

## Department of Wildlife and Natural Resources

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[www.tarleton.edu/degrees/bachelors/bs-wildlife-sustainability-ecosystem-science/index.html](http://www.tarleton.edu/degrees/bachelors/bs-wildlife-sustainability-ecosystem-science/index.html) (<http://www.tarleton.edu/degrees/bachelors/bs-wildlife-sustainability-ecosystem-science/>)

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Wildlife and Natural Resources is dedicated to the understanding and management of the earth's ecosystems. Our mission is to prepare students to confront the environmental challenges of the present and future generations by sustainably managing natural resources through multidisciplinary teaching, experiential learning, and research.

Many of our degree plans fulfill the educational requirements for certification by various professional organizations. Examples of professional certifications our graduates are eligible for are:

- Certified Wildlife Biologist -- The Wildlife Society
- Certified Fisheries Professional --The American Fisheries Society
- Certified Ecologist --The Ecological Society of America
- Certified Rangeland Professional --The Society for Range Management
- Certified Ecological Restoration Practitioner --Society for Ecological Restoration
- Certified Professional Soil Scientist -- Soil Science Society of America
- Certified Crop Advisor --The American Society of Agronomy

The Department of Wildlife and Natural Resources administers the following degrees and support areas:

### Bachelor Science in Wildlife, Sustainability, and Ecosystem Sciences

• Wildlife and Ecology Management. Designed to prepare graduates for a career in wildlife conservation and management and fulfills all the educational requirements to become a Certified Wildlife Biologist through The Wildlife Society. Graduates frequently find careers with state and federal wildlife agencies, non-governmental organizations, environmental consulting firms, and private ranches.

• Fisheries Ecology and Management. Combines a basic understanding of fish biology and aquatic sciences with a deep knowledge of applied ecology and fisheries management. Curriculum meets the requirements of the American Fisheries Society for a Certified Fisheries Professional. Graduates find careers in government as well as the private sector managing freshwater and marine fisheries for both recreational and commercial fishing.

• Pre-Veterinary Medicine. Designed to prepare students for admission to a college of veterinary medicine. The curriculum is based on the requirements set forth by the Texas A&M College of Veterinary Medicine. Additional courses prepare students for a career in wildlife science, or for a future specialization in wildlife or zoo medicine. Graduates can pursue any veterinary specialty (small-animal, livestock, or wildlife).

• Zoo Animal and Confined Wildlife Biology and Management. Combines wildlife science and animal science to create a unique educational experience that addresses the special needs of wildlife in confined situations. Graduates are equipped to manage wild animals in zoos, animal parks, game breeding operations, and wildlife rehabilitation facilities.

• Natural Resource Ecology. Encompasses such disciplines as range science and restoration ecology. Provides the required coursework to become Rangeland Management certified by the Society for Range Management, or a Certified Restoration Practitioner endorsed by the Society for Ecological Restoration. Focuses on management of plant communities in range, forest, and other wildland systems. Graduates find careers on private ranches and farms as owners or as professional consultants. They are also prepared for careers with the Natural Resource Conservation Service, Texas A&M AgriLife Extension, the US Forest Service, and The Nature Conservancy.

• Natural Resource Policy. For students interested in the laws and policies aspects of natural resource ecology and management. This degree includes a component of natural resource policy courses. It will prepare students for a career focused on natural resource law or policy formation such as a natural resource agency administrative position.

• Soil Science. Focuses on the chemical, physical, and ecological properties of soils vital to the conservation of many natural resources. Includes soil fertility, soil as a component of the environment, soil's role in land management, soil genesis, soil morphology, and soil classification. Prepares the student for careers as a soil conservationist or soil scientist with such agencies as the Natural Resource Conservation Service, or the US Forest Service, US Bureau of Land Management, US Environmental Protection Agency, and other State and Federal agencies working in both wildland and agricultural systems.

• Entomology. Designed to provide students with an ecological framework of insects and related arthropods for a holistic approach towards the conservation and management of insects as they pertain to ecosystem services and other species of wildlife. Curriculum equips students with scientifically and environmentally-sound techniques to pursue careers in ecological monitoring, environmental risk assessment, integrated pest management, nature education, and taxonomy at the private, state, and federal level.

### The Bachelor of Science Degree in Wildlife, Sustainability, and Ecosystem Sciences

#### Field of Study Courses

BIOL 1406 [shared]	Biology for Science Majors
BIOL 1407 [shared]	Biology for Science Majors II
CHEM 1311 [shared]	College Chemistry I (Lecture)
CHEM 1111 [shared]	College Chemistry I (Laboratory)
MATH 2412 [shared]	Precalculus Math
PHIL 2303 [shared]	Introduction to Logic

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WSES 2405	Ecology for Natural Resource Managers	4
WSES 2322	Principles of Wildlife Conservation and Management	3
BIOL 3303	Genetics	3
ENTO 3312	General Entomology	3
SOIL 3301	Soil Science	3
WSES 3350 [WI ( <a href="http://catalog.tarleton.edu/academicaffairs/">http://catalog.tarleton.edu/academicaffairs/</a> )]	Writing for the Natural Resource and Environmental Sciences	3
WSES 3385 [WI ( <a href="http://catalog.tarleton.edu/academicaffairs/">http://catalog.tarleton.edu/academicaffairs/</a> )]	Fish and Wildlife Laws and Administration	3
Experiential Learning Requirement (choose one):		1
WSES 4084	Internship in the Natural Resource Sciences	
WSES 4088	Undergraduate Research in the Natural Resource Sciences	
WSES 4340	Field Camp	
WSES 4342	Study Abroad	
WSES 4187	Senior Capstone Seminar	1
<b>Other Required Courses</b>		
<b>General Education Requirements (<a href="http://catalog.tarleton.edu/academicaffairs/">http://catalog.tarleton.edu/academicaffairs/</a>)</b>		<b>43</b>
<b>Total Hours</b>		<b>67</b>

### Additional Required Courses for Concentrations

#### Wildlife Ecology and Management

Physical Science Elective (choose one):		2
CHEM 1312 & CHEM 1112	College Chemistry II (Lecture) and College Chemistry II (Laboratory)	
PHYS 1401	College Physics I	
GEOL 1403	Physical Geology	
GEOL 1404	Historical Geology	
GEOL 1407	Introduction to Environmental Science	
GEOL 1408	Natural Disasters	
SOIL 4213	Soil Physical Properties	
GEOG 2451	Introduction to Geographic Information Systems	4
MATH 3450	Principles of Bio-Statistics	4
SOIL 3101	Soil Science Laboratory	1
WSES 3310	Wildlife Management Techniques	3
WSES 3311	Wildlife Diseases	3
or WSES 3305	GIS for Natural Resource Scientists	
Choose one of the following:		3
WSES 3308	Analysis of Natural Resource Data	
WSES 4313	Vegetation Measurement, Inventory, and Monitoring	
Choose two of the following (at least one must be BIOL 4430, BIOL 4440, or BIOL 4451):		7
WSES 3403	Natural History of the Vertebrates	
BIOL 4430	Ornithology	
BIOL 4440	Herpetology	
BIOL 4451	Mammalogy	
BIOL 4320	Behavioral Ecology	
NRSC 4303	Animal Behavior	
ANSC 4401	Ethology	
Choose two of the following:		8
WSES 3406	Wildland Plant Identification and Ecology	
WSES 3408	Dendrology and Woody Plant Identification	
BIOL 3415	Plant Taxonomy	
Natural Resource Policy, Administration, and Law Requirement (choose one):		3
WSES 3323	Ethical Issues in Agriculture and the Natural Resources	
WSES/POLS 3315	Sustainability	
WSES 3386	Human Dimensions of Fish and Wildlife Management	
WSES 3387	Natural Resource Conservation Outreach and Interpretation	
POLS 3310 [WI ( <a href="http://catalog.tarleton.edu/academicaffairs/">http://catalog.tarleton.edu/academicaffairs/</a> )]	Environmental Policy	
SOIL 3302	Soils, Land Use, and The Environment	
WSES 4301	Population Dynamics, Modeling, and Analysis	3
WSES 4302	Habitat Management	3
Advanced Ecology and Management Elective (choose one):		3
WSES 3314	Pollinator Ecology and Conservation	
WSES 4326	Big Game Ecology and Management	
WSES 4327	Avian Ecology and Management	
WSES 4341	Southern African Ecology and Culture	
Electives:		2

Choose at least two hours in WSES or SOIL 3XXX or 4XXX, or RNRM 3301

**Total Hours** 49**Natural Resource Ecology**

MATH 3450	Principles of Bio-Statistics	4
GEOG 2451	Introduction to Geographic Information Systems	4
SOIL 3101	Soil Science Laboratory	1
SOIL 3302	Soils, Land Use, and The Environment	3
SOIL 4212	Soil Ecology	2
WSES 3305	GIS for Natural Resource Scientists	3
WSES 3313	Plant Diversity and Conservation	3
WSES 3314	Pollinator Ecology and Conservation	3
WSES 3406	Wildland Plant Identification and Ecology	4
WSES 3408	Dendrology and Woody Plant Identification	4
WSES 4302	Habitat Management	3
WSES 4303	Ecological Restoration	3
WSES 4309 [WI ( <a href="http://catalog.tarleton.edu/academicaffairs/">http://catalog.tarleton.edu/academicaffairs/</a> )]	Plant-Animal Interactions	3
WSES 4311	Fire Ecology	3
WSES 4313	Vegetation Measurement, Inventory, and Monitoring	3
Elective:		3

Choose at least three hours from WSES 3XXX or 4XXX, SOIL 3XXX or 4XXX, or BIOL 3436.

**Total Hours** 49**Pre-veterinary Medicine**

BIOL 3407	Microbiology	4
BIOL 4374	Biochemistry I	3
CHEM 1312 & CHEM 1112	College Chemistry II (Lecture) and College Chemistry II (Laboratory)	4
CHEM 2323 & CHEM 2123	Organic Chemistry I and Organic Chemistry I Laboratory	4
CHEM 2325 & CHEM 2125	Organic Chemistry II and Organic Chemistry II Laboratory	4
COMM 1315 [shared] or COMM 2302	Public Speaking Business and Professional Speaking	
MATH 3450	Principles of Bio-Statistics	4
PHYS 1401	College Physics I	4
PHYS 1402	College Physics II	4
WSES 3310	Wildlife Management Techniques	3
WSES 3311	Wildlife Diseases	3
WSES 4301	Population Dynamics, Modeling, and Analysis	3
WSES 4302	Habitat Management	3
ANSC 3308	Principles of Animal Nutrition	3
Choose one of the following:		3
WSES 3314	Pollinator Ecology and Conservation	
WSES 3340	Fisheries Conservation and Management	
WSES 3403	Natural History of the Vertebrates	
WSES 4326	Big Game Ecology and Management	
WSES 4327	Avian Ecology and Management	
WSES 4341	Southern African Ecology and Culture	
BIOL 4430	Ornithology	
BIOL 4440	Herpetology	
BIOL 4451	Mammalogy	
NRSC 4303	Animal Behavior	
BIOL 4320	Behavioral Ecology	
ANSC 4401	Ethology	

**Total Hours** 49**Fisheries Ecology and Management**

MATH 3450	Principles of Bio-Statistics	4
Physical Science Elective (choose at least 1 hour):		1
SOIL 3101	Soil Science Laboratory	
CHEM 1312 & CHEM 1112	College Chemistry II (Lecture) and College Chemistry II (Laboratory)	
EASC 3340	Oceanography	
EASC 3370	Biogeography	
GEOL 1403	Physical Geology	
GEOL 1404	Historical Geology	
GEOL 1407	Introduction to Environmental Science	

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GEOL 1408	Natural Disasters	
PHYS 1401	College Physics I	
GEOG 2451	Introduction to Geographic Information Systems	4
WSES 3309	Aquaponics	3
WSES 3340	Fisheries Conservation and Management	3
WSES 3308	Analysis of Natural Resource Data	3
or MATH 2413	Calculus I	
ENTO 3316	Aquatic Entomology	3
Botany requirement (choose one):		4
WSES 3406	Wildland Plant Identification and Ecology	
WSES 3408	Dendrology and Woody Plant Identification	
BIOL 3415	Plant Taxonomy	
BIOL 3430	Phycology	
Choose two of the following:		6
WSES 3311	Wildlife Diseases	
WSES 3403	Natural History of the Vertebrates	
BIOL 4320	Behavioral Ecology	
BIOL 3449	Animal Diversity	
BIOL 4445	Parasitology	
BIOL 4440	Herpetology	
NRSC 4303	Animal Behavior	
ANSC 4401	Ethology	
Natural Resource Policy, Administration, and Law Requirement (choose one)		3
WSES/POLS 3315	Sustainability	
WSES 3323	Ethical Issues in Agriculture and the Natural Resources	
WSES 3385 [WI ( <a href="http://catalog.tarleton.edu/academicaffairs/">http://catalog.tarleton.edu/academicaffairs/</a> )]	Fish and Wildlife Laws and Administration	
WSES 3386	Human Dimensions of Fish and Wildlife Management	
WSES 3387	Natural Resource Conservation Outreach and Interpretation	
WSES 4306	Water Resources Policy and Management	
POLS 3310 [WI ( <a href="http://catalog.tarleton.edu/academicaffairs/">http://catalog.tarleton.edu/academicaffairs/</a> )]	Environmental Policy	
POLS 4310 [WI ( <a href="http://catalog.tarleton.edu/academicaffairs/">http://catalog.tarleton.edu/academicaffairs/</a> )]	International Environmental Issues	
POLS 4311 [WI ( <a href="http://catalog.tarleton.edu/academicaffairs/">http://catalog.tarleton.edu/academicaffairs/</a> )]	Environmental Law	
BIOL 3407	Microbiology	4
BIOL 3340	Introduction to Marine Biology	3
or BIOL 4441	Freshwater Biology	
BIOL 4462	Ichthyology	4
WSES 4301	Population Dynamics, Modeling, and Analysis	3
WSES Electives:		1
Choose at least one course from WSES 3XXX or 4XXX.		
<b>Total Hours</b>		<b>49</b>

#### Zoo Animal and Confined Wildlife Biology and Management

BIOL 3103	Genetic Techniques	1
BIOL 4325	Conservation Biology	3
AGRI 1419	General Animal Science	4
ANSC 2350	Anatomy and Physiology of Domestic Animals	3
ANSC 3308	Principles of Animal Nutrition	3
ANSC 3408	Physiology of Reproduction	4
or ANSC 3410	Principles of Equine Reproduction	
ANSC 4308	Environmental Physiology of Farm Animals	3
WSES 3311	Wildlife Diseases	3
Choose one of the following:		3
WSES 3323	Ethical Issues in Agriculture and the Natural Resources	
WSES 3386	Human Dimensions of Fish and Wildlife Management	
WSES 3387	Natural Resource Conservation Outreach and Interpretation	
Choose one of the following:		3
WSES 3403	Natural History of the Vertebrates	
WSES 4326	Big Game Ecology and Management	
WSES 4327	Avian Ecology and Management	
WSES 4341	Southern African Ecology and Culture	
Choose one of the following:		4

BIOL 4430	Ornithology	
BIOL 4440	Herpetology	
BIOL 4451	Mammalogy	
WSES 4302	Habitat Management	3
or WSES 4309	Plant-Animal Interactions	
WSES 4310	Zoo Biology and Management	3
NRSC 4303	Animal Behavior	3
or ANSC 4401	Ethology	

**Must complete at least 6 hours from one of the Subject Areas below. At least 3 hours must be advanced.**

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#### Natural Resource Management Subject Area

MATH 1342	Elementary Statistical Methods	
RNRM 3301	Principles of Range Management	
WSES 3308	Analysis of Natural Resource Data	
WSES 3314	Pollinator Ecology and Conservation	
WSES 3406	Wildland Plant Identification and Ecology	
WSES 3313	Plant Diversity and Conservation	
WSES 3408	Dendrology and Woody Plant Identification	
WSES 4301	Population Dynamics, Modeling, and Analysis	
WSES 4303	Ecological Restoration	

#### Management and Marketing Subject Area

BCIS 1315	Principles of Web Design	
BCIS 3315	Web Development	
MGMT 3300	Principles of Management	
MGMT 3302	Human Resource Management	
MGMT 3304	Small Business Management	
MGMT 3350	Organization Behavior	
MKTG 3312	Marketing	
MKTG 3317	Retailing	
MKTG 3318	Promotional Strategy	

#### Outreach, Interpretation, and Public Relations Subject Area

COMM 2325	Event Coordination	
COMM 3305	Environmental Communication	
COMM 3320	Public Relations	
COMM 3321	Advertising	
COMM 3329	Travel & Tourism	
COMM 4320	Event Planning and Management	
COMM 4325	Applied Public Relations and Event Planning	

**Total Hours**

49

### Horticultural Science

CHEM 1312 & CHEM 1112	College Chemistry II (Lecture) and College Chemistry II (Laboratory)	4
CHEM 2323 & CHEM 2123	Organic Chemistry I and Organic Chemistry I Laboratory	4
BIOL 3407	Microbiology	4
BIOL 3415	Plant Taxonomy	4
BIOL 3420	Plant Pathology	4
BIOL 3436	Plant Physiology	4
MATH 3450	Principles of Bio-Statistics	4
HORT 1301	Horticulture	3
HORT 3300	Plant Propagation	3
HORT 3390	Horticultural Plants	3
HORT 4301	Greenhouse and Nursery Management	3
WSES 4309 [WI ( <a href="http://catalog.tarleton.edu/academicaaffairs/">http:// catalog.tarleton.edu/academicaaffairs/</a> )]	Plant-Animal Interactions	3
AGRI 4350	Retail Merchandising of Agricultural Products	3
Choose at least 3 hours from the following:		3
HORT 3301	Landscape Design	
HORT 3309	Aquaponics	
HORT 3370	Floriculture Operations and Management	
HORT 4323	Principles of Horticultural Crop Production	
HORT 4470	Turfgrass Management and Irrigation	
SOIL 3319	Composting	
SOIL 4212	Soil Ecology	
SOIL 4213	Soil Physical Properties	
SOIL 4450	Soil Nutrient Cycling	
WSES 3313	Plant Diversity and Conservation	
WSES 3380	Ecological Pest Management	

WSES 4303	Ecological Restoration	
WSES 4324	Organic Agriculture	
<b>Total Hours</b>		<b>49</b>
<b>Entomology</b>		
CHEM 1312 & CHEM 1112	College Chemistry II (Lecture) and College Chemistry II (Laboratory)	4
MATH 3450	Principles of Bio-Statistics	4
BIOL 3103	Genetic Techniques	1
BIOL 3449	Animal Diversity	4
Choose one of the following:		3
WSES 3308	Analysis of Natural Resource Data	
WSES 4313	Vegetation Measurement, Inventory, and Monitoring	
ENTO 3316	Aquatic Entomology	3
ENTO 4402	Insect Taxonomy and Systematics	4
Choose one of the following:		4
WSES 3406	Wildland Plant Identification and Ecology	
WSES 3408	Dendrology and Woody Plant Identification	
BIOL 3415	Plant Taxonomy	
WSES 4309 [WI ( <a href="http://catalog.tarleton.edu/academicaffairs/">http://catalog.tarleton.edu/academicaffairs/</a> )]	Plant-Animal Interactions	3
WSES 3380	Ecological Pest Management	3
ENTO 3112	General Entomology Lab	1
WSES 4301	Population Dynamics, Modeling, and Analysis	3
WSES 4302	Habitat Management	3
BIOL 4320	Behavioral Ecology	3
or NRSC 4303	Animal Behavior	
WSES 3314	Pollinator Ecology and Conservation	3
Electives:		3
Choose at least three hours in WSES, SOIL, or BIOL 3XXX or 4XXX.		
<b>Total Hours</b>		<b>49</b>
<b>Soil Science</b>		
HORT 1301 or AGRI 1307	Horticulture Agronomy	3
CHEM 1312 & CHEM 1112	College Chemistry II (Lecture) and College Chemistry II (Laboratory)	4
WSES/GEOG/ENVS 2451	Introduction to Geographic Information Systems	4
GEOL 1403	Physical Geology	4
GEOL/CHEM 3314	Geochemistry	3
MATH 3450	Principles of Bio-Statistics	4
SOIL 2112	Soil Morphology	1
SOIL 3101	Soil Science Laboratory	1
SOIL 3302	Soils, Land Use, and The Environment	3
SOIL 3412	Soil Genesis, Morphology, and Classification	4
SOIL 4212	Soil Ecology	2
SOIL 4213	Soil Physical Properties	2
SOIL 4450	Soil Nutrient Cycling	4
Writing-Intensive Requirement		3
WSES 4309 [WI ( <a href="http://catalog.tarleton.edu/academicaffairs/">http://catalog.tarleton.edu/academicaffairs/</a> )]	Plant-Animal Interactions	
EASC 4313 [WI ( <a href="http://catalog.tarleton.edu/academicaffairs/">http://catalog.tarleton.edu/academicaffairs/</a> )]	Environmental Techniques	
GEOL 4305 [WI ( <a href="http://catalog.tarleton.edu/academicaffairs/">http://catalog.tarleton.edu/academicaffairs/</a> )]	Field Geology	
Upper-level Electives:		7
Choose at least 7 upper-level hours (3XXX or 4XXX) from SOIL, WSES, or HORT.		
<b>Total Hours</b>		<b>49</b>
<b>Natural Resource Policy</b>		
LEGL 2330	Introduction to Legal Studies	3
COMM 3305	Environmental Communication	3
POLS 3307	Public Administration	3
POLS 3310 [WI ( <a href="http://catalog.tarleton.edu/academicaffairs/">http://catalog.tarleton.edu/academicaffairs/</a> )]	Environmental Policy	3
POLS 4310 [WI ( <a href="http://catalog.tarleton.edu/academicaffairs/">http://catalog.tarleton.edu/academicaffairs/</a> )]	International Environmental Issues	3

POLS 4311 [WI ( <a href="http://catalog.tarleton.edu/academicaaffairs/">http://catalog.tarleton.edu/academicaaffairs/</a> )]	Environmental Law	3
WSES 3310	Wildlife Management Techniques	3
WSES 3386	Human Dimensions of Fish and Wildlife Management	3
WSES 4301	Population Dynamics, Modeling, and Analysis	3
WSES 4302	Habitat Management	3
Ecology and Conservation Elective (choose one):		3
WSES 3314	Pollinator Ecology and Conservation	
WSES 3340	Fisheries Conservation and Management	
WSES 4326	Big Game Ecology and Management	
WSES 4327	Avian Ecology and Management	
WSES 4341	Southern African Ecology and Culture	
Ethics Elective (choose one):		3
LEGL 3332	Legal Ethics	
PHIL 3301	Ethics in the Professions	
PHIL 4305	Environmental Ethics	
Upper-level Electives		13
Choose at least 13 upper-level hours (3XXX or 4XXX) from WSES, SOIL, POLS, or LEGL.		

**Total Hours** 49

## The Bachelor of Science Degree in Horticultural and Plant Sciences

• **Horticultural Science.** Firmly grounded in the biology of plant growth and development, with additional applied courses to give students a well-rounded set of skills to become horticulture scientists. For students with strong interests in science and/or technology opportunities in research related fields, including graduate studies. Graduates have the knowledge and skills to pursue a M.Sc. or Ph.D. degree or a career as a professor? (teacher, lecturer or instructor) at a university or research scientist for public and private organizations.

• **Horticultural Management:** Emphasizing floriculture, landscape management, and operations of nurseries and greenhouses. This applies to students interested in a profession of practical horticultural skills; this could range (or ranging from) from production of plants for food crops or wholesale nurseries, raising plants for use in parks, gardens and public green spaces, or giving garden design advice, including appropriate planting and care.

• **Horticultural Business.** Emphasizes the business aspect of the horticulture industry. Includes a strong horticulture foundation with a business foundation and courses in finance, economics, and retail merchandising. Applies to students interested in horticulture business management. Graduates have the knowledge and skills to manage a horticulture business or work in a market-associated position.

• **Sustainable Agriculture and Agroecology.** Emphasizes agronomy and crop sciences. Includes courses that highlights the three main objectives of sustainability: a healthy environment, economic profitability, and social and economic equity. Graduates have the knowledge to implement the best crop production and management practices used in agronomical and horticultural crops. With careful selection of agriculture and agroecology courses, horticulture graduates can take the International Certified Crop Adviser Exam sponsored by The American Society of Agronomy.

## The Bachelor of Science Degree in Horticultural and Plant Sciences

### Required Courses

General Education Requirements ( <a href="http://catalog.tarleton.edu/academicaaffairs/">http://catalog.tarleton.edu/academicaaffairs/</a> )		42
BIOL 1406 [shared]	Biology for Science Majors	
BIOL 1407 [shared]	Biology for Science Majors II	
BIOL 3407	Microbiology	4
BIOL 3420	Plant Pathology	4
BIOL 3436	Plant Physiology	4
CHEM 1311 & CHEM 1111	College Chemistry I (Lecture) and College Chemistry I (Laboratory)	4
CHEM 1312 & CHEM 1111	College Chemistry II (Lecture) and College Chemistry I (Laboratory)	4
CHEM 2323 & CHEM 2123	Organic Chemistry I and Organic Chemistry I Laboratory	4
ENGL 3309 [WI ( <a href="http://catalog.tarleton.edu/academicaaffairs/">http://catalog.tarleton.edu/academicaaffairs/</a> )]	Professional Writing	3
ENTO 3312	General Entomology	3
HORT 1301	Horticulture	3
HORT 2320	Fundamentals of Market Gardening	3
MATH 2412 [shared]	Precalculus Math	
Extra Hour from MATH 2412		1
SOIL 3301 & SOIL 3101	Soil Science and Soil Science Laboratory	4
WSES 2405	Ecology for Natural Resource Managers	4
WSES 4187	Senior Capstone Seminar	1
Experiential Learning Requirement (choose one):		1
WSES 4084	Internship in the Natural Resource Sciences	
WSES 4088	Undergraduate Research in the Natural Resource Sciences	
WSES 4340	Field Camp	
WSES 4342	Study Abroad	

**Total Hours** 89



**Additional Required Courses for Concentrations****Sustainable Agriculture and Agroecology**

AGEC 2317 [shared]	Introductory Agricultural Economics	
AGRI 1307 & AGRI 1107	Agronomy and Agronomy Laboratory	4
MATH 3450	Principles of Bio-Statistics	4
SOIL 4212	Soil Ecology	2
or SOIL 4213	Soil Physical Properties	
SOIL 4450	Soil Nutrient Cycling	4
Environmental Policy Requirement (choose one):		3
POLS 3310 [WI ( <a href="http://catalog.tarleton.edu/academicaffairs/">http://catalog.tarleton.edu/academicaffairs/</a> )]	Environmental Policy	
POLS 4310 [WI ( <a href="http://catalog.tarleton.edu/academicaffairs/">http://catalog.tarleton.edu/academicaffairs/</a> )]	International Environmental Issues	
POLS 4311 [WI ( <a href="http://catalog.tarleton.edu/academicaffairs/">http://catalog.tarleton.edu/academicaffairs/</a> )]	Environmental Law	
GEOG 2451	Introduction to Geographic Information Systems	4
WSES 3380	Ecological Pest Management	3
WSES 4325	Crop Production and Management	3
Upper-level Elective:		4
Choose at least four hours from WSES, SOIL, or HORT 3XXX or 4XXX		
<b>Total Hours</b>		<b>31</b>

**Horticultural Science**

BIOL 3303 & BIOL 3103 or AGRI 3409	Genetics and Genetic Techniques Genetics	4
HORT 3300	Plant Propagation	3
HORT 3390	Horticultural Plants	3
HORT 4301	Greenhouse and Nursery Management	3
MATH 3450	Principles of Bio-Statistics	4
PHIL 2303 [shared]	Introduction to Logic	
SOIL 4450	Soil Nutrient Cycling	4
WSES 3314	Pollinator Ecology and Conservation	3
WSES 4309 [WI ( <a href="http://catalog.tarleton.edu/academicaffairs/">http://catalog.tarleton.edu/academicaffairs/</a> )]	Plant-Animal Interactions	3
Elective (choose four hours from the following):		4
HORT 3301	Landscape Design	
HORT 3309	Aquaponics	
HORT 3333	Mushroom Cultivation and Utilization	
HORT 3370	Floriculture Operations and Management	
HORT 4323	Principles of Horticultural Crop Production	
HORT 4470	Turfgrass Management and Irrigation	
SOIL 3319	Composting	
SOIL 4212	Soil Ecology	
SOIL 4213	Soil Physical Properties	
WSES 3313	Plant Diversity and Conservation	
WSES 3380	Ecological Pest Management	
WSES 4303	Ecological Restoration	
WSES 4324	Organic Agriculture	
<b>Total Hours</b>		<b>31</b>

**Horticultural Management**

AGEC 2317 [shared]	Introductory Agricultural Economics	
AGRI 4350	Retail Merchandising of Agricultural Products	3
HORT 3300	Plant Propagation	3
HORT 3390	Horticultural Plants	3
HORT 4301	Greenhouse and Nursery Management	3
WSES 3314	Pollinator Ecology and Conservation	3
WSES 4309 [WI ( <a href="http://catalog.tarleton.edu/academicaffairs/">http://catalog.tarleton.edu/academicaffairs/</a> )]	Plant-Animal Interactions	3
HORT 3370	Floriculture Operations and Management	3
HORT 3301	Landscape Design	3
Electives (choose at least seven hours of the following):		7
HORT 3333	Mushroom Cultivation and Utilization	
HORT 4320	Landscaping with Native Plants	



HORT 4470	Turfgrass Management and Irrigation	
SOIL 4212	Soil Ecology	
SOIL 4213	Soil Physical Properties	
SOIL 4450	Soil Nutrient Cycling	
WSES 3309	Aquaponics	
WSES 3313	Plant Diversity and Conservation	
WSES 3380	Ecological Pest Management	
WSES 4303	Ecological Restoration	
WSES 4324	Organic Agriculture	

**Total Hours** **31**

### Horticultural Business

ACCT 2301	Principles of Accounting I-Financial	3
AGRI 2317 [shared]	Introductory Agricultural Economics	
AGRI 4350	Retail Merchandising of Agricultural Products	3
AGSD 3302 [WI ( <a href="http://catalog.tarleton.edu/academicaaffairs/">http://catalog.tarleton.edu/academicaaffairs/</a> )]	Agricultural Sales and Services	3
HORT 3300	Plant Propagation	3
HORT 3390	Horticultural Plants	3
HORT 4301	Greenhouse and Nursery Management	3
Choose four hours from the following:		4
SOIL 3319	Composting	
SOIL 4212	Soil Ecology	
SOIL 4213	Soil Physical Properties	
SOIL 4450	Soil Nutrient Cycling	
WSES 3314	Pollinator Ecology and Conservation	
WSES 3380	Ecological Pest Management	
WSES 4309 [WI ( <a href="http://catalog.tarleton.edu/academicaaffairs/">http://catalog.tarleton.edu/academicaaffairs/</a> )]	Plant-Animal Interactions	
WSES 4324	Organic Agriculture	

Any upper-level HORT course

Business electives: 6

Choose any six hours of ACCT, AGECE, BCIS, BLAW, BUSI, ECON, FINC, MGMT, or MKTG (at least three hours must be 3XXX or 4XXX).

**Total Hours** **28**

## Minors

### Minor in Fisheries Management

#### Required Courses

WSES 2405	Ecology for Natural Resource Managers	4
or BIOL 4401	Ecology	
WSES 2322	Principles of Wildlife Conservation and Management	3
WSES 3340	Fisheries Conservation and Management	3
BIOL 4462	Ichthyology	4
Choose one of the following:		3-4
BIOL 4441	Freshwater Biology	
ENTO 3316	Aquatic Entomology	
Choose one of the following:		3
BIOL 3340	Introduction to Marine Biology	
WSES 3309	Aquaponics	
WSES 3385 [WI ( <a href="http://catalog.tarleton.edu/academicaaffairs/">http://catalog.tarleton.edu/academicaaffairs/</a> )]	Fish and Wildlife Laws and Administration	

**Total Hours** **20-21**

### Minor in Ecological Restoration

#### Required Courses

WSES 3406	Wildland Plant Identification and Ecology	4
or WSES 3408	Dendrology and Woody Plant Identification	
WSES 3313	Plant Diversity and Conservation	3
WSES 4303	Ecological Restoration	3
WSES 4313	Vegetation Measurement, Inventory, and Monitoring	3
SOIL 3301 & SOIL 3101	Soil Science and Soil Science Laboratory	4
Choose one of the following:		2-3
SOIL 4212	Soil Ecology	

WSES 4311

Fire Ecology

**Total Hours****19-20****Minor in Soil Science****Required Courses**

SOIL 3301 & SOIL 3101	Soil Science and Soil Science Laboratory	4
SOIL 3302	Soils, Land Use, and The Environment	3
SOIL 3412	Soil Genesis, Morphology, and Classification	4
SOIL 4450	Soil Nutrient Cycling	4
SOIL 4212	Soil Ecology	2
SOIL 4213	Soil Physical Properties	2

**Total Hours****19****Minor in Agroecology****Required Courses**

WSES 2405	Ecology for Natural Resource Managers	4
SOIL 3301 & SOIL 3101	Soil Science and Soil Science Laboratory	4
HORT 1301 or AGRI 1307 & AGRI 1107	Horticulture Agronomy and Agronomy Laboratory	3
WSES 2301 or WSES 3415	General Entomology	3
HORT 3300 or SOIL 4450	Plant Propagation Soil Nutrient Cycling	3
Choose one of the following:		3
WSES 4325	Crop Production and Management	
WSES 4324	Organic Agriculture	
WSES 3319	Composting	
WSES 3315	Sustainability	
WSES 3309	Aquaponics	

**Total Hours****20****Minor in Crop Science****Required Courses**

AGRI 1307 & AGRI 1107	Agronomy and Agronomy Laboratory	4
SOIL 3301 & SOIL 3101	Soil Science and Soil Science Laboratory	4
ENTO 3312	General Entomology	3
BIOL 3436	Plant Physiology	4
WSES 4325	Crop Production and Management	3
Choose one of the following:		3-4
FDSC 4408	Sustainable Food Systems	
WSES 3314	Pollinator Ecology and Conservation	
WSES 3380	Ecological Pest Management	
WSES 4324	Organic Agriculture	
HORT 3415	Weed Management	
SOIL 4450	Soil Nutrient Cycling	
SOIL 4212 & SOIL 4213	Soil Ecology and Soil Physical Properties	
BIOL 3420	Plant Pathology	
BIOL 3303 & BIOL 3103	Genetics and Genetic Techniques	
AGRI 3409	Genetics	

**Total Hours****21-22****Minor in Natural Resource Ecology****Required Courses**

Choose one of the following:		3-4
WSES 2405	Ecology for Natural Resource Managers	
BIOL 4401	Ecology	
RNRM 3315	Range Ecology	
WSES 4309 [WI ( <a href="http://catalog.tarleton.edu/academicaffairs/">http://catalog.tarleton.edu/academicaffairs/</a> )]	Plant-Animal Interactions	3
WSES 4311	Fire Ecology	3
SOIL 4212	Soil Ecology	2
BIOL 3353	Ecology and Evolution	3

Choose two of the following:

6

WSES 3314	Pollinator Ecology and Conservation
WSES 4326	Big Game Ecology and Management
WSES 4327	Avian Ecology and Management
BIOL 4320	Behavioral Ecology

**Total Hours****20-21**

## Academic Advising Guides

Academic Advising Guides area available at the following website:

<https://web.tarleton.edu/majorinfo/>

### Professors

- Breeden, Jeffrey Dr.
- Cummings, Hennen Dr.
- McGahan, Donald Dr.
- Muir, James Dr.

### Associate professors

- Mathewson, Heather Dr.
- Schwertner, T. Wayne Dr.

### Assistant professors

- Kafley, Hemanta Dr.
- Mitchell, Adam Dr.
- Murray, Darrel Dr.
- Weiss, Stuart Dr.

## Agriculture Courses

**AGRI 1000. TCC Dual Admit. 0 Credit Hours (Lecture: 0 Hours, Lab: 0 Hours).**

**AGRI 1100. Transitioning to University Studies in Agriculture & Natural Resources. 1 Credit Hour (Lecture: 1 Hour, Lab: 1 Hour).**

Practical study designed to prepare the student for university life, aid in the development of skills for academic success, promote personal growth and responsibility, and encourage active involvement in the learning process from an individual college perspective.

**AGRI 1107. Agronomy Laboratory. 1 Credit Hour (Lecture: 0 Hours, Lab: 3 Hours).**

This laboratory-based course accompanies AGRI 1307. Laboratory activities will reinforce the fundamental principles in the development, production, and management of field crops including growth and development, climate, plant requirements, pest management, and production methods. Prerequisite: AGRI 1307 or concurrent enrollment.

**AGRI 1307. Agronomy. 3 Credit Hours (Lecture: 3 Hours, Lab: 0 Hours).**

Principles and practices in the development, production, and management of field crops including growth and development, climate, plant requirements, pest management, and production methods.

**AGRI 1309. Microcomputer Applications in Agriculture. 3 Credit Hours (Lecture: 3 Hours, Lab: 2 Hours).**

Microcomputer technology applied to management, record keeping, and agribusiness. Emphasis on the application of database, spreadsheet, and other business software in various agricultural environments. Lab fee: \$2.

**AGRI 1419. General Animal Science. 4 Credit Hours (Lecture: 3 Hours, Lab: 2 Hours).**

The scientific study of animal agriculture involving beef cattle, dairy cattle, swine, sheep, goats, and horses. Topics covered will include general management practices, reproduction, nutrition, health, handling, genetic selection, shelter/housing and marketing strategies and procedures. Lab fee: \$2.

**AGRI 2301. Agricultural Power Units. 3 Credit Hours (Lecture: 2 Hours, Lab: 2 Hours).**

Fundamentals of internal combustion engine operation to include gasoline, diesel, and liquefied petroleum. Preventative maintenance and general servicing of tractor engine systems: intake & exhaust; fuel; lubrication; cooling; electrical; power trains; and hydraulic. Also covered are tractor tune-up; small engine operation maintenance & reconditioning; and plumbing & irrigation power systems. Lab fee: \$2.

**AGRI 2303. Agricultural Construction I. 3 Credit Hours (Lecture: 2 Hours, Lab: 3 Hours).**

A course designed to acquaint students with principles and application of carpentry, tool maintenance, tool and hardware nomenclature, preparation of drawings and bills of materials, blueprint reading, and the preparation and use of concrete. Also included are maintenance needs for the home and agricultural buildings. Lab fee: \$2.

**AGRI 2304. Introductory Metals and Welding. 3 Credit Hours (Lecture: 2 Hours, Lab: 4 Hours).**

Cold metal work, soldering, pipe fitting, tool conditioning, hardware nomenclature, arc and oxyacetylene welding. Lab fee: \$2.

**AGRI 2317. Introductory Agricultural Economics. 3 Credit Hours (Lecture: 3 Hours, Lab: 0 Hours).**

An introduction to economics principles and concepts in agriculture today as they relate to the American economic system. Emphasis will be on management problem-solving techniques under various situations, especially those agricultural in nature, including producing, processing, distributing, and consuming farm and ranch products.

**AGRI 2330. Wildlife Conservation and Management. 3 Credit Hours (Lecture: 3 Hours, Lab: 0 Hours).**

Principles and practices used in the conservation and management of wildlife resources. Aesthetic, ecological, and recreational uses of public and private lands. Intended for non-wildlife and non-science majors; will not count toward Wildlife Science option in the BS in Wildlife, Sustainability, and Ecosystem Sciences and is not a prerequisite for advanced WSES courses.

**AGRI 3409. Genetics. 4 Credit Hours (Lecture: 3 Hours, Lab: 2 Hours).**

Fundamental principles of genetics: variation, heredity, and interaction of genes, linkage, sex linkage, and mutation. Special emphasis given to breeding of farm crops and domestic animals. Laboratory includes demonstration of Mendelian ratios with field crops and *Drosophila* and an introduction to statistical methods as applied to agricultural research. Prerequisite: BIOL 1406 or 1407 and junior classification. Lab fee: \$7.

**AGRI 4350. Retail Merchandising of Agricultural Products. 3 Credit Hours (Lecture: 1 Hour, Lab: 6 Hours).**

Management of a retail store with emphasis on agricultural products, including meat, produce, live plants, and processed foods. Display, care, merchandising, inventory control, customer relations, and point of sale. Laboratory involves working shifts in the College of Agricultural and Environmental Sciences retail center and associated facilities.

## Entomology Courses

### ENTO 3112. General Entomology Lab. 1 Credit Hour (Lecture: 0 Hours, Lab: 3 Hours).

Anatomy, morphology, and identification of select insect taxa conducted in both laboratory and field setting. Use of dichotomous keys to identify insects. Specimen collection required. Prerequisite: Concurrent enrollment in ENTO 3312.

### ENTO 3312. General Entomology. 3 Credit Hours (Lecture: 3 Hours, Lab: 0 Hours).

Principal orders of insects; the relation of anatomy and physiology of insects to control methods; insecticides and their uses; development, habits, and economic importance of more common insects with control methods for the injurious species. Prerequisite: C or better in BIOL 1406 or BIOL 1407.

### ENTO 3314. Pollinator Ecology and Conservation. 3 Credit Hours (Lecture: 2 Hours, Lab: 2 Hours).

Plant-insect interactions concerning floral resources and the conservation of pollinator insects. Floral morphology, coevolution of plant and pollinator, insect ecology and behavior, management of honeybees for commercial purposes, managing pollinators in urban and suburban settings, and conservation of pollinator habitat. Identifications of major pollinator insect groups, and techniques to monitor native pollinators and floral resources. Prerequisites: WSES 2405 or BIOL 4401; and WSES 3312.

### ENTO 3316. Aquatic Entomology. 3 Credit Hours (Lecture: 2 Hours, Lab: 2 Hours).

Identification of aquatic insects and interactions with their environment. General concepts in limnology and entomology; systematics, ecology, management of aquatic systems for insects, and conservation of freshwater invertebrates. Techniques for the sampling and monitoring of aquatic communities. Collection of immature aquatic insects is required. Prerequisite: ENTO 3312.

### ENTO 3380. Ecological Pest Management. 3 Credit Hours (Lecture: 3 Hours, Lab: 0 Hours).

An introduction to the principles of managing pest populations to reduce economic and ecological loss in agriculture, horticulture, domestic, and natural settings in an environmentally compatible manner. Information gleaned from this course should prepare students to apply for state certification as a licensed pesticide applicator. Prerequisite: WSES 2405 and either WSES/ENTO 3312 or WSES 2301.

### ENTO 4402. Insect Taxonomy and Systematics. 4 Credit Hours (Lecture: 3 Hours, Lab: 3 Hours).

Classification of insects and identification of insect orders and families in Texas and the southwestern United States. Systematics, phylogeny, morphology, and natural history of insect families and select taxa of environmental, economic, or medical importance. Identification of insects by sight and through use of dichotomous key. Prerequisite: ENTO 3312.

## Horticulture Courses

### HORT 1301. Horticulture. 3 Credit Hours (Lecture: 3 Hours, Lab: 0 Hours).

Introduction to the horticulture industry and the career opportunities that are available. The course includes an introduction to plant classification and structure, greenhouse construction and management, orchard and vegetable crops, and plant propagation.

### HORT 2320. Fundamentals of Market Gardening. 3 Credit Hours (Lecture: 2 Hours, Lab: 2 Hours).

Introduction to gardening with a focus on using sustainable methods. A broad range of topics will be presented that include crop selection by season and geography, soil health, nutrient management, weed management, insect and disease identification, and pest management (insect, weed, and pathogen). Different crop management disciplines will be taught that include both conventional and organic production systems. Basic landscape design and garden establishment will be conveyed. This course will also include the principles and practices of garden-based learning and the application of horticulture in agriculture education programs. Biodiversity and the effects of organic and non-organic practices on the garden ecosystem will be emphasized. Conservation agriculture and other sustainable cultural practices (e.g. no-till, strip till and intercropping) will be examined. Students practice growing a garden using the techniques discussed in lecture. Home landscaping, container gardens, diversified garden systems, transplant production, herbs, and entry level greenhouse management are woven into class and laboratory lessons.

### HORT 2470. Introduction to Turfgrass Science. 4 Credit Hours (Lecture: 3 Hours, Lab: 3 Hours).

An introduction to turfgrass history, benefits, and use. Growth and development of various turfgrass species and their culture.

### HORT 3300. Plant Propagation. 3 Credit Hours (Lecture: 2 Hours, Lab: 2 Hours).

Principles of propagating plants, including vegetables, ornamentals, and fruits. Methods of handling seed; starting plants by the use of cuttings, layers, buds, grafts, and bulbs; ways of propagating specific plants; factors influencing growth of plants after transplanting. Prerequisites: BIOL 1406 and HORT 1301. Lab fee \$2.

### HORT 3301. Landscape Design. 3 Credit Hours (Lecture: 2 Hours, Lab: 2 Hours).

Planting design and use of plants in the landscape. Use of drafting instruments, preparation of plans, perspective drawings, and cost estimates. Prerequisite: Prior completion of or concurrent enrollment in HORT 3390.

### HORT 3309. Aquaponics. 3 Credit Hours (Lecture: 2 Hours, Lab: 2 Hours).

Students will examine the pros and cons of various aquaponics methods like raft, nutrient film, vertical towers, and media filled beds and their applications for growing fish and plants sustainably for a family/community or for profit. Students will construct a backyard aquaponics system, establish/harvest plants, and prepare a meal in laboratory. Topics covered are plant and fish choices and recommendations; planting/growing techniques; fish biology, stocking rates, and feeds; plant/fish care and health; water quality; system design, filtration and plumbing components; daily operation; greenhouse management/seasonal adjustments; system start up; food preparation; economics and business considerations.

### HORT 3310. Regenerative Agriculture Systems. 3 Credit Hours (Lecture: 2 Hours, Lab: 2 Hours).

This course will serve as a bridge between foundational horticulture concepts, agroecological processes, and regenerative agriculture systems that can be applied to horticultural crop, agronomic crop, and integrated crop-livestock grazing systems. Course curriculum will emphasize regenerative agriculture principles and practices that includes soil conservation, agroecology, sustainable farming methods, biodiversity, and organic agriculture. This course will examine how a healthy soil microbiome are a critical component of healthy soils and how healthy soils influence and contribute to biotic facilitation, nutrient cycling, symbiotic relationships, ecosystem provisioning, regulating, and supporting services. Students will learn the importance of soil structure and composition to rain water and irrigation infiltration. Cover crop dynamics will be explored and the important role cool and warm season cover crops play in regenerative agriculture. The importance of conservation agriculture through no-till and reduced tillage practices will be emphasized. The varied ecosystem services resulting from these and other natural resource conservation measures as they apply to horticultural cropping systems from a regenerative agriculture perspective are fundamental concepts that this course will convey. Topics of study will include the importance of crop selection, soil health, nutrient management, weed management, integrated pest management, phytoremediation, integrated crop-livestock grazing, and perennial/annual horticultural cropping systems.

### HORT 3333. Mushroom Cultivation and Utilization. 3 Credit Hours (Lecture: 2 Hours, Lab: 2 Hours).

Culture techniques, environmental requirements, species selection, and production systems. Current state of mushroom production, innovations, and new opportunities in the field. Intended for majors and non-majors.

### HORT 3370. Floriculture Operations and Management. 3 Credit Hours (Lecture: 2 Hours, Lab: 2 Hours).

Principles and basic techniques in floral design and merchandising, introduction to the floral branch of the horticulture industry and floral production. The course will feature history of floral design, principles of design, design specific lab activities, work with the Floriculture contests in the spring, and hands-on design experience.

### HORT 3390. Horticultural Plants. 3 Credit Hours (Lecture: 2 Hours, Lab: 2 Hours).

Identification, classification, and characteristics of horticultural plants. Includes the study of trees, shrubs, aroids, cacti, bromeliads, ferns, begonias, and orchids. Prerequisite: HORT 1301 or equivalent or approval of department head. Lab fee \$2.

**HORT 3415. Weed Management. 4 Credit Hours (Lecture: 3 Hours, Lab: 3 Hours).**

General principles in the development of weed management programs. Common weed ecology and life cycles, land management factors, herbicide selection and performance, and cultural control strategies are presented. Laboratory includes weed identification and herbicide application methods. Prerequisites: AGRI 1307 and AGRI 1107; or WSES 1305; or HORT 1301.

**HORT 4086. Horticultural Problems. 1-6 Credit Hours (Lecture: 0 Hours, Lab: 1-6 Hours).**

Individualized study of current topics in student's major concentration of study or supporting discipline. Specific content and credit dependent upon student's interest, needs, and depth of study.

**HORT 4088. Undergraduate Research in Horticulture. 1-6 Credit Hours (Lecture: 0 Hours, Lab: 1-6 Hours).**

Fundamental research methods will be addressed through a faculty-directed project. Participation in an abbreviated lecture series may be required. Project components may include a literature review, data collection and analysis, testing, planning, project design, and/or computer modeling. Student may be required to prepare a final report and produce a presentation. Course will be graded as satisfactory or unsatisfactory. Prerequisite: Approval of the instructor.

**HORT 4090. Special Topics. 1-6 Credit Hours (Lecture: 1-6 Hours, Lab: 1-6 Hours).**

Selected topics in horticulture. May be repeated for credit when topics vary.

**HORT 4301. Greenhouse and Nursery Management. 3 Credit Hours (Lecture: 2 Hours, Lab: 2 Hours).**

A study of the variables affecting greenhouse and nursery crop production. Both economic and physical variables will be explored. Particular emphasis will be placed on management techniques used by commercial establishments in producing and marketing ornamental nursery and greenhouse plants. Prerequisites: HORT 1301 and 3300. Lab fee \$2.

**HORT 4320. Landscaping with Native Plants. 3 Credit Hours (Lecture: 3 Hours, Lab: 0 Hours).**

Identification, characterization, and utilization of herbaceous and woody plants indigenous to Texas and other areas useful for landscaping purposes. Principles and procedures of xeriscaping will be emphasized. Field trips will be required. Prerequisite: HORT 1301.

**HORT 4323. Principles of Horticultural Crop Production. 3 Credit Hours (Lecture: 2 Hours, Lab: 2 Hours).**

Students will dig into the intricate world of horticultural cropping systems learning principles, practices, and sustainable management techniques necessary to be successful at commercial fruit and vegetable production. Vegetable production techniques including plant health, nutrient management, integrated pest management, weed management, disease identification, environmental stress resilience, agricultural adaptation, irrigation, conservation agriculture, and ecosystem services are some of the primary topics of study. Additional topics of this course include crop selection, crop rotation, and sustainable farm design to maximize production. Seasonal variations (spring, summer, fall, and winter) that influence crop selection and crop rotation will be presented for the diverse regions of Texas. Each class member will gain practical horticultural crop production through active participation in vegetable production in our horticultural gardens that integrates different fruit and vegetable crops using applied management practices learned in class. Prerequisite: HORT 1301.

**HORT 4324. Organic Agriculture. 3 Credit Hours (Lecture: 3 Hours, Lab: 0 Hours).**

Organic Agriculture will examine a brief history of organic farming, the organic food movement, and modern organic industry development. Students will learn USDA-NOP rules and regulations and the USDA organic certification process needed to certify farms/ranches organic. The course will emphasize the science of horticultural organic crop production (fruits and vegetables) for different agroecosystems and the required organic management principles and practices that meet organic production standards. The course will study different organic agricultural production systems that integrate agroecology, regenerative agriculture, and integrated pest management concepts into organic crop and animal production systems. Organic crop nutrient management, forage and grazing management, plant propagation and greenhouse management, soil health, and pest management (weed, arthropod, and pathogen) are fundamental components of this course.

**HORT 4330. Horticultural Enterprises. 3 Credit Hours (Lecture: 2 Hours, Lab: 2 Hours).**

Horticultural business and educational enterprises will be visited or explored. Students are required to complete a business portfolio which will include photographs and written documents. Prerequisite: Jr or Sr classification. Lab fee: \$2.

**HORT 4342. Study Abroad. 3 Credit Hours (Lecture: 3 Hours, Lab: 0 Hours).**

Conducted at various domestic and international locations for extended periods (frequently outside the United States). Hands-on activities and experiences in agriculture and natural resources. Topics will vary. Enrollment requires a significant study abroad program fee.

**HORT 4470. Turfgrass Management and Irrigation. 4 Credit Hours (Lecture: 3 Hours, Lab: 3 Hours).**

Characteristics and management of turfgrasses used for home lawns, recreational areas and sports fields. Turfgrass irrigation system design. Prerequisites: HORT 2470; or AGRI 1307 and AGRI 1107.

## Soil Science Courses

**SOIL 2112. Soil Morphology. 1 Credit Hour (Lecture: 1 Hour, Lab: 0 Hours).**

Soil morphology, characterizations of soil, and judging of soils for various uses by field-based assessment. May receive credit for WSES 2112 or SOIL 2112.

**SOIL 2375. Soil as the Basis for Society. 3 Credit Hours (Lecture: 3 Hours, Lab: 0 Hours).**

The underpinnings of the scientific principles of soils, how people have harmed them, and why everyone should be concerned with how we treat them. This course may not be used to fulfill the degree requirements for wildlife or ecosystem sciences.

**SOIL 3101. Soil Science Laboratory. 1 Credit Hour (Lecture: 0 Hours, Lab: 4 Hours).**

Basic laboratory techniques used to analyze soil chemical, physical, and biological properties. Hands on examples will demonstrate core soil science principles. Prerequisites: ENVS 3301 or SOIL 3301 (or concurrent enrollment); and CHEM 1311 and 1111, CHEM 1407, or CHEM 1409.

**SOIL 3301. Soil Science. 3 Credit Hours (Lecture: 3 Hours, Lab: 0 Hours).**

Basic principles of soil science, including physical, biological, and chemical properties. Discussion will include soils applications in wildland, cropland, and developed environments. This course does not include a laboratory section. Credit will not be awarded for both this course and WSES 3401. Prerequisites: CHEM 1311 and 1111, CHEM 1407, or CHEM 1409.

**SOIL 3302. Soils, Land Use, and The Environment. 3 Credit Hours (Lecture: 3 Hours, Lab: 0 Hours).**

Interactions among soil physical, chemical, and biological processes affecting soil, water, and environmental quality. Addressed in relation to land use management practices such as erosion control, soil conservation, soil reclamation, riparian buffers, bioswales, and artificial wetlands. Land use planning tools, including WebSoil Survey and GIS will be used. Prerequisites: WSES/ENVS 3401; or WSES/SOIL 3301 and WSES/SOIL 3101.

**SOIL 3319. Composting. 3 Credit Hours (Lecture: 2 Hours, Lab: 2 Hours).**

The art and science of composting of agricultural, municipal, foodservice and household wastes to include composting techniques, waste products and feedstocks, aerobic vs. anaerobic processes, evaluation of composted products and their beneficial uses. Biological processes used to decompose organic materials will be studied. Prerequisites: Junior standing or permission of the instructor.

**SOIL 3412. Soil Genesis, Morphology, and Classification. 4 Credit Hours (Lecture: 3 Hours, Lab: 3 Hours).**

Soil development, classification, and mapping. Laboratory work will consist of field-based study of the morphological features of the soil profile and mapping of designated areas using standardized methods. Student may receive credit for either WSES 3412 or SOIL 3412. Prerequisites: SOIL 3301 and SOIL 3101.

**SOIL 4212. Soil Ecology. 2 Credit Hours (Lecture: 2 Hours, Lab: 0 Hours).**

Characterizations of organisms in the soil food web, analyses of interrelationships among soil organisms, and assessments of interactions between soil organisms and their environmental conditions. Credit will only be given for WSES 4212 or SOIL 4212. Prerequisites: WSES 2405, SOIL 3301, and SOIL 3101.

**SOIL 4213. Soil Physical Properties. 2 Credit Hours (Lecture: 2 Hours, Lab: 0 Hours).**

Soil physical characteristics and their relationship to soil management. Methods of measuring soil and soil conservation. Soil phases, soil water properties, particle size, clay and clay mineralogy, and environmental impacts. Credit will only be given for WSES 4213 or SOIL 4213. Prerequisites: SOIL 3301 and SOIL 3101.



**SOIL 4450. Soil Nutrient Cycling. 4 Credit Hours (Lecture: 3 Hours, Lab: 3 Hours).**

Plant nutrition, soil nutrient cycling, and nutrient management. Biological, physical, and chemical soil properties and implications for nutrient availability to crops and nutrient fate in the environment. Plant nutrition and soil fertility problems and corrective action, soil and nutrient management. Credit will only be given for WSES 4450 or SOIL 4450. Prerequisites: SOIL 3301 and SOIL 3101.

**Wildlife, Sustainability, and Ecosystem Sciences Courses****WSES 1100. Transitioning to University Studies in the Natural Resource Sciences. 1 Credit Hour (Lecture: 1 Hour, Lab: 1 Hour).**

Practical study designed to prepare the student for university life, aid in development of skills for academic success, promote personal growth and responsibility, encourage active involvement in the learning process from an individual college perspective, and introduce students to the field of wildlife, sustainability, and ecosystem sciences. Prerequisites: Major in WSES or approval of the instructor.

**WSES 1119. Natural Resource Competition I. 1 Credit Hour (Lecture: 1 Hour, Lab: 0 Hours).**

This course provides an introduction to various natural resource-based competitive events. Competition rules, conduct, and etiquette are discussed. The students are introduced to basic facts regarding their chosen field of study. Prerequisites: Approval of the instructor.

**WSES 1301. Society, Natural Resources, and the Environment. 3 Credit Hours (Lecture: 3 Hours, Lab: 0 Hours).**

This course provides a broad overview of the role of the environment and natural resources in human society, with particular emphasis on Texas and the United States. A history of the environmental movement is presented. Students study the importance of natural resources in providing basic human necessities, and how these resources are managed. Various careers in environmental science, natural resource management, and wildlife conservation are also discussed.

**WSES 1307. Concepts and Controversies in Food Studies. 3 Credit Hours (Lecture: 3 Hours, Lab: 0 Hours).**

Principles of food studies and exploration of the role food narratives and exposés play in the consumer's perception of the current food supply. Foundation for understanding the connections among food production, ecology, ethics, cuisine, nutrition and health within the framework of sustainability. Can receive credit for either FDSC 1307 or WSES 1307.

**WSES 2119. Natural Resource Competition II. 1 Credit Hour (Lecture: 1 Hour, Lab: 0 Hours).**

Intended for students with basic understanding of the conduct of their chosen natural resource event, this course provides more advanced study of the topic. Students expand upon the introductory material discussed in Natural Resource Competition I to include a wider array of natural resource science related facts and concepts. Prerequisites: WSES 1119 or approval of the instructor.

**WSES 2301. General Entomology. 3 Credit Hours (Lecture: 2 Hours, Lab: 2 Hours).**

Principal orders of insects; the relation of anatomy and physiology of insects to control methods; insecticides and their uses; development, habits, and economic importance of more common insects with control methods for the injurious species. Prerequisite: C or better in BIOL 1406 or BIOL 1407.

**WSES 2322. Principles of Wildlife Conservation and Management. 3 Credit Hours (Lecture: 3 Hours, Lab: 0 Hours).**

An in-depth treatment of the fundamental principles of wildlife conservation and management, stressing the application of ecological principles to achieve wildlife management objectives. Topics include conservation, management, and restoration of wildlife habitats; wildlife population assessment and management; human dimensions and human-wildlife interactions; management of wildlife in agricultural, range, and forested ecosystems; and wildlife policy at the local, state, national, and international level. Provides knowledge and understanding required for advancing in the wildlife and natural resource conservation disciplines. Satisfies requirements for Wildlife Science majors. Prerequisite for advanced wildlife science courses. Prerequisites: Grade of C or better in BIOL 1406 and BIOL 1407; grade of C or better in MATH 1316 or MATH 2412; and grade of C or better in WSES 2405, RNRM 3315, or BIOL 4401.

**WSES 2405. Ecology for Natural Resource Managers. 4 Credit Hours (Lecture: 3 Hours, Lab: 3 Hours).**

A study of the interactions of plants, animals, and the environment and how these interactions respond to human influence. Emphasis will be placed on terrestrial ecosystems (rangelands, grasslands, deserts, wetlands, and forests), and specific interactions among species which can be manipulated to achieve management outcomes. The laboratory will have a significant outdoor field component. Credit will not be awarded for both WSES 2405 and WSES 3103. Prerequisite: Grade of C or better in BIOL 1406 OR BIOL 1407.

**WSES 2451. Introduction to Geographic Information Systems. 4 Credit Hours (Lecture: 3 Hours, Lab: 2 Hours).**

Basic concepts of design, planning and implementation of geographic information systems. Students will learn how to create, manipulate, project, and interpret geographic information. Students are encouraged to take GEOG 1451: Pre-GIS before this course. Can receive credit for either WSES 2451, GEOG 2451, EASC 2451 or ENVS 2451. Lab fee: \$2.

**WSES 3103. Ecological Field Methods Laboratory. 1 Credit Hour (Lecture: 0 Hours, Lab: 4 Hours).**

Field methodologies used in the investigation of ecological systems including terrestrial plant, terrestrial animal, and aquatic systems. For students who have completed an introductory ecology or environmental biology course with no laboratory component. Credit will not be offered for both WSES 3103 and WSES 2405. Prerequisites: Grade of C or better in an approved 1000- or 2000-level ecology or environmental biology course; and a grade of C or better in BIOL 1406; and a grade of C or better in either BIOL 1407 or GEOL 1407; or approval of the department head.

**WSES 3112. Dendrology Lab. 1 Credit Hour (Lecture: 0 Hours, Lab: 3 Hours).**

Laboratory section to accompany WSES 3312. Hands-on study and identification of woody plants, including trees, shrubs, and vines. Morphological, ecological and phenological traits will be used in field identification. Proficiency in the use of a dichotomous key to identify plant species will be stressed. Prerequisite: Concurrent registration with WSES 3312.

**WSES 3119. Natural Resource Competition III. 1 Credit Hour (Lecture: 1 Hour, Lab: 0 Hours).**

This course is a more advanced treatment of the student's chosen natural resource event. It is intended for students with experience in the competition, having participated in at least one competitive event. Prerequisite: WSES 2119 and approval of the instructor.

**WSES 3303. Veterinary Entomology. 3 Credit Hours (Lecture: 2 Hours, Lab: 2 Hours).**

Classification, biology, and control of arthropods associated with livestock and wildlife. Identification will be emphasized in the laboratory. Prerequisites: BIOL 1406 and BIOL 1407, or approval of the instructor.

**WSES 3304. Food Processing. 3 Credit Hours (Lecture: 2 Hours, Lab: 3 Hours).**

The world food supply, trends and traditions in diet and food sanitation, safety, security, and biotechnology, and impact of processing on diet quality. Lab fee: \$2.

**WSES 3305. GIS for Natural Resource Scientists. 3 Credit Hours (Lecture: 2 Hours, Lab: 2 Hours).**

An intermediate course on the use of geographic information systems (GIS) in natural resource management. Builds on concepts learned in introductory GIS course. Laboratory exercises will apply knowledge learned in lectures to solve real world problems in natural resource management using GIS software. Prerequisite: WSES 2451 or GEOG 2451 Lab fee \$2.

**WSES 3307. Systems Thinking. 3 Credit Hours (Lecture: 2 Hours, Lab: 2 Hours).**

This course focuses on the examination and analysis of complex systems, particularly in the environmental, natural resources, and sustainability fields. Major topics will include system structure, system behavior, feedback loops, stock and flow models, non-linear and emergent properties, self-organization, and the application of systems thinking to problem-solving. A significant component of the course will be development and analysis of computer models of complex systems. Prerequisite: C or better in MATH 1314 or equivalent, or approval of the instructor. Lab fee: 2.

**WSES 3308. Analysis of Natural Resource Data. 3 Credit Hours (Lecture: 2 Hours, Lab: 2 Hours).**

Application of statistical principles to the analysis of natural resource science data. Methods of designing studies, managing and analyzing data, and interpreting results. Descriptive statistics, estimation, inference, tests of significance, measurements of relationship and correlation, and non-parametric analyses. Prerequisite: Grade of C or better in MATH 1342 or MATH 3450.

**WSES 3309. Aquaponics. 3 Credit Hours (Lecture: 2 Hours, Lab: 2 Hours).**

Students will examine the pros and cons of various aquaponics methods like raft, nutrient film, vertical towers, and media filled beds and their applications for growing fish and plants sustainably for a family/community or for profit. Students will construct a backyard aquaponics system, establish/harvest plants, and prepare a meal in laboratory. Topics covered are plant and fish choices and recommendations; planting/growing techniques; fish biology, stocking rates, and feeds; plant/fish care and health; water quality; system design, filtration and plumbing components; daily operation; greenhouse management/seasonal adjustments; system start up; food preparation; economics and business considerations.

**WSES 3310. Wildlife Management Techniques. 3 Credit Hours (Lecture: 2 Hours, Lab: 2 Hours).**

Field and laboratory techniques used in wildlife management and research. Determining age and food habits, population analysis, habitat analysis, and introduction to research. Modest cost of field trips will be borne by student. Prerequisites: Grades of C or better in WSES 2322, and either MATH 1316 or MATH 2412.

**WSES 3311. Wildlife Diseases. 3 Credit Hours (Lecture: 3 Hours, Lab: 0 Hours).**

Basic mechanisms of disease as they occur in wildlife populations; interplay of environmental conditions, individual physiological requirements, and disease agents of various wildlife species. Epidemiology and management of infectious and non-infectious diseases. Prerequisites: Grade of C or better in WSES 2322 or approval of instructor.

**WSES 3312. Dendrology. 3 Credit Hours (Lecture: 3 Hours, Lab: 0 Hours).**

Study of woody plants, including trees, shrubs, and vines. Morphological, ecological and phenological traits will be used in field identification. The distribution, habitat, ecology, and importance of these species to wildlife and people will be explored, including community dynamics and the effects of disturbance and succession. Proficiency in the use of a dichotomous key to identify plant species will be stressed. Prerequisite: WSES 2405 or BIOL 4401; concurrent registration with WSES 3112.

**WSES 3313. Plant Diversity and Conservation. 3 Credit Hours (Lecture: 3 Hours, Lab: 0 Hours).**

Patterns and distribution of plant diversity and threats to plant diversity. Plant communities found in a variety of range, forests, and other systems. Strategies and approaches used in plant conservation will be discussed. Prerequisite: Grade of C or better in WSES 2405, RNRM 3315, or BIOL 4401.

**WSES 3314. Pollinator Ecology and Conservation. 3 Credit Hours (Lecture: 2 Hours, Lab: 2 Hours).**

Plant-insect interactions concerning floral resources and the conservation of pollinator insects. Floral morphology, coevolution of plant and pollinator, insect ecology and behavior, management of honeybees for commercial purposes, managing pollinators in urban and suburban settings, and conservation of pollinator habitat. Identifications of major pollinator insect groups, and techniques to monitor native pollinators and floral resources. Prerequisites: Grade of C or better in WSES 2405 or BIOL 4401; and ENTO 3312.

**WSES 3315. Sustainability. 3 Credit Hours (Lecture: 3 Hours, Lab: 0 Hours).**

Explore the varied perspectives of sustainability and analyze factors that contribute to or decrease system sustainability. Investigation of the social, economic, and environmental barriers to achieving sustainable systems and options for overcoming these barriers. Credit will be awarded only for POLS 3315, ENVS 3315, or WSES 3315. Prerequisite: GOVT 2305 or GOVT 2306 or POLS 2304 or approval of the instructor.

**WSES 3319. Composting. 3 Credit Hours (Lecture: 2 Hours, Lab: 2 Hours).**

The art and science of composting of agricultural, municipal, foodservice and household wastes to include composting techniques, waste products and feedstocks, aerobic vs. anaerobic processes, evaluation of composted products and their beneficial uses. Biological processes used to decompose organic materials will be studied. Prerequisites: Junior standing or permission of the instructor.

**WSES 3320. Watershed Management. 3 Credit Hours (Lecture: 3 Hours, Lab: 0 Hours).**

Management and planning of range or forest land watersheds for maintenance or improvement of water and soil resources. Effects of vegetation and land management practices on water quality and quantity, erosion, and sedimentation. Prerequisite: Grade of C or better in WSES 2405, RNRM 3315, or BIOL 4401.

**WSES 3323. Ethical Issues in Agriculture and the Natural Resources. 3 Credit Hours (Lecture: 3 Hours, Lab: 0 Hours).**

Students will examine the several major ethical issues facing agriculture and natural resources sciences in our current society. Readings, discussions and lectures will focus on the scientific, capitalistic, and philosophical motivation in common ethical issues. Upon completion of the course, students will be able to construct and dissect ethical arguments and hopefully become more aware of the ethical dilemmas we all face each day.

**WSES 3340. Fisheries Conservation and Management. 3 Credit Hours (Lecture: 3 Hours, Lab: 0 Hours).**

Fundamentals of fisheries management population estimation and management, harvest management, applicable state and federal laws, invasive species management, and human dimensions. Prerequisites: Grade of C or better in WSES 2322.

**WSES 3350. Writing for the Natural Resource and Environmental Sciences. 3 Credit Hours (Lecture: 3 Hours, Lab: 0 Hours). [WI (<http://catalog.tarleton.edu/academicaffairs/>)]**

Use of appropriate strategies to produce written professional and interpretive documents for wildlife and natural resource audiences. Prerequisites: ENGL 1301 and 1302.

**WSES 3375. Population, Pollution, and Resource Depletion. 3 Credit Hours (Lecture: 3 Hours, Lab: 0 Hours).**

Principles and philosophies associated with the development, management, and use of natural resources are studied in the relationship to the ecological and social implications inherent in management alternatives involving the natural environmental and the use of renewable natural resources. Can receive credit for either ENVS 3375 or WSES 3375. Prerequisite: junior classification.

**WSES 3380. Ecological Pest Management. 3 Credit Hours (Lecture: 3 Hours, Lab: 0 Hours).**

An introduction to the principles of managing pest populations to reduce economic and ecological loss in agriculture, horticulture, domestic, and natural settings in an environmentally compatible manner. Information gleaned from this course should prepare students to apply for state certification as a licensed pesticide applicator. Prerequisites: WSES 2405 and either WSES/ENTO 3312 or WSES 2301.

**WSES 3385. Fish and Wildlife Laws and Administration. 3 Credit Hours (Lecture: 3 Hours, Lab: 0 Hours). [WI (<http://catalog.tarleton.edu/academicaffairs/>)]**

A review and analysis of state and federal laws and international treaties and conventions affecting fish and wildlife; their application and administration. The organizational structure of state, federal and international agencies; their objectives, policies and practices. Prerequisites: GOVT 2305 and GOVT 2306 or; core complete in the Government/Political Science component area.

**WSES 3386. Human Dimensions of Fish and Wildlife Management. 3 Credit Hours (Lecture: 3 Hours, Lab: 0 Hours).**

Today's natural resource scientist must interact with diverse publics and stakeholders to achieve conservation goals. Few professionals receive training to navigate the murky waters of human dimensions of natural resources management. This course will give students an understanding of ways in which elements of human psychology and society shape our perceptions and management of wildlife and fisheries resources, and how to interact with these stakeholders to achieve ecologically-sound management and conservation. Prerequisite: Grade of C or better in WSES 2322.

**WSES 3387. Natural Resource Conservation Outreach and Interpretation. 3 Credit Hours (Lecture: 2 Hours, Lab: 2 Hours).**

Survey of the history, principles, and content of the Texas Master Naturalist Program as an example of education, public outreach, volunteerism, and interpretation in natural resource conservation and management. Classroom and field instructional modules of foundational concepts and regional specifics about biotic and abiotic natural resources. Principles of interpretation and written analysis of observed teaching and interpretive activities by resource specialists. Students who co-register with the Prairie Oaks Chapter of the Texas Master Naturalist program and complete all class activities can satisfy a portion of the requirements for certification as a Texas Master Naturalist. Attendance at occasional weekend field trips required.



**WSES 3403. Natural History of the Vertebrates. 4 Credit Hours (Lecture: 3 Hours, Lab: 3 Hours).**

Survey of vertebrate taxa, including systematics, taxonomy, anatomy, physiology, and ecology. Identification in laboratory and field. Students required to handle preserved and live specimens. Students required to bear the cost of multiple overnight and multi-day field trips. Prerequisites: Grade of C or better in BIOL 1406 and BIOL 1407.

**WSES 3404. The Vertebrate Fauna of Southern Africa. 4 Credit Hours (Lecture: 0 Hours, Lab: 4 Hours).**

A general discussion of the animals of southern Africa, with particular focus on vertebrates. The course will stress both field identification and the ecological role of various animal species. Other topics will include the use of dichotomous keys and field guides for animal identification, the use of various methods to capture and count animal species, and the interspecific interactions. This is a field-based course that will be conducted entirely at various sites in southern Africa. Students will be required to handle small mammals and other live animals. Certification by a physician that the student has a current rabies vaccine may be required for participation in the course. Enrollment in the Southern Africa Study Abroad Program and payment of all associated fees is required. Prerequisite: Concurrent enrollment in WSES 4342; permission of the instructor.

**WSES 3406. Wildland Plant Identification and Ecology. 4 Credit Hours (Lecture: 3 Hours, Lab: 3 Hours).**

Identification and classification of grasses and other herbaceous plants in the North America, with emphasis on distribution, ecology, and economic value of species found in rangeland, forest, grassland, desert, and wetland systems in Texas. Proficiency in the use of a dichotomous key to identify plant species will be emphasized. Prerequisite: WSES 2405, RNRM 3315, or BIOL 4401.

**WSES 3408. Dendrology and Woody Plant Identification. 4 Credit Hours (Lecture: 3 Hours, Lab: 3 Hours).**

Study of woody plants, including trees, shrubs, and vines. Morphological, ecological and phenological traits will be used in field identification. The distribution, habitat, ecology, and importance of these species to wildlife and people will be explored, including community dynamics and the effects of disturbance and succession. Proficiency in the use of a dichotomous key to identify plant species will be stressed. Prerequisite: WSES 2405, RNRM 3315, or BIOL 4401.

**WSES 3409. The Flora of Southern Africa. 4 Credit Hours (Lecture: 0 Hours, Lab: 4 Hours).**

A general discussion of the plants of southern Africa, with particular focus on gymnosperms and angiosperms. The course will stress both field identification and the ecological role of various plant species. Other topics will include the use of dichotomous keys and field guides for plant identification, response of plants to range management practices, and the role of individual species in the management of wildlife habitat. This is a field-based course that will be conducted entirely at various sites in southern Africa. Enrollment in the Southern Africa Study Abroad Program and payment of all associated fees is required. Prerequisite: Concurrent enrollment in WSES 4342; permission of the instructor.

**WSES 4084. Internship in the Natural Resource Sciences. 1-6 Credit Hours (Lecture: 0 Hours, Lab: 1-6 Hours).**

Formally arranged and approved on-the-job training with a cooperating sponsor in government or private sector of the natural resources or environmental field. A minimum of 75 hours of training is required for each hour of academic credit. A maximum of six hours of credit may be earned. A written report or other artifact of the experience may be required. Course will be graded as satisfactory or unsatisfactory. Prerequisite: Approval of the instructor.

**WSES 4086. Problems in Natural Resource Sciences. 1-6 Credit Hours (Lecture: 0 Hours, Lab: 1-6 Hours).**

Individualized study of current topics in wildlife, natural resources, environmental science, or related discipline. Specific content and credit depend upon student's interests, needs, and depth of study. May be repeated as topics vary. Prerequisite: approval of instructor.

**WSES 4088. Undergraduate Research in the Natural Resource Sciences. 1-6 Credit Hours (Lecture: 0 Hours, Lab: 1-6 Hours).**

Fundamental research methods will be addressed through a faculty-directed project. Participation in an abbreviated lecture series may be required. Project components may include a literature review, data collection and analysis, testing, planning, project design, and/or computer modeling. The student may be required to prepare a final report and produce a presentation. Course will be graded as satisfactory or unsatisfactory. Prerequisite: Approval of the instructor.

**WSES 4090. Special Topics in the Natural Resource Sciences. 1-6 Credit Hours (Lecture: 0-6 Hours, Lab: 0-6 Hours).**

Selected topics in wildlife, natural resources, environmental science, or related discipline. May be repeated for credit when topics vary.

**WSES 4119. Natural Resource Competition IV. 1 Credit Hour (Lecture: 1 Hour, Lab: 0 Hours).**

This course is intended for highly advanced students who have developed significant experience and competencies in their respective natural resource competition. Students will be expected to take a leadership role on the Tarleton State University Quiz Bowl Team and demonstrate significant ability during practice and competitive events. Prerequisite: WSES 3119 and approval of the instructor. Prerequisites: WSES 3119 and approval of the instructor.

**WSES 4185. Seminar. 1 Credit Hour (Lecture: 1 Hour, Lab: 0 Hours).**

Discussions of issues and developments in agriculture, natural resources, or environmental sciences.

**WSES 4187. Senior Capstone Seminar. 1 Credit Hour (Lecture: 1 Hour, Lab: 0 Hours).**

This one-hour seminar is designed to provide students with skills at synthesizing and presenting the results of lower-division work, specifically applied learning experiences such as internships, undergraduate research, and study abroad. Course will include a writing and public speaking component. Prerequisites: Successful completion of WSES 4084, WSES 4088, WSES 4340, or WSES 4342, or approval of the Department Head.

**WSES 4301. Population Dynamics, Modeling, and Analysis. 3 Credit Hours (Lecture: 2 Hours, Lab: 2 Hours).**

An introduction to population biology, including models of simple population growth, competition, and predator-prey interactions; demographic rates; and life tables. Prerequisites: Grade of C or better in WSES 2322; and a grade of C or better in MATH 1342 or MATH 3450; or approval of instructor.

**WSES 4302. Habitat Management. 3 Credit Hours (Lecture: 3 Hours, Lab: 0 Hours).**

Application of ecological principles to the management of native plant communities. Particular focus will be on plant ecology and physiology and their role in the conservation and management of wildlife habitat. Prerequisite: Grade of C or better in WSES 2322, or approval of the instructor.

**WSES 4303. Ecological Restoration. 3 Credit Hours (Lecture: 2 Hours, Lab: 2 Hours).**

Landscape-scale, process-oriented approaches to ecological restoration. Enhancing resource capture, techniques in re-vegetation, and restoration of historic vegetation. Prescribed fire and grazing as restoration and management techniques for range and forest systems. Prerequisites: BIOL 3415, RNRM 3300, WSES 3406, or WSES 3408; and a grade of C or better in WSES 2405, RNRM 3315, or BIOL 4401.

**WSES 4304. Population Genetics. 3 Credit Hours (Lecture: 3 Hours, Lab: 0 Hours).**

An exploration of the principles of population genetics. Lecture will be a discussion of factors affecting the dynamics of allelic frequencies and the population-level consequences of manipulating these factors. Lecture topics will include the effects of selection, mutation, population size and genetic drift, neutral theory, population structure, inbreeding, and linkage disequilibrium. A significant portion of the class will be dedicated to working on problem sets to provide an empirical connection to population genetic theories. Prerequisite: BIOL 3303, BIOL 3403, or AGRI 3409.

**WSES 4305. Urban Wildlife and Fisheries. 3 Credit Hours (Lecture: 3 Hours, Lab: 0 Hours).**

This course trains students to establish and maintain diverse, self-sustaining urban wildlife and fish populations at levels in harmony with ecological, social, and economic values of the human community and to develop optimal levels of public appreciation and use of urban wildlife and fish resources and associated habitats. Includes discussions on conservation education as a tool for furthering urban wildlife and fisheries appreciation.

**WSES 4306. Water Resources Policy and Management. 3 Credit Hours (Lecture: 3 Hours, Lab: 0 Hours).**

This course will present an overview of water policy, laws and regulations related to ecosystem resource management focusing on water quality, water quantity and water as habitat. Major US and Texas environmental laws regarding water will be covered including the respective agencies involved with regulations. Case studies will facilitate discussion of science-policy interactions with resource management in the implementation of these laws and regulations. Credit for SOCI 4306, WSES 4306, and SOCI 5306 will not be awarded.

**WSES 4308. Horticultural Entomology. 3 Credit Hours (Lecture: 2 Hours, Lab: 2 Hours).**

Identification, nature of injury, life history, and control of common insects and related arthropods attacking turf grasses, landscape plants, shade, fruit, and nut trees, and greenhouse succulents. Management and control strategies utilizing chemical, cultural, and biological control agents.

**WSES 4309. Plant-Animal Interactions. 3 Credit Hours (Lecture: 3 Hours, Lab: 0 Hours). [WI (<http://catalog.tarleton.edu/academicaffairs/>)]**

Arthropods and vertebrates in aquatic, terrestrial, managed, and natural systems spanning multiple scales and levels of organization. Prerequisite: Grade of C or better in WSES 2405, RNRM 3315, or BIOL 4401.

**WSES 4310. Zoo Biology and Management. 3 Credit Hours (Lecture: 3 Hours, Lab: 0 Hours).**

Biology and management of zoo animals, and the management of zoos. Nutrition, reproduction, behavior, care, and welfare of confined wildlife species. Captive breeding, genetics, herd management, record keeping, and conservation biology. History of zoos and their role in conservation. Zoo exhibits and outreach, legal aspects, and ethics of confined wildlife management. Prerequisite: Grade of C or better in WSES 2322.

**WSES 4311. Fire Ecology. 3 Credit Hours (Lecture: 2 Hours, Lab: 2 Hours).**

Ecological role of fire in natural systems, including rangelands, grasslands, shrublands, woodlands, and forests; adaptations of plants and animals to fire; long-term controls on wild fire; use of fire as an ecosystem management tool, with aspects of wildland firefighting; and prescribed burning, including fire behavior, fuels, weather, politics and policy. Hands-on prescribed burning experiences as circumstances and weather permit. Prerequisite: WSES 2405, RNRM 3315, or BIOL 4401.

**WSES 4313. Vegetation Measurement, Inventory, and Monitoring. 3 Credit Hours (Lecture: 2 Hours, Lab: 2 Hours).**

Vegetation sampling, measurement, monitoring, inventory, study design, and quantitative and statistical analysis. Assessment of range condition and forest health based on understanding ecological processes. Hands-on, field-based laboratory. Prerequisite: WSES 3406 or WSES 3408.

**WSES 4318. Spatial Ecology and Conservation Modeling. 3 Credit Hours (Lecture: 2 Hours, Lab: 2 Hours).**

Applications of Remote Sensing and GIS techniques in natural resources, landscape ecology, and spatial ecology. Contemporary modeling techniques such as species distribution, habitat suitability, and occupancy models in the broader landscape context. Credit will not be awarded for WSES 4318 and WSES 5318. Prerequisite: WSES 2405; GEOG, WSES, ENVS, or EASC 2415.

**WSES 4324. Organic Agriculture. 3 Credit Hours (Lecture: 3 Hours, Lab: 0 Hours).**

Organic agriculture will examine a brief history of the industry development, changes in the structure and industry, USDA NOP rules and regulations, and certification to provide a scope of understanding for the course. The majority of the course will focus on the mechanics of crop and vegetable production in an organic system including seed sources, planting considerations, environment, soil fertility, plant nutrition, soil preparation, weed control methods, insect and disease prevention, rules in applications, harvest issues, and marketing.

**WSES 4325. Crop Production and Management. 3 Credit Hours (Lecture: 3 Hours, Lab: 0 Hours).**

Current concepts and practices in field crop production with emphasis on the applications of technology. Recognition and discussion of cultural practices, fertilization, irrigation, weed and pest control from economic and environmental perspectives. Review of crop improvement strategies and bio-engineering. Prerequisites: SOIL 3301, SOIL 3101, AGRI 1307, and AGRI 1107.

**WSES 4326. Big Game Ecology and Management. 3 Credit Hours (Lecture: 2 Hours, Lab: 2 Hours).**

Survey of the distributions and life histories of North American big game species. Detailed examination of the biology and habitat relationships of several big game species, especially as they relate to management. Other topics include population dynamics, diet, economic significance, and conservation strategies. Modest cost of field trips will be borne by the student. Prerequisite: A grade of C or better in WSES 2322, or approval of the instructor.

**WSES 4327. Avian Ecology and Management. 3 Credit Hours (Lecture: 2 Hours, Lab: 2 Hours).**

A study of major wild bird groups, their interactions with their environment, and how these interactions can be manipulated to achieve management objectives. Course emphasis will be on species of conservation significance, including game, nongame, and vulnerable species. Major topics will include population management of migratory and non-migratory birds, habitat management, and wildlife policy consideration unique to bird conservation. Modest cost of field trips will be borne by the student. Prerequisite: A grade of C or better in WSES 2322, or approval of the instructor.

**WSES 4335. Food and Culture. 3 Credit Hours (Lecture: 2 Hours, Lab: 3 Hours).**

A study of the food beliefs and practices of the major ethnic and religious groups in the U. S. and the nutritional implications of these food practices, a cultural analysis of American food trends; ethnic issues and dietary changes; and research methods in food habits. Lab fee: \$25.

**WSES 4340. Field Camp. 3 Credit Hours (Lecture: 0 Hours, Lab: 6 Hours).**

A field course during which students learn a variety of skills necessary for a career as a wildlife biologist, fisheries biologist, range scientist, or other natural resource professional. Camp will be conducted away from the Tarleton campus, under primitive living conditions and adverse weather conditions. Camp will be scheduled M-F for two consecutive weeks and students will live at the camp location for the duration of the course. Students may be assessed a program fee to cover cost of meals. Prerequisite: Permission of the instructor.

**WSES 4341. Southern African Ecology and Culture. 3 Credit Hours (Lecture: 3 Hours, Lab: 0 Hours).**

Ecology of southern Africa, including climate, soils, vegetation, and wildlife. Ecological interactions with development, agriculture, and tourism. Identification and ecology of bird and large mammal species. Conservation of rare, threatened, and endangered species. Culture, politics, and history from the pre-Colonial Period through today, with emphasis on their effects on management of natural resources. Focuses mainly on South Africa, Botswana, Zambia, and Namibia.

**WSES 4342. Study Abroad. 3 Credit Hours (Lecture: 3 Hours, Lab: 0 Hours).**

Conducted at various domestic and international locations for extended periods (frequently outside the United States). Hands-on activities and experiences in agriculture and natural resources. Topics will vary. Enrollment requires a significant study abroad program fee.

**WSES 4401. Ethology. 4 Credit Hours (Lecture: 3 Hours, Lab: 4 Hours).**

An introductory course in the behavior of animals, with emphasis on the natural selection, ontogeny, and function of behaviors as they relate to feeding, reproduction, predator-avoidance, and other traits. Both proximate (sensory, hormonal, genetic) and ultimate (ecological and evolutionary) mechanisms are addressed. Prerequisite: C or better in BIOL 1406 and BIOL 1407, and a C or better in either AGRI 1419 or WSES 2322. Lab fee: \$2.

**WSES 4407. Fermentation and Brewing. 4 Credit Hours (Lecture: 3 Hours, Lab: 3 Hours).**

This course provides a basic understanding of the history of food safety, sanitation, fermentation, fermented foods, beer brewing, wine and cheese making, along with an introduction to industry organization; from commodities production, to processing, distribution, marketing, and sales. The course provides direct hands-on instruction in small-scale brewing. It combines elements of science (chemistry, biology, and physics), economics, food preparation, aesthetics, preferences, and taste. Modest cost of field trips will be borne by the student. Prerequisites: Senior classification and completion of 8 hours of BIOL and 8 hours of CHEM; or approval of the instructor. Must be 21 years of age or older on the first class day to enroll in this course.

**WSES 4408. Sustainable Food Systems. 4 Credit Hours (Lecture: 3 Hours, Lab: 3 Hours).**

This course will survey issues surrounding food production and examine the environmental and social impact of current food production systems. Specific emphasis will be placed on emerging trends to increase the sustainability of food production, distribution, and consumption. This course includes a laboratory field component and will require some field work outside normal class times. Lab fee: \$2.

**WSES 4410. Genomics. 4 Credit Hours (Lecture: 3 Hours, Lab: 3 Hours).**

An exploration of practical applications for high throughput DNA sequencing technology. Hands-on research projects will provide experience in proper sample collection and preparation, automated robotic DNA library preparation, DNA barcoding, quality control metrics, instrument loading and run initiation, and an overview of data processing for a single instrument run generating hundreds of millions of DNA sequences. Prerequisite: BIOL 3303 or AGRI 3409 Lab fee: \$2.