reflect areas of specialization. There are, however, specific departmental requirements regarding physical sciences, biological sciences, and mathematics courses, which differ depending on the area of specialization.

Research

Research projects vary over time, depending on funding and other factors. Students are encouraged to visit the home page web sites of the graduate faculty to determine research interests and lists of recent publications. Some of the research interests in the department include (1) the control of diseases, nematodes, weeds, and other hazards to fruit, vegetable, ornamental, and field crops; (2) physiological and genetic improvement of fruit, vegetable, ornamental, and field crops (breeding and biotechnology); (3) the evolution, genetic regulation, and utilization of apomixis and other developmental phenomena of higher plants; (4) management of agronomic and horticultural production systems; (5) horticultural landscape water management; (6) soil formation and landscape evolution; (7) soil, plant, water, and nutrient relationships; (8) management of saline and sodic soils; (9) alternative land uses; (10) improved management of animal wastes and biosolids; (11) management of soil microbial processes; (12) drainage and irrigation systems; (13) adaptations to weather and weather modification; (14) analyses and modification of large-scale surface evaporation from atmospheric boundary layer measurements; (15) spatial and temporal properties of sun flecks in plant canopies; and (16) spatial variation in surface fluxes of heat and water vapor in semiarid regions.

Financial Assistance and Assistantships

The financial awards provided by the School of Graduate Studies are listed on pages 71-72 of this catalog. The Department of Plants, Soils, and Biometeorology does not have a formal application form for financial assistance. Most monies used to assist students in the department come from research grants controlled by individual faculty members. Negotiations for financial assistance (research assistantships or part-time employment) are made between faculty members and students. The department provides a few part-time teaching assistantships (a semester at a time). Graduate teaching assistants are responsible to their major professor and to the instructor whom they assist. The MS and PhD in Biometeorology are Western Regional Graduate Programs (see page 71).

Career Opportunities

A broad range of career opportunities exists for students completing the MS or PhD degree from the Department of Plants, Soils, and Biometeorology. Graduate students specializing in the plant sciences may expect to find employment as consulting scientists, or in the private sector as plant breeders, weed scientists, etc. Graduate students specializing in the soil sciences may expect to find employment as soil scientists with government agencies or in the private sector, where they may pursue careers in environmental consulting, fertilizer retail, irrigation system design, waste management, mineland reclamation, or related environmental or agricultural pursuits. Graduate students specializing in biometeorology may expect to find employment with government agencies, as consulting scientists, or with the private sector. Graduate students specializing in ecology may expect to find employment as research scientists, as consulting ecologists, or with environmental agencies. Graduate students completing the PhD may also find career opportunities in academia.

Additional Information and Updates

Additional information and updates concerning graduate faculty and graduate student opportunities can be obtained from the web at: **http://psb.usu.edu**.

Plant Science Courses (PlSc)

PlSc 2000 (BLS). Plants, Genes, and Agriculture. Introduction to the scientific process as it relates to modern agriculture. Principles of the disciplines involved in production of agronomic and horticultural crops, both for food and aesthetic purposes. Data and interpretation as separate components of the scientific process. Prerequisite: Math competency. (3 cr) (Sp)

PlSc 2100. Introduction to Horticulture. Introduction to production of nursery, greenhouse, fruit, and vegetable crops. Explores residential and commercial landscape construction and management. Students also learn about interior plants, arboriculture, turf science, landscape plant materials, and home gardening. (3 cr) (F)

PlSc 2200. Pest Management Principles and Practices. Overview of pest control considerations, procedures, and principles. Topics include integrated pest management, organic and chemical pest control, environmental considerations, safety, life cycles of pests, and commercial pesticide licensing. (3 cr) (Sp)

PlSc 2250. Occupational Experience in Agronomy and Horticulture. Provides credit for on-the-job training in jobs related to plants or soils. (1-4 cr) (F,Sp,Su) ®

PlSc 2600. Annual and Perennial Plant Materials. Identification, culture, and utilization of herbaceous ornamental plants in the landscape, including annual and perennial flowering plants, herbaceous ground covers, ornamental grasses, and herbs. (1.5 cr) (F)

PlSc 2610. Indoor Plants and Interiorscaping. Identification, culture, use, and maintenance of indoor foliage and flowering plants used in the interior plantscaping industry. (1.5 cr) (F)

PlSc 2620. Woody Plant Materials: Trees and Shrubs for the Landscape. Identification, culture, and utilization of woody ornamental plants in the landscape, including shade trees, flowering trees and shrubs, hedge plants, and vines. Review of native plants commonly used in the landscape. (3 cr) (F)

PlSc 2650. Identification and Selection of Plants in Production Agriculture. Identification of plants important in horticulture/agronomy and the morphological features making them useful for various agricultural purposes. (1 cr) (F)

PlSc 2900. Special Problems in Plant Science. Student-selected practical problems in horticulture and/or agronomy. (1-4 cr) (F,Sp,Su) ®

PlSc 3010. Basic Flower Arranging. Principles of basic flower design using fresh, dried, and artificial flowers. Proper care of cut flowers and foliages. Basic plant physiology behind such principles. Lab fee required. (2 cr) (F)

PlSc 3020. Floral Crops Judging and Contemporary Design. Judging of potted ornamental plants and cut flowers for quality. Contemporary floral design and floral art. Prerequisite: PlSc 3010 or professional design experience. Lab fee required. (2 cr) (Sp)

PlSc 3050. Greenhouse Management and Crop Production. Design and management of commercial greenhouse facilities. Production requirements of primary greenhouse crops. (4 cr) (Sp)

PlSc 3200 (DSC). Horticultural Science. Methods, technology, and scientific basis of landscape, fruit, and vegetable gardening in the arid west. Interaction of gardening with the urban environment. Contact department for information about semester to be offered. (3 cr)

PlSc 3300. Residential Landscapes. Functional and aesthetic relationships of plants and structures in the landscape in connection with installation considerations. Use of imaging and CAD software in initial computer design layout. Prerequisite: PlSc 2620. Recommended: PlSc 2600. (3 cr) (Sp)

PlSc 3400. Managing for Sustainable Landscapes. Interaction of expectations, maintenance needs, cost/benefit analysis, physiology, and ecology in managing landscapes on a sustainable basis. Prerequisites: PlSc 2600, 2620. (3 cr) (F)

PlSc 3410. Practicum in Managing for Sustainable Landscaping. Practical experience in evaluating maintenance tasks required in managing a landscape, cost estimation of such tasks, and how to make changes to a landscape to reduce costs. (1 cr) (F)

PlSc 3500. The Structure and Function of Economic Crop Plants. Environmental effects on plant structure and function. Control of plant development for enhanced production of marketable goods. Introduction to principles using examples from horticulture and agronomy. Applications in these fields emphasized. Prerequisites: Integrated Science or comparable breadth course, Biol 1010. (3 cr) (Sp)

PlSc 3700. Plant Propagation. Propagation of plants by sexual and asexual means. Covers fundamental physiology of propagation, as well as cultural practices and techniques used in crop production. Recommended: Biol 1210. (4 cr) (F)

PlSc 3800. Turfgrass Management. Fundamentals of turfgrass science: species adaptation, identification, and cultural requirements; turfgrass growth and development; establishment; primary cultural practices (fertilization, irrigation, mowing); secondary cultural practices; pest management; integrated management planning for turfgrass systems. Prerequisites: Biol 1210, PlSc 2650, 3500, or equivalents. (3 cr) (F)

PlSc 4100. Landscape Water Conservation. Explains why water conservation is important, and how water can be conserved through precision irrigation and conversion to low-water-use landscapes. Contact department for information about semester to be offered. (2 cr)

PlSc 4280. Field Crops. Economic importance, use, distribution, origin, history, classification, identification, botanical nature, marketing, processing, storage, certification, grading, diseases, insects, commercial production, and improvement of cereal, root, and oilseed crops. Two lectures, one lab per week. (3 cr) (F)

PlSc 4300. World Food Crops and Cropping Systems: The Plants That Feed Us. Climatic, geographic, and management requirements of the world's plants that provide food for humans, including botanical relationships. Systems used to produce these crops and processes for turning them into food. Prerequisite: Integrated Science or comparable breadth course. (3 cr) (Sp)

PlSc 4320. Forage Production and Pasture Ecology. Cultivation and management of legumes and grasses used throughout the world for grazing, stored feed, soil improvement, and conservation. Forage plant growth and development, nutrient and water utilization, and responses to environmental stress. Prerequisite: Integrated Science or comparable breadth course. (3 cr) (Sp)

PlSc 4400. Modern Vegetable Production. Principles and practices underlying scientific vegetable culture. Discussion of production of important vegetables, focusing on the physiological processes influencing their culture. Explores crop performance in research and commercial applications. Prerequisite: Biol 1010 or 1210. (3 cr) (F)

PlSc 4500. Fruit Production. Cultivars, physiology, anatomy, propagation, sites, soils, climate, culture, irrigation, fertilizers, insects, diseases, integrated management, plant and fruit growth and development, harvesting, storage, pruning, orchard architecture, environmental protection, and economics for both tree and small fruits. Prerequisite: Biol 1010 or 1210. (4 cr) (Sp)

***PlSc 4600 (DSC, QI). Cereal Science.** Introduction to principles involved in cereal chemistry and processing. Covers starch chemistry, dry milling, wet milling, decortication, malting, and extrusion. Processing of all major cereals also covered. Prerequisite: Math 1030 or Stat 1040 or completion of quantitative literacy requirements. (3 cr) (Sp)

PlSc 4800. Professional Turfgrass Management. Fertilization, irrigation, and cultivation practices for managed landscapes. Construction issues, including compaction, soil modification, and specialized construction practices for golf courses and sports turf. Prerequisites: Soil 3000, PlSc 3800. (2 cr) (Sp)

PlSc 5200 (d6200).[1] Crop Physiology. The relationship between physiological processes and growth of whole plants. Energy balance and water use efficiency. Light interception and canopy geometry. Canopy photosynthesis and respiration. Carbon partitioning and source/sink relationships. Prerequisites: Biol 4400, Math 1050, or consent of instructor. (2 cr) (Sp)

PlSc 5210 (d6210). Crop Physiology Laboratory. Measurement and analysis of physiological processes that result in whole plant growth. Includes an individual lab project. Designed to be taken concurrently with PlSc 5200 or 6200. (1 cr) (Sp)

***PlSc 5300. Principles of Cytogenetics.** Examination and analysis of variation in chromosome structure, behavior, and number. Includes discussions of developmental and evolutionary effects of this variation, and practical applications in plant and animal genetics. Prerequisite: Biol 3200. (3 cr) (Sp)

****PlSc 5430 (d6430). Plant Nutrition.** Mechanisms of nutrient acquisition, rhizosphere interactions, root morphology and distribution, short- and long-distance transport, nitrogen fixation, and biochemical function of essential and beneficial elements. (2 cr) (F)

****PlSc 5440 (d6440). Plant Molecular, Cellular, and Developmental Biology I.** Examines background and recent advances. Students analyze and discuss structure, genome, molecular development, and photosynthesis topics from a research perspective. Prerequisites: Biol 3200, 4200; Chem 3700 or 5710. Also taught as Biol 5440/6440. (3 cr) (Sp)

***PlSc 5450 (d6450). Plant Molecular, Cellular, and Developmental Biology II.** Examines background and recent advances. Students analyze and discuss cell wall, growth regulator, and environmental response topics from a research perspective. Prerequisites: Biol 3200, 4200, Chem 3700 or 5710. Also taught as Biol 5450/6450. (3 cr) (Sp)

PlSc 5550 (d6550). Weed Biology and Control. Management strategies for undesirable plant species in native and agroecosystems. Interference and allelopathy, undesirable plant invasion and spread, noxious weed eradication principles and practices, integrated plant management strategies, herbicide interactions with weeds and crops, and economics of management emphases. (4 cr) (F)

****PlSc 5700. Principles of Plant Breeding.** Principles of plant breeding. Breeding techniques for self-pollinated, cross-pollinated, and asexually reproducing crops. Real-life breeding problems solved, showing that resource identification and allocation are the critical points in developing a successful program. Prerequisite: PlSc 2000 or Biol 3200. (3 cr) (Sp)

****PlSc 5750. Crop Biotechnology.** Lectures and laboratory exercises focusing on concepts, equipment, and procedures required for culturing plant cells and tissues, producing and processing secondary compounds in vitro, and genetic engineering of angiosperms. Presentation of physiological and biochemical factors important to success. Prerequisite: Biol 4400. (2 cr) (Sp)

PlSc 5760. Crop Ecology. Features of agroecosystems compared with natural ecosystems; input of energy and materials to manipulate agroecosystems and produce maximum, sustained quality and yield of agricultural products. Prerequisites: Biol 4400, PlSc 5200/6200, or instructor's consent. (2 cr) (Sp)

PlSc 6100. Advanced Landscape Water Conservation. Provides experience in setting up weather stations for measuring evapotranspiration. Students learn how to develop evapotranspiration-based landscape irrigation schedule using central controls. Analysis of landscape water demand with evapotranspiration data and geographical information systems database. Prerequisite: PlSc 4100. (3 cr) (Sp)

PlSc 6200 (d5200). Crop Physiology. The relationship between physiological processes and growth of whole plants. Energy balance and water use efficiency. Light interception and canopy geometry. Canopy photosynthesis and respiration. Carbon partitioning and source/sink relationships. Prerequisites: Biol 4400, Math 1050, or consent of instructor. (2 cr) (Sp)

PlSc 6210 (d5210). Crop Physiology Laboratory. Measurement and analysis of physiological processes that result in whole plant growth. Includes an individual lab project. Designed to be taken concurrently with PlSc 6200 or 5200. (1 cr) (Sp)

PlSc 6220. Professional Experience in Water Efficient Landscaping. Internship component of water efficient landscaping master's program. Summer employment with water purveyors, consulting firms, and businesses involved in landscape irrigation. (6 cr) (Su)

PlSc 6230. Water Efficient Landscaping Seminar I. Explores background topics in water development, as well as current topics in general water development and landscape water use. (1 cr) (Sp)

PlSc 6240. Water Efficient Landscaping Seminar II. Students present summaries of summer internship experiences and attend seminars given by outside speakers. (2 cr) (F)

PlSc 6300. Planting Design for Low Water Use Landscapes. Examines arid ecosystems, emphasizing the Intermountain West, and recreating such ecosystems in a range of amenity landscapes. Also covers procurement, propagation, establishment, and maintenance of plants appropriate for low water landscapes. Also taught as LAEP 6300. (3 cr) (F)

****PlSc 6430 (d5430). Plant Nutrition.** Mechanisms of nutrient acquisition, rhizosphere interactions, root morphology and distribution, short- and long-distance transport, nitrogen fixation, and biochemical function of essential and beneficial elements. (2 cr) (F)

****PlSc 6440 (d5440). Plant Molecular, Cellular, and Developmental Biology I.** Examines background and recent advances. Students analyze and discuss structure, genome, molecular development, and photosynthesis topics from a research perspective. Prerequisites: Biol 3200, 4200; Chem 3700 or 5710. Also taught as Biol 6440/5440. (3 cr) (Sp)

***PlSc 6450 (d5450). Plant Molecular, Cellular, and Developmental Biology II.** Examines background and recent advances. Students analyze and discuss cell wall, growth regulator, and environmental response topics from research perspective. Prerequisites: Biol 3200, 4200, Chem 3700 or 5710. Also taught as Biol 6450/5450. (3 cr) (Sp)

PlSc 6550 (d5550). Weed Biology and Control. Management strategies for undesirable plant species in native and agroecosystems. Interference and allelopathy, undesirable plant invasion and spread, noxious weed eradication principles and practices, integrated plant management strategies, herbicide interactions with weeds and crops, and economics of management emphases. (4 cr) (F)

***PlSc 6570. Herbicide Physiology and Mode of Action.** Entrance, movement, and metabolism of major herbicides; and a critical study of the physiological processes affected by them. Prerequisites: Biol 4400, PlSc 6550/5550 or instructor's consent. (3 cr) (Sp)

Soil Science Courses (Soil)

Soil 2000 (BPS). Soils, Waters, and the Environment. Introduction to principles of physical and biological science. Discussion of current environmental topics, focusing on soil and the waters that contact the soil. Topics include water quality, global climate change, deforestation, soil conservation, and agricultural sustainability. (3 cr) (Sp)

Soil 3000. Fundamentals of Soil Science. Fundamentals of soil science, emphasizing physical, chemical, mineralogical, and biological properties of soils, and how these properties relate to plant growth and environmental quality. Prerequisites: Chem 1110, Math 1050, or equivalents. (4 cr) (F,Sp)

Soil 3100 (DSC). Soils and Civilization. Lectures, readings, and discussions to explore effects of soil physical, chemical, and biological properties on civilization throughout history. Influence of soils on settlement patterns, land use/management, and civilization decline. Case studies focus on current soil and land use issues in western North America. (3 cr) (Sp)

Soil 4000. Soil and Water Conservation. Applied soil and water conservation in an agronomic setting. Management of soil-water-plant-atmosphere continuum. Soil conservation techniques as they apply to actual situations. (4 cr) (F)

Soil 4600 (d6600). Principles of Surface Hydrology. Study of physical elements of the water cycle, surface hydrological processes, and watershed responses. Explores basic hydrologic concepts and terminology, as well as collection, analysis, and presentation of hyrologic data. Includes field laboratory. Prerequisite: Soil 3000 or instructor's permission. Also taught as AWER 4600/6600. (3 cr) (Sp)

Soil 4700. Irrigated Soils. Soil salinity, soil-moisture-plant relationships, water supply and quality, irrigation water measurements, soil moisture movement, and irrigation methods. Prerequisite: Soil 3000 or equivalent, or instructor's consent. (2 cr) (Sp)

Soil 5050 (d6050). Principles of Environmental Soil Chemistry. Introduction to common chemical processes occurring among solid, liquid, and gas phases in soil systems. Emphasis placed on chemistry of arid land soils. Prerequisites: Chem 1110, Math 1050, Soil 3000. (3 cr) (Sp)

Soil 5130 (d6130). Soil Genesis, Morphology, and Classification. Morphology, development, and classification of soils. Lectures and weekly field exercises emphasize soil as a natural body of the landscape: its properties, distribution, behavior, and interpretations for diverse land uses. Prerequisite: Understanding of fundamental soil science; Soil 3000 recommended. (4 cr) (F)

***Soil 5310. Soil Microbiology.** Ecology and diversity of microorganisms in soils. Emphasis on factors controlling microbial activity and the role of microorganisms in organic matter decomposition and nutrient cycling. Prerequisites: Biol 1210, 1220; Chem 2300 or 2310; Soil 3000. Also taught as Biol 5310. (3 cr) (F)

***Soil 5320. Soil Microbiology Laboratory.** Techniques for measuring microbial activity and diversity in soils. Includes use of molecular and isotope methods. Prerequisite: Concurrent or prior enrollment in Biol/Soil 5310. Also taught as Biol 5320. (2 cr) (F)

Soil 5350 (d6350). Wildland Soils. Application of basic principles of soil science to wildland ecosystems. Effects of disturbance and land use on wildland soil properties. Role of soils in natural resource management. Prerequisites: Chem 1110, Soil 3000, and one additional upper-division Soils course, or permission of instructor. Also taught as FRWS 5350/6350. (3 cr) (Sp)

Soil 5550 (QI) (d6550). Soils and Plant Nutrient Bioavailability. Description of forms, transformations, and movement of plant nutrients in soils. Discussion of factors affecting nutrient supply, both qualitatively and quantitatively, for nutrient elements essential for plant growth. Prerequisites: Soil 3000; Chem 1110 or 1210. (3 cr) (Sp)

Soil 5560 (d6560). Analytical Techniques for the Soil Environment. Analysis of chemical and biological soil characteristics. Results interpreted for soil fertility, land use, and environmental remediation. Graduate credit requires a paper reviewing analysis of element or compound class. Prerequisite: Soil 5050/6050 or 5550/6550 (may be taken concurrently), or instructor's permission. (2 cr) (Sp)

Soil 5620. Aquatic Chemistry. Provides students with understanding of principles of aquatic chemistry, emphasizing chemical equilibria, acid-base reactions, complex formation, oxidation-reduction reactions, complex formation, and dissolution chemistry. Prerequisites: Chem 1210, CEE 3640. Also taught as CEE 5620. (3 cr) (F)

Soil 5650 (d6650). Applied Soil Physics. Characterization of the physical properties of soils and other porous media. Measurement, prediction, and control of processes taking place in and through soils (e.g., water flow and solute transport), including atmospheric and groundwater interactions. (3 cr) (F)

Soil 5750. Environmental Quality: Soil and Water. Senior capstone course for Environmental Soil/Water Science (ESWS) major. Students analyze current soil and water environmental quality problem(s), formulate remediation or mitigation plans, and present findings in oral and written reports. Prerequisites: Soil 5130 and two 5000-level Soil courses. (2 cr) (Sp)

Soil 6050 (d5050). Principles of Environmental Soil Chemistry. Introduction to common chemical processes occurring among solid, liquid, and gas phases in soil systems. Emphasis placed on chemistry of arid land soils. Prerequisites: Chem 1110, Math 1050, and Soil 3000. (3 cr) (Sp)

Soil 6130 (d5130). Soil Genesis, Morphology, and Classification. Morphology, development, and classification of soils. Lectures and weekly field exercises emphasize soil as a natural body of the landscape: its properties, distribution, behavior, and interpretations for diverse land uses. Prerequisite: Understanding of fundamental soil science; Soil 3000 recommended. (4 cr) (F)

****Soil 6140. Unsaturated Flow and Transport.** Measurement, prediction, and control of transport processes taking place in and through partially saturated porous formations (e.g., water flow and solute transport), emphasizing parameter estimation and multi-dimensional flow. (3 cr) (F)

****Soil 6190. Salt-affected Soils.** Emphasis on chemistry of salt-affected soils. Topics include carbonate chemistry, cation exchange, and reclamation of sodium and salt-affected soils. Exploration of effects of sodium accumulation on soil hydraulic conductivity and the biochemistry of salt and potentially toxic elements. (2 cr) (Sp)

****Soil 6200. Biogeochemistry of Terrestrial Ecosystems.** Inputs, outputs, and cycling patterns of major nutrients. Emphasis on mechanisms for transformations, factors influencing process rates, and the impacts of management and global change on nutrient cycles and air and water quality. Prerequisites: Biol 1220, Soil 3000, Chem 2300 or 2310, or permission of instructor. Also taught as Biol 6200 and FRWS 6200. (3 cr) (F)

Soil 6350 (d5350). Wildland Soils. Application of basic principles of soil science to wildland ecosystems. Effects of disturbance and land use on wildland soil properties. Role of soils in natural resource management. Prerequisites: Chem 1110, Soil 3000, and one additional upper-division Soils course, or permission of instructor. Also taught as FRWS 6350/5350. (3 cr) (Sp)

****Soil 6400. Spatial and Temporal Estimation Methods for Environmental Sciences.** Introduction to methods for obtaining spatial information and interpolation schemes. Incorporation of uncertainty into dynamic models (temporal predictions). Methods and models for combining spatial and temporal information, with applications to monitoring and forecasting natural processes. (2 cr) (Sp)

Soil 6550 (d5550). Soils and Plant Nutrient Bioavailability. Description of forms, transformations, and movement of plant nutrients in soils. Discussion of factors affecting nutrient supply, both qualitatively and quantitatively, for nutrient elements essential for plant growth. Prerequisites: Soil 3000; Chem 1110 or 1210. (3 cr) (Sp)

Soil 6560 (d5560). Analytical Techniques for the Soil Environment. Analysis of chemical and biological soil characteristics. Results interpreted for soil fertility, land use, and environmental remediation. Graduate credit requires a paper reviewing analysis of element or compound class. Prerequisite: Soil 6050/5050 or 6550/5550 (may be taken concurrently), or instructor's permission. (2 cr) (Sp)

Soil 6600 (d4600). Principles of Surface Hydrology. Study of physical elements of the water cycle, surface hydrological processes, and watershed responses. Explores basic hydrologic concepts and terminology, as well as collection, analysis, and presentation of hyrologic data. Includes field laboratory. Prerequisite: Soil 3000 or instructor's permission. Also taught as AWER 6600/4600. (3 cr) (Sp)

Soil 6650 (d5650). Applied Soil Physics. Characterization of the physical properties of soils and other porous media. Measurement, prediction, and control of processes taking place in and through soils (e.g., water flow and solute transport), including atmospheric and groundwater interactions. (3 cr) (F)

****Soil 6720. Chemistry of Arid Land Soils.** Chemical equilibria and kinetics of arid land soils. Special emphasis on solubility relationships of soil minerals and on carbonate chemistry. (3 cr) (Sp)

***Soil 7200. Soil Interfacial Processes and Reactive Transport.** Course divided into two blocks. Subject matter for first block is soil electrochemistry and surface chemistry. Second block applies material from first block to system in which transport limits reaction time. (3 cr) (Sp)

Soil 7210. Advanced Topics in Pedology. Strategies for designing and critiquing pedological research through literature, discussions, and field trips. Topics will change, depending upon student interest, and can include factors and processes involved in pedogenesis, soil mineralogy, soil-biota relationships, and landscape evolution. Prerequisite: Soil 6130/5130. (2 cr) (Sp) ®

Biometeorology Courses (Bmet)

Bmet 2000 (BPS). The Atmosphere and Weather. Survey of the processes governing the behavior of the atmosphere and the phenomenon of weather. Basic physical principles of radiation, energy, evaporation, and heat transport are introduced and connected to atmospheric circulation and weather. (3 cr) (F,Sp)

Bmet 3250. Aviation Weather. Discussion, observation, and analysis of weather important for pilots and those associated with air travel. (3 cr) (Sp)

Bmet 3820 (DSC, QI). Global Climatology. Develops general understanding of how the climate of the earth functions. Focuses on the connections of the earth system, along with its inherent variability. Prerequisites: Bmet 2000 or Geog 1130. Also taught as AWER 3820. (4 cr) (F)

Bmet 4300. General Meteorology. Introductory meteorology for students with background in physical sciences. Emphasis placed on physical processes (quantitatively) in the atmosphere, resulting in general weather phenomena around the world. Prerequisite: Bmet 2000. (3 cr) (F)

Bmet 5250 (d6250). Remote Sensing of Land Surfaces. Basic principles of radiation and remote sensing. Techniques for ground-based measurements of reflected and emitted radiation, as well as ancillary data collection to support airborne and satellite remote sensing studies in agriculture, geography, and hydrology. Prerequisites: Basic calculus and physics. Also taught as BIE 5250/6250 and FRWS 5250/6250. (4 cr) (Sp)

Bmet 5400 (d6400). Introduction to Meteorology. Designed for senior and graduate students in different fields who desire some basic introduction to meteorology. Bridges a large gap between courses describing meteorological phenomena in broad and simple terms and other courses treating the atmosphere more theoretically. (3 cr) (F)

Bmet 5500 (d6500). Land-Atmosphere Interactions. Examination of interactions between the surface and atmosphere. Consideration of flows of mass and energy in soil-vegetation-atmosphere continuum, and their linkage to local and regional climates. Detailed study of feedbacks between vegetation and atmosphere. (3 cr) (Sp)

*****Bmet 5680 (d6680). Paleoclimatology.** Covers climate through the past four billion years of geologic time. Explores driving forces behind climate changes. Examines data and methods used in paleoclimate research. Includes discussion of literature and stresses local paleoclimate records. Three lectures per week, along with field trips. Prerequisite: Geol/AWER 3600 or permission of instructor. Also taught as Geol 5680/6680 and AWER 5680/6680. (3 cr)

Bmet 5700 (d6700). Environmental Measurements. Examination of critical instrumentation and principles involved in measuring key properties of terrestrial environment. Consideration of measurements in soils, plants, and atmosphere. (3 cr) (Sp)

Bmet 6250 (d5250). Remote Sensing of Land Surfaces. Basic principles of radiation and remote sensing. Techniques for ground-based measurements of reflected and emitted radiation, as well as ancillary data collection to support airborne and satellite remote sensing studies in agriculture, geography, and hydrology. Prerequisites: Basic calculus and physics. Also taught as BIE 6250/5250 and FRWS 6250/5250. (4 cr) (Sp)

Bmet 6300. Principles of Atmospheric Science. Introduction to fundamental physical principles upon which atmospheric sciences are based. Thorough description and interpretation of wide range of atmospheric phenomena. Prerequisite: Instructor's consent. (3 cr) (F)

Bmet 6400 (d5400). Introduction to Meteorology. Designed for senior and graduate students in different fields who desire some basic introduction to meteorology. Bridges a large gap between courses describing meteorological phenomena in broad and simple terms and other courses treating the atmosphere more theoretically. (3 cr) (F)

Bmet 6410. Applied Agricultural Meteorology. Explores applied concepts in agricultural meteorology, with emphasis on weather-agriculture and microclimate-agriculture relationships. Includes crop modeling applications. Course materials, resources, and teaching provided in cooperation with Iowa State University. (2 cr)

Bmet 6500 (d5500). Land-Atmosphere Interactions. Examination of interactions between the surface and atmosphere. Consideration of flows of mass and energy in soil-vegetation-atmosphere continuum, and their linkage to local and regional climates. Detailed study of feedbacks between vegetation and atmosphere. (3 cr) (Sp)

*****Bmet 6680 (d5680). Paleoclimatology.** Covers climate through the past four billion years of geologic time. Explores driving forces behind climate changes. Examines data and methods used in paleoclimate research. Includes discussion of literature and stresses local paleoclimate records. Three lectures per week, along with field trips. Prerequisite: Geol/AWER 3600 or permission of instructor. Also taught as Geol 6680/5680 and AWER 6680/5680. (3 cr)

Bmet 6700 (d5700). Environmental Measurements. Examination of critical instrumentation and principles involved in measuring key properties of terrestrial environment. Consideration of measurements in soils, plants, and atmosphere. (3 cr) (Sp)

Bmet 6800. Environmental Biophysics. Explores connections between biosphere and atmosphere at many scales. Introduces processes governing exchanges of mass and energy between surface and atmosphere, as well as connections to climate. Examines role of the biota at local to global scales. (2 cr) (Sp)

Bmet 6910. Special Problems in Climatology. Study of physical causes and effects of various climate regimes found upon the Earth. Study of the basis and mechanisms of all types of physically-based climate models. Assists students in comprehending relative complexities and applicabilities of the whole range of climate models. (3 cr) (Sp) ®

Plants, Soils, and Biometeorology Courses (PSB)

PSB 1050. Plants, Soils, and Biometeorology Orientation. Orientation to the teaching, research, and extension programs of the department, and to career opportunities. Optional orientation to a specific major: Horticulture, Crop Science, or Environmental Soil/Water Science. (1-2 cr) (F)

PSB 4250. Internship in Plants, Soils, and/or Biometeorology. Professional internship in crop science, horticulture, environmental soil/water science, and/or biometeorology. (1-4 cr) (F,Sp) ®

PSB 4800. Teaching Practicum for Undergraduate Students. Offers undergraduate students an opportunity for guided teaching and methods for student evaluation in a variety of Plants, Soils, and Biometeorology courses. (1-3 cr) (F,Sp)

PSB 4890 (CI). Senior Seminar. Student preparation for careers. Familiarization with placement processes. Discussion of role in society and career opportunities for graduates. Experiences in team building. Opportunities for oral presentations of solutions to current issues and scientific information. (1 cr) (F,Sp) ®

PSB 4900. Special Problems. Special topics and problems in crop science, horticulture, environmental soil/water science, and/or biometeorology. Subject, time, and credit arranged individually as needed. Department approval required. (1-4 cr) (F,Sp,Su) ®

PSB 5160. Methods in Biotechnology: Cell Culture. Techniques and fundamental knowledge for culturing mammalian and insect cells. Students will learn maintenance, growing, genetic engineering of cells, cytotoxicity, hybridoma creation, cloning, etc. Extensive laboratory experience is provided. Also taught as ADVS 5160, Biol 5160, Chem 5160, and NFS 5160. (3 cr) (Sp)

PSB 5200. Site-Specific Agriculture and Landscape/Horticultural Management. Integration of site-specific management technology, such as computers, GPS, yield monitors, variable rate controllers, mechanized samplers, and postharvest processing controllers with planning, tillage, planting, chemical applications, and harvesting to optimize off-site inputs and environmental/economical sustainability in crop or landscape management. (3 cr) (Sp)

PSB 5240. Methods in Biotechnology: Protein Purification Techniques. Reviews basic methods of protein purification, including scaled-up use of 100L fermenter, large-scale centrifugation, diafiltration, chromotography, and use of BioCAD. Prerequisite: Chem 3700. Also taught as ADVS 5240, Biol 5240, Chem 5240, and NFS 5240. (3 cr) (Sp)

PSB 5260. Methods in Biotechnology: Molecular Cloning. Laboratory-oriented course designed to teach molecular biology techniques such as DNA cloning, genetic probes, polymerase chain reaction, and DNA sequencing. Prerequisite: Chem 3700 or 5710; or Biol 3200; or permission of instructor. Also taught as ADVS 5260, Biol 5260, Chem 5260, and NFS 5260. (3 cr) (F)

PSB 6700. Integrative Topics in Plants, Soils, and Biometeorology. Team-taught special topics course encouraging interdisciplinary analysis of a research or policy area from the current literature, encompassing the three departmental subdisciplines. Emphasis on written and oral student presentations. (1-3 cr) (F) ®

PSB 6800. Graduate Student Teaching Practicum. Offers graduate students an opportunity for guided teaching and methods for student evaluation in a variety of Plants, Soils, and Biometeorology courses. (1-3 cr) (F,Sp)

PSB 6890. Plants, Soils, and Biometeorology Graduate Seminar. Review and critique of presentations. Communication practice in extemporaneous, extension, research, poster, and lecture presentations. PSB graduate students must enroll during both fall and spring semesters. (1 cr) (F,Sp) ®

PSB 6900. Special Problems in Plants, Soils, and/or Biometeorology. (1-8 cr) (F,Sp,Su) ®

PSB 6970. Research and Thesis. (1-18 cr) (F,Sp,Su) ®

PSB 6990. Continuing Graduate Advisement. (1-12 cr) (F,Sp,Su) ®

PSB 7800. Graduate Student Teaching Practicum. Offers graduate students an opportunity for guided teaching and methods for student evaluation in a variety of Plants, Soils, and Biometeorology courses. (1-3 cr) (F,Sp)

PSB 7890. Plants, Soils, and Biometeorology Graduate Seminar. Review and critique of presentations. Communication practice in extemporaneous, extension, research, poster, and lecture presentations. PSB graduate students must enroll during both fall and spring semesters. (1 cr) (F,Sp) ®

PSB 7900. Special Problems in Plants, Soils, and/or Biometeorology. (1-8 cr) (F,Sp,Su) ®

PSB 7970. Research and Thesis. (1-18 cr) (F,Sp,Su) ®

PSB 7990. Continuing Graduate Advisement. (1-12 cr) (F,Sp,Su) ®

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[1]Parenthetical numbers preceded by *d* indicate a *dual* listing.

® Repeatable for credit. Check with major department for limitations on number of credits that can be counted for graduation.

*Taught 2002-2003

**Taught 2003-2004.

***This course is taught alternating years. Check with department for information about when course will be taught.