ANIMAL AND RANGE SCIENCES

Undergraduate Program Information

The Department of Animal and Range Sciences provides opportunities for you to follow a variety of interests in modern scientific agriculture. The animal science curriculum provides a background for many phases of the food animal industry, from farm animal production on rangelands to management positions in the food processing industry to highly technical careers in research and companion animal management. The range science curriculum provides you with knowledge and skills necessary to sustainably manage rangelands for multiple uses. These curricula allow you to acquire the background necessary to adjust easily to variations in specific job opportunities. If you are majoring in either animal science or range science, you must meet general education requirements, have a minimum of 48 credits of upper-division courses (numbered 300 and above), and complete a minimum of 35 credits in courses in the College Agricultural, Consumer and Environmental Sciences.

Graduate Program Information

The Department of Animal and Range Sciences offers graduate work leading to the Master of Science and the Doctor of Philosophy degrees with majors in animal science and range science. The Doctor of Philosophy degree in animal science is only in the areas of reproductive physiology or ruminant nutrition.

Prerequisite for admission as a regular graduate student in the department is the completion of a curriculum, substantially equivalent to that required of undergraduate students in animal or range science at this institution, 3.0 GPA, and three letters of reference.

For the Master of Science degree, a minimum of 30 semester credits of graduate work in the major and related subjects will be required, together with a thesis for most majors. A non-thesis option is available for certain students.

For the Master of Agriculture with specialization in Domestic Animal Biology, students must complete 32 credit hours of graduate courses which include 2 credits of ANSC 598 Special Research Programs for the creative component.

The Doctor of Philosophy student must demonstrate proficiency in a foreign language or research tool, such as experimental statistics, philosophy of science, computer science, or mathematics. Choice of the research tool will remain the option of the student subject to approval by the student's graduate committee. Demonstration of proficiency may be accomplished by satisfactory completion of courses or by other suitable evidence acceptable to the student's committee. In addition, doctoral students are required to complete advanced courses in a field of study closely related to animal science or range science. The number of courses to be completed in the related area will be determined by the student's committee. Related areas of study often are biology, chemistry, or experimental statistics.

The Department of Animal and Range Sciences is a sponsoring department in the recently approved interdisciplinary graduate degree program that offers both a MS and Ph.D. degree in Water Science Management. The degree program is being handled through the College of Agricultural, Consumer and Environmental Sciences (ACES), and the program description, including application guidelines, classes involved, and topic areas being supported can be found in the catalog under the section describing ACES Programs. Interested students are encouraged to contact the Department Head of Animal and Range Sciences, Shanna Ivey at (575) 646-2515 for more information.

Graduate work in the department is designed to prepare the student for work in the fields of research, extension, teaching, production, and conservation.

Facilities available to graduate students include herds and flocks of the major livestock species, animal nutrition laboratories, physiology laboratories, meats laboratory, small animal laboratory, 25,000-specimen herbarium, two ranches of approximately 92,000 acres, and a 1,000-head experimental feedlot. Active cooperation is maintained with federal research agencies located on and off the campus.

A number of graduate assistantships will be available each year. Inquiries should be addressed to the head of the department.

Degrees for the Department

Bachelor Degree(s)

- Animal Science (Animal Industry) - Bachelor of Science in Agriculture (https://catalogs.nmsu.edu/nmsu/agricultural-consumer-environmental-sciences/animal-range-sciences/animal-science-animal-industry-bachelor-science-agriculture/)
- Animal Science (Science) - Bachelor of Science in Agriculture (https://catalogs.nmsu.edu/nmsu/agricultural-consumer-environmental-sciences/animal-range-sciences/animal-science-science-bachelor-science-agriculture/)
- Range Science - Bachelor of Science in Agriculture (https://catalogs.nmsu.edu/nmsu/agricultural-consumer-environmental-sciences/animal-range-sciences/range-science-bachelor-science-agriculture/)

Master Degree(s)

- Agriculture (Domestic Animal Biology) - Master of Agriculture (https://catalogs.nmsu.edu/nmsu/graduate-school/agriculture-domestic-animal-biology-ma-agriculture/)
- Agriculture (Domestic Animal Biology) - Master of Agriculture (Online) (https://catalogs.nmsu.edu/global/nmsu-global/agriculture-domestic-animal-biology-master-agriculture-online/)
- Animal Science - Master of Science (https://catalogs.nmsu.edu/nmsu/graduate-school/animal-science-ma-science/)
- Mathematics - Graduate Minor (https://catalogs.nmsu.edu/nmsu/graduate-school/mathematics-graduate-minor/)
- Music (Collaborative Piano) - Master of Music (https://catalogs.nmsu.edu/nmsu/graduate-school/music-collaborative-piano-master-music/)
- Range Science - Master of Science (https://catalogs.nmsu.edu/nmsu/graduate-school/range-science-master-science/)

Doctoral Degree(s)

- Animal Science - Doctor of Philosophy (https://catalogs.nmsu.edu/nmsu/graduate-school/animal-science-doctor-philosophy/)
- Mathematics - Graduate Minor (https://catalogs.nmsu.edu/nmsu/graduate-school/mathematics-graduate-minor/)
- Music (Collaborative Piano) - Master of Music (https://catalogs.nmsu.edu/nmsu/graduate-school/music-collaborative-piano-master-music/)

- Range Science - Doctor of Philosophy (https://catalogs.nmsu.edu/nmsu/graduate-school/range-science-doctor-philosophy/)

Minors for the Department

- Animal Science - Graduate Minor (https://catalogs.nmsu.edu/nmsu/graduate-school/animal-science-graduate-minor/)
- Dairy Science - Undergraduate Minor (https://catalogs.nmsu.edu/nmsu/agricultural-consumer-environmental-sciences/animal-range-sciences/dairy-science-undergraduate-minor/)
- Horse Management - Undergraduate Minor (https://catalogs.nmsu.edu/nmsu/agricultural-consumer-environmental-sciences/animal-range-sciences/horse-management-undergraduate-minor/)
- Human Animal Interaction - Undergraduate Minor (https://catalogs.nmsu.edu/nmsu/agricultural-consumer-environmental-sciences/animal-range-sciences/human-animal-interaction-undergraduate-minor/)
- Livestock Production - Undergraduate Minor (https://catalogs.nmsu.edu/nmsu/agricultural-consumer-environmental-sciences/animal-range-sciences/livestock-production-undergraduate-minor/)
- Ranch Management - Undergraduate Minor (https://catalogs.nmsu.edu/nmsu/agricultural-consumer-environmental-sciences/animal-range-sciences/ranch-mgt-undergraduate-minor/)
- Range Science - Graduate Minor (https://catalogs.nmsu.edu/nmsu/graduate-school/range-science-graduate-minor/)
- Range Science - Undergraduate Minor (https://catalogs.nmsu.edu/nmsu/agricultural-consumer-environmental-sciences/animal-range-sciences/range-science-undergraduate-minor/)

Department Head **Shanna L. Ivey**

Professors Ashley, Fasenko, Fernald, Hernandez Gifford, Ivey, Löest, Scholljegerdes, Soto

Associate Professors Fuentes-Soriano, Geli, Gifford, Utsumi

Assistant Professors Garbowksi, Mezzomo Giotto, Wendt

College Track Associate Professors Campbell

College Track Assistant Professor Smythe

Instructors Bilovesky; Painter; Priest, Rogers

Co-operators (USDA) Estell, Herrick, Peters

Emeritus Faculty Allred, Bailey, Cibils, Holechek, McDaniel, Ross, Thomas

S. L. Ivey, Department Head, Ph.D. (New Mexico State University)- ruminant nutrition/microbiology; K. W. Allred, Ph.D. (emeritus, Texas A&M University)– plant taxonomy; R.L. Ashley, Ph.D. (Colorado State University)– physiology of reproduction; D.W. Bailey, Ph.D. (emeritus, Colorado State University)– rangeland management; J.W. Campbell, Ph.D. (New Mexico State University)-reproductive physiology; A.F. Cibils, Ph.D. (emeritus, Colorado State University)– grazing management and ecology; G.C. Duff, Ph.D. (New Mexico State University)-animal nutrition; G.M. Fasenko, Ph.D. (North Carolina State University)– companion animal management; A. G. Fernald, Ph.D. (Colorado State University)– land use hydrology and water quality hydrology; S. Fuentes-Soriano, Ph.D. (University of Missouri-Saint Louis)-biology in plant systematics and evolution; M. Garbowksi, Ph.D. (Colorado State University) - restorative ecology; H. M. E. Geli, Ph.D. (Utah State University)-landscape hydrology; C. Gifford, Ph. D. (University of Idaho)-animal science; J. Hernandez-Gifford, Ph.D. (Washington State University)-reproductive physiology; J. L. Holechek, Ph.D. (emeritus, Oregon State)– range ecology; C. A. Löest, Ph.D. (Kansas State University)– ruminant nutrition; K. C. McDaniel, Ph.D. (emeritus, Texas A&M University)– brush management; F. Mezzomo Giotto, Ph. D. (University of Nevada, Reno) - meat science and food safety; L. Prihodko, Ph.D. (Colorado State University)-range ecology; T. T. Ross, Ph.D. (emeritus, North Carolina State University)– physiology of reproduction and sheep production; E.J. Scholljegerdes, Ph.D. (University of Wyoming)– ruminant nutrition; B.G. Smythe, Ph.D. (New Mexico State University)- veterinary entomology; S.A. Soto-Navarro, Ph.D. (New Mexico State University)– ruminant nutrition; J. D. Thomas, Ph.D. (emeritus, University of Missouri-Columbia)– meat science; S. Utsumi, Ph. D. (New Mexico State University) - range ecology; J .Wendt, Ph.D. (Montana State University) - Ecology and Environmental Sciences

Adjunct faculty: *C. D. Allison, Ph.D. (Texas A&M University)– range management; R.A. Cushman, Ph.D. (North Carolina State University)-physiology of reproduction; A. Faist, Ph. D. (University Colorado Boulder) - range ecology; K. M. Harvstad, Ph.D. (Utah State University)– range animal nutrition; J.E. Herrick, Ph.D. (Ohio State University)– soils; M.R. Levi, Ph. D. (University of Arizona)-soil morphology/classification; T.J. Nagaraja, Ph.D. (Kansas State University)-rumen microbiology; D.P. Peters, Ph.D. (Colorado State University)– landscape ecology; S. Spiegal, Ph.D. (University of California Berkeley)-range management; M. Steele, Ph.D. (University of Guelph)– ruminant nutrition; A.F. Summers, Ph.D. (University of Nebraska)-physiology of reproduction.*

Cooperative Extension Service: *D. Cram, Ph.D. (New Mexico State University)-range science; R. Hagevoort, Ph. D. (*Texas A&M University) - dairy science; *R. Sallenave, Ph.D (*University of Guelph)*-aquatic ecology; S. Smallidge, Ph.D. (New Mexico State University) - wildlife; C. Spackman, Ph.D. (*Utah State University)*- range science; J. L. Turner, Ph.D. (Kansas State University)– equine immunology and physiology; M. Ward, Ph.D. (North Dakota State University)- ruminant nutrition;*

Animal Science Courses

ANSC 1110. Animal Science Careers
1 Credit (1)
Introduction to scientific disciplines and career options in animal-agriculture career skill development, including resume preparation, networking, importance of internships, and leadership experiences in animal agriculture.
Learning Outcomes

1. Increasing the understanding of career opportunities in animal agriculture.
2. Gain a broad experience in the development of creative thinking about the career choices available in animal agriculture.
3. Apply the increased knowledge of career development in the career path and internship directions for each student.
4. Gain leadership experience that will be impactful for the student in their pursuit of a career in animal agriculture.

ANSC 1120. Introduction to Animal Science
3 Credits (3)
Survey of the livestock industry throughout the world. Basic management practices will be covered, including livestock selection, nutrition, reproduction, anatomy and marketing to the consumer. This course will also discuss animal behavior and welfare.

Learning Outcomes

1. Understand the role of farm animals in a global setting.
2. Describe the role of nutrition, breeding, behavior, welfare, and physiology of livestock in the world.
3. Explain the structure and organization of livestock industries.
4. Discuss concepts and terminology of the livestock industries as they relate to the global perspective.
5. Classify the overall management, care, marketing of animals, represented in the various livestock industries.

ANSC 1120H. Introduction to Animal Science Honors
3 Credits (3)
This course is designed to provide an introduction to nutrients and their function in livestock animals. Basic feed identification, evaluation, and diet formulation will be discussed. The anatomy of the digestive tract of animals and their ability to utilize feedstuffs is presented. Classification, digestion, absorption, transport and metabolism of major nutrients required by animals are studied. Additional course work will be required. Restricted to Las Cruces campus only.
Prerequisite(s): Eligibility for membership in honors college.
Learning Outcomes

1. Identify conventional and non-conventional feedstuffs that are fed to livestock animals.
2. Describe various methods for feed processing and storage.
3. Assess the nutritional value of a ration or feed ingredients.
4. Interpret the NRC (Nutrient Requirement Council) guidelines for feeding livestock.
5. List the basic digestive anatomy for all classes of livestock.
6. Describe nutritional deficiencies and digestive disorders common to livestock animals

ANSC 1120L. Introduction to Animal Science Lab
1 Credit (2P)
Students will observe and participate in activities related to farm animal management and will include areas of livestock selection, nutrition, reproductive physiology, animal ID and animal health. This lab is required for animal science majors.
Prerequisite(s)/Corequisite(s): ANSC 1120.
Learning Outcomes

1. To provide the students with an understanding of the principles, concepts and terminology of today's livestock industry

ANSC 1125. Equestrian Team Competition
1 Credit (1)
Basic principles of equestrian team competition, including care and management of the riding horse, equitation equipment, and development of riding skills. Emphasis will be placed competition within the Intercollegiate Horse Show Association. Consent of Instructor required. May be repeated up to 8 credits.
Learning Outcomes

1. Have a general knowledge of horses and basic horsemanship/equitation position.
2. Explain and demonstrate basic techniques of balance, control, and safety skills while being in contact and mounted on a horse.
3. Explain and demonstrate proper handling and safety around horses and the proper care of the stable and tack.
4. Be able to ride unassisted at the walk, jog, and lope in either English or Western tack.
5. Apply general knowledge of horsemanship and equitation to competitive equine events in a safe manner including equitation on the flat, equitation over fences, horsemanship, ranch riding and reining.

ANSC 1130. Western Equitation I
2 Credits (4P)
Basic principles of Western riding, including care and management of the riding horse, equitation equipment, and development of riding skills.
Learning Outcomes

1. Articulate basic horsemanship position and how it is used to communicate with the horse.
2. Implement proper handling and basic techniques of balance, control, and safety while working with or riding a horse.
3. Execute a basic horsemanship pattern at a walk, jog, and lope.
4. Integrate general knowledge of horsemanship to competitive equine events in a safe manner.

ANSC 1140. Introduction to Dairy Science
3 Credits (3)
Introduction to the basic aspects of dairy science and how to apply key concepts to the practical feeding and management of dairy cattle and production of dairy products. Students should also obtain an appreciation for the size and diversity of the dairy industry.
Prerequisite(s)/Corequisite(s): ANSC 1120. Restricted to Las Cruces campus only.
Learning Outcomes

1. Learn key concepts in dairy production and management
2. Be familiar with terms used in production of milk and milk products

ANSC 1160. Introductory Horse Science
3 Credits (2+2P)
The light horse industry; breeds; introduction to feeding, breeding, marketing and management; handling and selecting horses for breeding and performance.
Learning Outcomes

1. Describe and identify breeds of horses, their characteristics and their uses.
2. Demonstrate knowledge of basic physiology of horses by recalling parts of the horse, including bones, muscle, tendons and ligaments. Also, by ageing horses via teeth, body condition scoring and taking vital signs.
3. Demonstrate safe and proper handling of horses.
4. Demonstrate comprehension of basic nutrition and feedstuffs by formulating/correcting diets in clinical and non-clinical situations.
5. Recall aspects of basic reproduction by calculating a stallion book and recalling appropriate procedures for breeding.
6. Create informative articles that seek to educate the lay horse person about a topic covered in class.

ANSC 1170. Introduction to Animal Metabolism
3 Credits (3)
Principles underlying the mechanisms of animal metabolism as they relate to production, maintenance, and health of animals.
Prerequisite: CHEM 1215G.
Learning Outcomes

1. This course provides an introduction to the study of the physiology of life.
2. The first part of the course covers acids and bases and the chemical nature of organic compounds.

3. The second part of the course relates to the chemistry of biomolecules (nutrients) and summarizes the chemical reactions of life (metabolism).

ANSC 1180. Companion Animal in Society
3 Credits (3)
Examination of the historical, current, and potential future roles of companion animals in human society. Topics include animal domestication, breeds, exotic companion animals, the companion animal industry, and competitions and sports involving companion animals. Emphasis is on canine and feline species. May be repeated up to 3 credits. Restricted to Las Cruces campus only.
Learning Outcomes
1. Discuss the theories regarding why, how, and when companion animals became domesticated.
2. Describe how selective breeding has optimized certain physiological and behavioral traits of companion animals in order to fulfill the needs of individual people and society.
3. Explain the concept of human-companion animal interaction (HAI) and the influence this bond has on human behavior, health, society, and government policy/laws.
4. Understand the breadth and economic impact of the rapidly expanding companion animal industry and the recent expenditure trends of pet owners.
5. Discuss the past and present uses of companion animals and theorize regarding the future uses of companion animals in society
6. Be effective in searching for, and critically evaluating, scientific based resources.

ANSC 2120. Equine Management
3 Credits (3)
Introduction and application of the business skills necessary to effectively manage the equine operation. Students will learn how to use strategic thinking and sound business management practices to succeed in the demanding equine industry.
Prerequisite: ANSC 1160.
Learning Outcomes
1. Develop a working knowledge of the business principles needed to operate a successful entrepreneurial enterprise.
2. Increase the awareness of the need for business principles in the aggregate function of an equine operation.
3. Gain a greater perspective of accounting, economic and financial principles in an equine business operation.

ANSC 2130. Western Equitation II
2 Credits (4P)
Intermediate principles of Western riding, including reading horse behavior, limbering-up exercises, and developing riding skills. Introduction to rollbacks, turnarounds and stops.
Prerequisite: consent of instructor.
Learning Outcomes
1. Increasing the understanding of the student relative to equitation practices
2. Increase the students' ability to apply principles of Western Equitation to applied settings across a broad spectrum of outlets
3. Prepare the student to engage equine in a professional manner

ANSC 2140. Introduction to Companion Animal Science
3 Credits (3)
Introduction to the care of common companion animal species. Species specific housing and nutrition are covered in the context of maximizing animal health and well-being and reducing disease. May be repeated up to 3 credits.
Learning Outcomes
1. Accurately use scientific terminology common to the companion animal discipline.
2. Compare and contrast the physiological similarities and differences between the various companion animal species studied in class.
3. Create dietary plans based on the nutritional needs of different companion animal species to optimize animal health and lifespan.
4. Identify symptoms of disease/injury at the early stages of illness in order to obtain Veterinary care and treatment as quickly as possible.
5. Design and construct species specific cages/vivariums to maximize animal well- being and health.
6. Educate others regarding providing the best possible care for a variety of companion animal species.

ANSC 2150. Management of Equine Operations
3 Credits (3)
Introduction and application of business skills necessary to effectively manage the equine operation. Students will learn how to use strategic thinking and sound business management practices to succeed in the demanding equine industry.
Prerequisite(s): ANSC 1160.
Learning Outcomes
1. Acquire a working knowledge of different sectors of the equine industry, including business practices, management and marketing skills.

ANSC 2310. Introduction to Meat Science
3 Credits (2+3P)
Fundamental aspects of the red meat industry. Lecture topics and laboratory exercises include the nutrient value of meat, meat preservation, meat safety, muscle structure and contraction, slaughter and processing of beef, lamb and pork, sausage manufacture, meat curing, meat cookery, and muscle and bone anatomy.
Learning Outcomes
1. Increasing the understanding of meat science applications across animal agriculture.
2. Increase the students' ability to apply principles of production to the industry perspective.
3. Apply the increased knowledge of meat science in a global situation.
4. Gain an understanding of the components involved in the development and processing of the red meat industry.

ANSC 2330. Animal Production
3 Credits (2+2P)
Production and utilization of beef cattle, sheep, and swine; emphasis on feeding, breeding, management problems and marketing; selection of animals for breeding and market
Learning Outcomes
1. Increasing the understanding of meat animal production.
2. Increase the students' ability to apply principles of production to the industry perspective.
3. Apply the increased knowledge of meat animal production to global situations.
4. Gain a broader understanding of the importance of meat animals in the global food system.

ANSC 2340. Genetics in Animal Science
3 Credits (3)

Introduction to genetics and inheritance relative to livestock production. Introduction to procedures for collection and use of performance information in livestock improvement programs.
Prerequisites: BIOL 2610G.
Learning Outcomes
1. Gain a broader understanding of the role genetic impacts in the livestock industry.
2. Employ an increased knowledge of impact of genetics in the food animal industry and the production and economic principles that apply.
3. Recognition of the global impacts of genetics in the food animal industry in a global setting.

ANSC 2996. Special Topics
1-4 Credits
Specific subjects and credits to be announced in the Schedule of Classes. Maximum of 4 credits per semester. No more than 9 credits toward a degree.
Learning Outcomes
1. Varies

ANSC 301. Animal and Carcass Evaluation
3 Credits (2+2P)
Determination of the market value of meat animals by relating live animal and carcass traits. Topics include the identification of economically important traits, grading, growth and development, wholesale and retail pricing, and futures and options markets. May be repeated up to 3 credits.
Learning Outcomes
1. Students should have a basic understanding of basic animal internal and external anatomy Yield and quality grades.
2. Students should have a basic understanding of live animal evaluation Carcass evaluation.
3. Students should have a basic understanding of economically important live and carcass traits.

ANSC 303. Livestock, Meat and Wool Evaluation
4 Credits (3+2P)
Selection, classification, grading, and judging of livestock, meat, and wool. May be repeated up to 4 credits.
Learning Outcomes
1. Judge all species of livestock to make decisions on class evaluation.
2. Assess classes of wool and make decisions on placing and be able to determine grade and quality of fleeces.
3. Evaluate and grade classes of meat and be able to make decisions on placing classes.
4. Defend decisions on class placing through written and oral defense.

ANSC 304. Feeds and Feeding
3 Credits (2+2P)
Digestibility of feeds, their nutritive values, grades, and classes, principles of ration formulation and computer ration formulations, and practical feeding of farm animals. May be repeated up to 3 credits.
Prerequisite: CHEM 1215G.
Learning Outcomes
1. Discuss how animals utilize nutrients.
2. Explain why feedstuffs differ in nutritional value.
3. Apply nutritional concepts to the practical feeding of farm animals.
4. Formulate diets that balance nutrient supply with the requirements of farm animals.

ANSC 305. Principles of Genetics
3 Credits (3)
Covers fundamental principles of reproduction, variation, and heredity in plants and animals. May be repeated up to 3 credits.
Prerequisite: (BIOL 2610G and BIOL 2110G, or BIOL 2110G and BCHE 140, and either CHEM 1215G or CHEM 1216).
Learning Outcomes
1. To provide an introduction to the basic concepts, methods, and terminology of genetics. Introduction to genomics and bioinformatics.
2. To develop a working understanding of genetics and heredity
3. To understand in some depth, the mechanism of DNA replication, transcription and protein synthesis. To understand the regulation of gene expression.
4. To examine the impact of genetics on both basic and applied aspects of the biological sciences, as well as its effects on our everyday lives.

ANSC 308. Horse Evaluation
4 Credits (2+4P)
Students will acquire a working knowledge of selection and classification of horses, learn criteria for evaluation and selection of breeding and show animals, gain a broad understanding of judging conformation and performance in the horse, and learn effective oral and written communication skills through defense of class placings. This course is considered an introduction to the NMSU Horse Judging Team. May be repeated up to 4 credits.
Learning Outcomes
1. Evaluate the conformation and performance of horses using established criteria and demonstrate proficiency in applying these skills.
2. Formulate decisions confidently and efficiently based on observed data and established selection principles.
3. Apply a working vocabulary of equine industry terminology to accurately describe and discuss horse evaluation and classification.
4. Identify conformational faults in horses and analyze how these faults relate to potential performance or soundness issues.
5. Defend class placings through effective oral and written communication, demonstrating clarity, reasoning, and industry appropriate language.

ANSC 310. Exhibiting Livestock
3 Credits (1+4P)
Fitting and showing beef cattle, dairy cattle, sheep and swine. May be repeated up to 3 credits.
Learning Outcomes
1. Demonstrate proper grooming, fitting, and handling techniques for multiple species of livestock commonly exhibited at fairs and shows.
2. Apply principles of animal selection and evaluation to choose appropriate livestock for exhibition based on conformation, health, and market readiness.
3. Implement best practices in animal care and management to ensure ethical treatment, optimal health, and performance of livestock throughout the exhibition process.
4. Analyze the rules, ethics, and regulations governing youth livestock exhibitions at local, state, and national levels.

ANSC 312V. Companion Animals and the Human- Animal Interaction
3 Credits (3)
The science behind human-animal interactions (HAI). An examination of the interactions between humans and companion animals and the effects

on human and animal health and wellness. Cultural differences in HAI will be explored. Topics will include Animal Assisted Activity (AAA), Animal Assisted Therapy (AAT), and service animals. Emerging and future uses of companion animals in HAI will be discussed.

Learning Outcomes

1. Provide an overall description of "Human-Animal Interaction" (HAI).
2. Understand and accurately use terminology common to the discipline of HAI.
3. Be able to demonstrate how HAI has influenced human behavior, health, society, and government policy/laws.
4. Provide examples of how HAI influences human and animal physical and psychological health and well-being.
5. Accurately compare and contrast the different categories of HAI animals (ESA, AAA, AAT, Facility and Service Animals) and the training and laws that apply to each animal's presence in public places with a handler.
6. Provide examples of how the field of HAI is interdisciplinary and applies to both social (sociology, psychology, child development, criminal justice) and physical (physiology, animal behavior) sciences.
7. Theorize the future roles of companion animals in HAI.
8. Be competent in applying the knowledge gained in this class to everyday situations, and educate family, friends and members of society, using factual information, about the roles and benefits of companion animals in HAI.

ANSC 320. Equine Behavior and Training
3 Credits (6P)

Basic principles, methods and philosophies of handling, breaking and training the two-year-old Western horse. May be repeated up to 6 credits.
Prerequisite: ANSC 2130 or consent of instructor.

Learning Outcomes

1. Demonstrate ability to acceptably catch, lead, tie, pick up all four feet, and groom an assigned horse.
2. Develop a means of communication to work a young horse in the round pen to develop confidence in both handler and young horse.
3. Evaluate horse natural abilities to determine its direction of training.
4. Integrate desensitizing techniques in order to saddle and unsaddle a horse safely.

ANSC 321. Advanced Equine Behavior and Training
3 Credits (6P)

Continuation of ANSC 320. Further development of skills required to advance the training of the two-year-old Western horse. Emphasis will be placed on lateral work, lead changes, turn-arounds, obstacles, and making the horse accustomed to ranch and trail riding situations.
Prerequisite: ANSC 320 or consent of instructor.

Learning Outcomes

1. Students will apply knowledge gained on natural behavior of the horse while working horses in the round pen, and all groundwork associated with starting a young horse under saddle.
2. Students will demonstrate the ability to use natural aids as a means of communication while putting the first rides on their assigned horse in a safe environment.
3. Students will demonstrate their understanding of the natural reactions and instincts of a young horse by completing a 5 minute demonstration of their assigned horse at the Horse Preview before the NMSU Horse Sale.

ANSC 350. Special Topics
1-4 Credits

Specific subjects and credits to be announced in the Schedule of Classes. Maximum of 4 credits per semester. No more than 9 credits toward a degree.

ANSC 351V. Agricultural Animals of the World
3 Credits (3)

Global study of the development and use of animals for production of food and nonfood products. Climatic, cultural, and economic influences on systems of livestock production and species and breeds of livestock utilized will be evaluated.

Learning Outcomes

1. Define fundamental/basic terms related to animal science systems.
2. Reproduce the cycles of reproduction and nutrition related to farm animals.
3. Give examples of animal domestication.
4. Compare and contrast ruminate and non-ruminate farm animals.
5. Identify and list characteristics of common breeds of farm animals.
6. List farm animals used in other parts of the world.

ANSC 360. Meat and Muscle Biology
3 Credits (3)

Course will explore in depth the antemortem and postmortem factors that influence the properties of meat.
Prerequisite: BIOL 2610G.

Learning Outcomes

1. Identify anatomical parts of the animal's muscular system.
2. Employ principles of respiration within muscle contraction and relaxation.
3. Contrast the relationship between biochemistry and physiology in the context of muscle to meat conversion.
4. Explain the influence of stressors on meat quality.
5. Identify campus resources to successfully complement classroom materials.

ANSC 370. System Physiology of Farm Animals
4 Credits (3+2P)

Structure and function of the animal body. Includes studies of the horse, cow, sheep, pig, and comparisons with the human body. May be repeated up to 4 credits.
Prerequisite: CHEM 1215G and BIOL 2610G or BIOL 2110G.

Learning Outcomes

1. The objective of this course is to introduce the basic terminology and concepts of animal anatomy and physiology.
2. The course will stress the understanding of the functions of the entire body.
3. The interaction of different systems and the effect of environmental factors will be emphasized.

ANSC 383. Equine Reproductive Management
3 Credits (1+4P)

Anatomy, physiology, and endocrinology of reproduction of the mare and stallion; training in modern reproductive techniques employed in the horse industry. May be repeated up to 3 credits.
Prerequisite: ANSC 1160, ANSC 2150, and ANSC 370.

Learning Outcomes

1. Develop an equine management plan related to reproduction to improve the health and performance of horses.
2. Recognize behaviors and signs of the mare's estrous cycle and interpret reproductive records to make informed breeding decisions.

3. Identify and explain the anatomy and physiology of the mare's and stallion's reproductive tract.
4. Compare and contrast various breeding methods, including their advantages, challenges, and suitability for specific scenarios.
5. Assess a mare's pregnancy status and calculate expected foaling dates based on diagnostic and observational data.

ANSC 390. Internship
1-3 Credits
Professional work experience under the joint supervision of the employer and a faculty member. A written report is required. No more than 3 credits toward a degree. Graded S/U.
Prerequisite: consent of instructor.

ANSC 391. Undergraduate Research Experience
1-3 Credits (1-3)
Formal laboratory, library, or field study of problems related to animal sciences, emphasizing hypothesis development, testing, and reporting results. Projects are preplanned, reviewed, and approved. Students submit periodic written reports and final written and oral reports. May be repeated for a maximum of three credits. Consent of Instructor required.

ANSC 392. Animal Sciences Teaching/Extension Experience
1-3 Credits (1-3)
: Formal teaching experience related to animal sciences supervised by a faculty member. May involve classroom instruction, educational material development, and/or student evaluation and assessment. Students may also be involved in development, implementation, or assessment of adult or youth educational programs related to animal sciences, supervised by a faculty member. Students submit periodic written reports and a final written and oral report. May be repeated for a maximum of three credits. Consent of Instructor required.

ANSC 402. Animal Science Seminar
1 Credit (1)
A seminar course designed to inform students of the career opportunities, develop their interviewing and other interpersonal skills may also include reading, discussions, written reports, and seminar presentations of current relevant literature.
Learning Outcomes
1. Design resume and cover letter.
2. Develop a 30 second elevator speech.
3. Create answers to common interview questions.
4. Outline personal skills for professional settings.

ANSC 402 H. Animal Science Seminar
1 Credit (1)
Taught with ANSC 402 with additional work. Before enrollment, student must meet Honors eligibility and/or Crimson Scholar status.
Learning Outcomes
1. Design resume and cover letter.
2. Develop a 30 second elevator speech.
3. Create answers to common interview questions.
4. Outline personal skills for professional settings.

ANSC 411. Canine and Feline Behavior and Training
3 Credits (3)
The influence of domestication, breeds, genetics, and physiology on the behavior of canine and feline species. Training methods and modification of problem behaviors are examined. The impact of the pet parent on their animal's behavior is addressed.
Prerequisite: Junior or Senior status or consent of the instructor.
Learning Outcomes
1. Provide evidence why the dominance theory and use of punishment are outdated methods of training.
2. Be able to fully describe and provide examples of classical and operant conditioning learning methods.
3. Justify the importance of socialization in puppies and kittens and the impact this has on adult animals.
4. Accurately interpret canine and feline visual and vocal communication.
5. Demonstrate how to use reward-based learning.
6. Assess the most common behavioral issues in dogs and cats and describe in detail the steps to take to redirect and/or modify undesirable behaviors.
7. Be able to demonstrate how a clicker is used including appropriate timing and reward.
8. Critically evaluate, summarize, and effectively articulate information on behavior and training using both verbal and written skills.
9. Be confident in applying the knowledge gained in this class to everyday situations, and educate family, friends and members of society about companion animal behavior and humane training.

ANSC 412. Canine and Feline Health and Diseases
3 Credits (3)
A review of common infectious and non-infectious diseases and the basics of the immune response. Pathophysiology and treatment of these diseases and the role the pet parent plays in pre-disposing their animals to disease.
Prerequisite: ANSC 2140 or consent of instructor.
Learning Outcomes
1. Accurately use scientific terminology common to the canine and feline health and diseases discipline.
2. Describe what a disease is and the difference between non-infectious and infectious disease.
3. Identify normal versus abnormal vital signs in canines and felines and how they differ between the species.
4. Explain how non-specific (innate) and specific (adaptive) immunity defend against disease.
5. Compare and contrast the etiology (cause) and pathophysiology (physical symptoms) of different canine and feline diseases and identify and understand appropriate preventative measures and treatments.
6. Be competent and confident in educating dog and cat owners regarding the important role they play in disease prevention of their animals.

ANSC 421. Physiology of Reproduction
4 Credits (3+2P)
Fertility and the role of hormones, nutrition, selection, management and environment in the maintenance of high reproductive rate. May be repeated up to 4 credits.
Prerequisite: ANSC 370.
Learning Outcomes
1. Debate past, present, and future ethical issues in the animal science industries.
2. Compare relationships between anatomy, physiology, nutrition, genetics, and reproduction among animal species.
3. Examine interrelationships between nutrition, genetics, reproduction, and their effects on animal health and the environment.

ANSC 422. Animal Nutrition
3 Credits (3)
Nutrient utilization and measurement and nutrient requirements for the various body functions. May be repeated up to 3 credits.
Prerequisite: CHEM 313 or ANSC 1170.
Learning Outcomes
1. Compare digestion, absorption and metabolism of nutrients between ruminants and non-ruminants.
2. Demonstrate how animal physiology drives nutrient usage in the body.
3. Integrate animal nutrition concepts to better understand efficient animal production and health.

ANSC 423. Animal Breeding
3 Credits (2+2P)
Mating systems, and selection procedures; calculation of inbreeding coefficients, genetic relationships, and gene frequency. May be repeated up to 3 credits.
Prerequisite: ANSC 2340 or 305.
Learning Outcomes
1. Explain the basic principles of Mendelian and quantitative genetics.
2. Interpret and apply population genetics and selection models to livestock breeding programs.
3. Calculate and analyze genetic parameters such as heritability, repeatability, and breeding values.
4. Evaluate breeding strategies including inbreeding, crossbreeding, and composite formation.
5. Apply molecular genetics tools and genomic concepts to animal breeding.
6. Design simple breeding plans incorporating selection, mating strategies, and reproductive technologies.

ANSC 424. Swine Production
3 Credits (2+2P)
Breeding, feeding, and care of swine. May be repeated up to 3 credits.
Prerequisite: ANSC 304.
Learning Outcomes
1. Identify major livestock production systems in the US.
2. Analyze basic animal physiological adaptations to environmental challenges.
3. Analyze production losses due to environmental challenges.
4. Explain physiological mechanisms resulting in production losses.
5. Research management intervention strategies to mitigate environmental challenges.
6. Solve a production loss scenario using an economically viable management strategy.
7. Generate research article based on thermography research.

ANSC 425. Horse Science and Management
3 Credits (2+2P)
Senior level course requiring students to apply basic knowledge acquired in the previous courses to solve typical problems encountered in the horse industry. Specific topics include genetics and animal breeding, business and legal issues, reproduction, health, nutrition and exercise physiology. May be repeated up to 3 credits.
Prerequisite: ANSC 304 and ANSC 370 or concurrent registration.
Learning Outcomes
1. Demonstrate advanced knowledge of equine genetics, breeding and reproduction.
2. Demonstrate advanced knowledge of equine management.
3. Demonstrate advanced knowledge of equine health, nutrition and exercise physiology.
4. Demonstrate advanced knowledge of equine business and legal issues.
5. Effectively problem solve issues pertaining to management of equine programs and facilities.
6. Develop a comprehensive business and management plan for an equine business such as a breeding farm, training center, boarding facility, etc.

ANSC 426. Beef Production: Cow-Calf Management
3 Credits (2+2P)
Senior level course examining management practices for the cow-calf producers. Specifically focusing on nutrition, reproduction, genetics, marketing, and health. May be repeated up to 3 credits.
Prerequisite: ANSC 304 and (ANSC 2340 or ANSC 305) or concurrent registration.
Learning Outcomes
1. Demonstrate knowledge of the different systems utilized to produce a unit of beef: topics considered will include discussion of breeding, reproduction, nutrition, health, management, and marketing strategies.

ANSC 427. Dairy Production
3 Credits (2+2P)
Breeding, nutrition, physiology and management of dairy cattle. May be repeated up to 3 credits.
Prerequisite: ANSC 304 and (ANSC 2340 or ANSC 305) or concurrent registration.
Learning Outcomes
1. Students will be able to evaluate appropriate housing for production practices.
2. Summarize ethical issues in the dairy industry along with regulations guiding production of the dairy industry.
3. Evaluate popular press and scientific literature related to dairy production practices.

ANSC 428. Sheep and Wool Production
3 Credits (2+2P)
Genetics, nutrition, physiology and management of sheep. Wool grading, shearing, and disease control. May be repeated up to 3 credits.
Prerequisite: ANSC 304, ANSC 370.
Learning Outcomes
1. Enhance knowledge and understanding of the different systems utilized to produce a sheep and wool: topics discussed will include breeding, nutrition, reproduction, management and marketing strategies.

ANSC 429. Beef Production: Feedlot Management
3 Credits (2P)
Senior level course in feedlot management of beef cattle. Topics of interest include cattle handling and processing, health and nutrition, intake management, and growth. Feed mill operation, marketing strategies, and regulatory concerns associated with finishing cattle production may also be discussed.
Prerequisite: ANSC 304 or Consent of Instructor.
Learning Outcomes
1. Examine requirements necessary to optimize animal health and welfare and growth performance. By the end of the semester, students will be able to plan appropriate management decisions to increase productivity in stocker/feedlot production.

2. Determine selective breeding decisions on productivity of stocker/feeder cattle.
3. Review appropriate scientific and popular press literature to improve management of stocker/feedlot cattle.

ANSC 448. Problems
1-4 Credits
Individual investigation in a specific area of animal science. Maximum of 4 credits per semester. No more than 6 credits toward a degree. Consent of Instructor required.

ANSC 458. Livestock Behavior, Welfare and Handling
3 Credits (2+3P)
Principles of animal behavior and evaluation of management practices on animal welfare in confined and rangeland livestock operations. Low stress livestock handling techniques. Design of livestock handling facilities. Crosslisted with: RGSC 458
Prerequisite(s): RGSC 2110 or ANSC 1120.

ANSC 462. Parasitology
3 Credits (3)
Same as EPWS 462.

ANSC 468. Advanced Dairy Herd Management
3 Credits (3)
The course is offered through the Southern Great Plains Dairy Consortium in Clovis, NM, and will include breeding, nutrition, physiology, health and management of large herd dairies of the Southwest. Students must apply for the course through the Consortium, and can take it more than once, as topics vary. Consent of instructor required.
Prerequisite(s): ANSC 304.

ANSC 480. Environmental Physiology of Domestic Animals
3 Credits (3)
Influence of environmental factors on physiological processes of domestic animals.
Prerequisite: ANSC 370.
Learning Outcomes
1. Identify major livestock production systems in the US.
2. Analyze basic animal physiological adaptations to environmental challenges.
3. Analyze production losses due to environmental challenges.
4. Explain physiological mechanisms resulting in production losses.
5. Research management intervention strategies to mitigate environmental challenges.
6. Solve a production loss scenario using an economically viable management strategy.
7. Generate research article based on thermography research.

ANSC 484. Ruminant Nutrition
3 Credits (3)
Energy, nitrogen, and mineral nutrition of ruminants with special emphasis on digestive physiology and metabolism of nonprotein nitrogen compounds.
Prerequisite/Corequisite: ANSC 422.
Learning Outcomes
1. Examine the parts of the ruminant digestive tract and their function in digestion.
2. Integrate ruminal bacteria and their role into fermentation pathways.
3. Appraise fermentation/metabolic modifiers and their role in improving animal performance.
4. Calculate energy and protein requirements.
5. Integrate environmental and physiological impacts on intake and digestibility.
6. Combine animal requirements, feed nutrients, and knowledge of fermentation into feeding recommendations for various classes of ruminants.

ANSC 501. Advanced Animal Nutrition
3 Credits (3)
Emphasis on digestive physiology and metabolism. Basic mechanisms involved in the intake, digestion, and absorption of nutrients studied.
Learning Outcomes
1. Describe how animals utilize nutrients.
2. Explain why feedstuffs differ in nutritional value.
3. Apply nutritional concepts to practical feeding of domestic livestock ('critical thinking' skills).
4. Formulate diets for domestic livestock, with emphasis on mixing feedstuffs to balance nutrient supply with nutrient requirements ('quantitative reasoning' skills).

ANSC 507. Laboratory Techniques in Nutrition
4 Credits (2+6P)
Methodology and experimental procedures in measuring nutrient requirements and value of diets. May be repeated up to 4 credits.
Prerequisite: ANSC 422 or consent of instructor.
Learning Outcomes
1. Orient to the NMSU Animal Science Nutrition Laboratory.
2. Gain an understanding and familiarity with the basic techniques used in nutrition research.
3. Develop critical, scientific thinking.
4. Facilitate use of communication skills.

ANSC 509. Endocrinology of Domestic Animals
3 Credits (3)
The role of hormones in growth, development, metabolism, temperature regulation, lactation, and reproduction of domestic animals, including commercial applications.
Learning Outcomes
1. Explain the mechanisms in which physiological systems are influenced by hormonal regulation and chemical mediators.
2. Describe cellular and whole animal behavior related to endocrine function.
3. Interpret scientific literature related to molecular and endocrine physiology.
4. Articulate in comprehensive and succinct manner written communication specific functions of the endocrine system.

ANSC 510. Range Nutrition Techniques
3 Credits (3)
Animal and plant methods of determining quantity and quality of range forage. Taught with RGSC 510.
Prerequisite: ANSC 484 or consent of instructor.
Learning Outcomes
1. Students will organize a protocol with a description of research techniques needed to answer a research question related to grazing management.
2. Students will be able calculate diet digestibility of a diet using marker data.

3. Students will be able design a set of experiments that utilize a variety of techniques to answer hypothesis related to animal and range interactions.

ANSC 512. Research Methods in Animal Science
4 Credits (3+2P)
Procedures used in animal science research, including planning and conduct of investigations and interpretation of results. May be repeated up to 4 credits.
Learning Outcomes
1. Design rigorous animal science experiments.
2. Apply statistical methods to analyze experimental data.
3. Critically evaluate experimental designs and statistical methods of published research.
4. Communicate experimental statistical findings clearly and effectively.
5. Differentiate among core experimental designs.

ANSC 515. Graduate Seminar
1 Credit (1)
Exploration of current and emerging topics, with subject matter varying based on recent developments and trends. May be repeated up to 4 credits.
Learning Outcomes
1. Design a structured outline for a seminar presentation that reflects clear organization and purpose.
2. Analyze the key elements that contribute to an effective and professionally designed PowerPoint presentation.
3. Evaluate the relevance and appropriateness of content for inclusion in a professional presentation.
4. Create a PowerPoint presentation on a self-selected topic, demonstrating effective visual and informational design.
5. Analyze the content and structure of the presentation to predict potential audience questions.
6. Deliver a professional PowerPoint presentation tailored to a target audience.
7. Assess peer presentations using established criteria for content, design, and delivery.

ANSC 520. Advanced Nutritional Management I: Feedlot
3 Credits (3)
Emphasis on feeding systems for beef cattle from weaning to slaughter. Primary focus on feedlot nutrition and management.
Prerequisite: ANSC 484 or consent of instructor.
Learning Outcomes
1. Explain concepts and applications of nutritional management of feedlot cattle.
2. Critique scientific literature on nutritional management of feedlot cattle.
3. Solve feedlot case studies by analyzing, interpreting, and evaluating real-world cattle feeding scenarios.
4. Create a diet formulation using National Research Council equations to meet feedlot cattle nutrient requirements.

ANSC 521. Advanced Nutritional Management II: Cow Calf/Stocker
3 Credits (3)
Emphasis on nutritional management for cow-calf and stocker operations. Primary focus on applications to range animal nutrition and management.
Prerequisite: ANSC 484 or consent of instructor.
Learning Outcomes
1. Summarize basic nutrient metabolism in ruminants.
2. Identify physiological factors that influence maintenance requirements.
3. Characterize physiological factors that influence reproductive processes.
4. Outline nutrient requirements for calves, cows, steers, heifers, and bulls.
5. Formulate rations for calves, cows, steers, heifers, and bulls.
6. Justify nutritional recommendations that address a real-world scenario.

ANSC 522. Animal Nutrition
3 Credits (3)
Nutrient utilization and measurement; nutrient requirements for the various body functions. Taught with ANSC 422 with additional requirements for graduate students. Recommended for nonmajors.
Learning Outcomes
1. Compare digestion, absorption and metabolism of nutrients between ruminants and non-ruminants.
2. Demonstrate how animal physiology drives nutrient usage in the body.
3. Integrate animal nutrition concepts to better understand efficient animal production and health.

ANSC 560. Rumen Microbiology
3 Credits (3)
Issues in ruminal and gastrointestinal microbiology. Includes physiological and genetic mechanisms in carbohydrate and nitrogen utilization. Taught with FSTE 560.
Prerequisite: ANSC 501.
Learning Outcomes
1. Explain the mechanisms by which the rumen microbial population contributes to rumen function and structure.
2. Illustrate nutrient digestion and metabolism by rumen microbes.
3. Interpret scientific literature related to rumen microbiology.
4. Manage livestock in real world scenarios utilizing skills gained throughout the course.

ANSC 580. Environmental Physiology of Domestic Animals
3 Credits (3)
Influence of environmental factors on physiological processes of domestic animals. Specific focus on fetal and developmental programming, heat and cold stress.
Learning Outcomes
1. Identify major livestock production systems in the US.
2. Analyze basic animal physiological adaptations to environmental challenges.
3. Analyze production losses due to environmental challenges.
4. Explain physiological mechanisms resulting in production losses.
5. Research management intervention strategies to mitigate environmental challenges.
6. Solve a production loss scenario using an economically viable management strategy.
7. Generate research article based on thermography research.

ANSC 598. Special Research Programs
1-4 Credits (1-4)

Individual investigations, either analytical or experimental. Maximum of 4 credits per semester. No more than 6 credits toward a degree. Consent of Instructor required.

ANSC 599. Master's Thesis
1-15 Credits (1-15)
Thesis. Consent of Instructor required. Thesis/Dissertation Grading. May be repeated up to 88 credits.
Learning Outcomes
1. Various

ANSC 600. Research
1-15 Credits
This course is for Ph.D. students before they have completed qualifiers. Consent of Instructor required. Thesis/Dissertation Grading.
Prerequisite(s): ANSC 421 or consent of instructor.

ANSC 602. Advanced Reproductive Physiology
3 Credits (3)
Mechanisms of reproductive function; research methodology.
Prerequisite: ANSC 421 or consent of instructor.
Learning Outcomes
1. Assess the biochemical properties and mechanisms of action for reproductive hormones, including receptor interactions and intracellular signaling.
2. Summarize endocrine regulation in reproduction, mapping the HPG axis and its role in puberty, cycles, and gametogenesis.
3. Compare ovarian and testicular functions including follicular development, ovulation, spermatogenesis, and steroidogenesis.
4. Integrate the physiological steps of fertilization, including gamete transport, capacitation, acrosome reaction, and sperm-egg interactions.
5. Evaluate hormonal and physiological mechanisms in pregnancy, including maternal recognition, implantation, and placental function.
6. Develop a proposal outlining the stages of parturition, including fetal signaling, maternal adaptations, and hormonal control.

ANSC 604. Hypothalamo-Hypophyseal-Pineal Endocrinology (fe)
1 Credit (1)
Hormones and other neurochemicals synthesized and secreted by the hypothalamus, pituitary, and pineal glands. Neuroendocrinology of the hypothalamo-hypophyseal axis.
Prerequisite: ANSC 509.

ANSC 605. Gonadal and Uterine Endocrinology
1 Credit (1)
Endocrinology of mammalian ovaries, testes, and uteri including developing trophoblasts.
Prerequisite: ANSC 509.
Learning Outcomes
1. Explain and evaluate advanced reproductive endocrine concepts of the uterus, ovaries, and testes in domestic animals.
2. Critically analyze and synthesize foundational and modern research literature on gonadal and uterine endocrinology.
3. Effectively communicate complex concepts in reproductive endocrinology through written discussion and abstract composition.
4. Integrate knowledge across modules to evaluate reproductive regulation and dysfunction in livestock.

ANSC 606. Endocrinology of Pregnancy, Parturition, and Lactation (fe)
1 Credit (1)
Hormones and other chemical messengers involved in maintenance of pregnancy, control of parturition, and initiation and maintenance of lactation in farm animals.
Prerequisite: ANSC 509.

ANSC 621. Metabolic Functions and Dysfunctions
3 Credits (3)
Physiological chemistry of ruminants and other domestic animals, with attention to metabolic dysfunctions and nutritional toxicology.
Prerequisite: CHEM 345 and ANSC 501.
Learning Outcomes
1. Explain the cellular and molecular mechanisms that control metabolic function and dysfunction in major organ systems.
2. Analyze the roles of organ systems in maintaining metabolic homeostasis.
3. Evaluate metabolic disorders in terms of pathophysiology, clinical symptoms, and treatments.
4. Integrate knowledge of proper metabolic functions to understand how metabolic dysfunction of one system affects the function of other systems.
5. Design evidence-based management strategies to mitigate common metabolic dysfunctions in livestock.

ANSC 625. Nutrient Metabolism I: Mineral, Vitamin, and Nitrogen Metabolism
4 Credits (4)
Cellular metabolism, physiological function(s), toxicities, and deficiencies of minerals, vitamins and nitrogen in ruminants and nonruminants.
Prerequisite: ANSC 501.
Learning Outcomes
1. To introduce the student to the absorption and disposition of vitamins and minerals in the animal.
2. To provide the student with a basic understanding of the importance of vitamins and minerals in animal metabolism.
3. To introduce the student to the concept of nitrogen metabolism and the partitioning of nitrogen in the animal.

ANSC 626. Nutrient Metabolism II: Carbohydrates, Lipids, and Energetics
4 Credits (4)
Basic principles of carbohydrate, lipid, and energy metabolism; integration of metabolism with emphasis on nutritional and biochemical processes related to efficiency of nutrient use.
Prerequisite: ANSC 501.
Learning Outcomes
1. Varies.

ANSC 698. Special Research Programs
1-4 Credits
Advanced individual investigations, either analytical or experimental. Maximum of 4 credits per semester. No more than 6 credits toward a degree. Consent of Instructor required.

ANSC 700. Doctoral Dissertation
15 Credits
Dissertation. Consent of Instructor required. Thesis/Dissertation Grading.

Range Science Courses

RGSC 1110. The Range Science Profession
1 Credit (1)
Introduction to scientific disciplines and career opportunities in rangeland science and management.

Learning Outcomes

1. To introduce students to the Range Science program and to a variety of career opportunities in Range Science.
2. To develop an individualized course curriculum that prepares the student to achieve their career goals.
3. To examine opportunities to gain practical work experience through internships and cooperative employment.

RGSC 2110. Introduction to Rangeland Management
3 Credits (3)
This course covers the principles of managing and understanding pasture and rangelands. Plant physiology and ecology, plant communities and rangeland sustainability and how they relate to livestock production and wildlife management will be discussed. Restricted to: Main campus only.
Learning Outcomes

1. Understand rangeland management operations.
2. Identify rangeland plants.
3. Gain a perspective of watershed management.
4. Discuss the management of rangeland resources.
5. Understand the process of rangeland evaluation through a broad understanding of monitoring and production of these rangelands.
6. Gain a perspective of the correlation of rangelands and the economic principles guiding resource management.
7. Understand the process of rangeland condition.
8. Understand the concepts of stocking rates and usage of rangelands.
9. Gain a broad perspective of different classes of land ownership; Tribal, federal, private and state. 1
10. Recognize vegetative communities, ecological sites, plant physiology andapplication to rangeland management considerations.

RGSC 2996. Special Topics
1-4 Credits
Specific subjects and credits announced in the Schedule of Classes. Maximum of 4 credits per semester and a grand total of 9 credits.
Learning Outcomes

1. Varies

RGSC 302V. Forestry and Society
3 Credits (3)
Global study of the development and use of forest resources for production of wood, fuel, fiber, and food products. Climatic, edaphic, cultural, and economic influences on forests of the world evaluated. Same as HORT 302V.
Learning Outcomes

1. Demonstrate comprehension of basic plant physiology.
2. Analyze various inputs and environmental factors that affect trees and forests.
3. Identify forest biomes based on plant morphology and environmental characteristics.
4. Categorize different types of forest products and harvesting methods.
5. Compare and contrast various forest management practices in the US and worldwide.
6. Evaluate climate and ecological issues as they relate to society.
7. Develop an awareness of the interconnection of nature and society.

RGSC 316. Rangeland Plants
3 Credits (2+3P)
Identification, classification, cultural uses, and economic importance of native and introduced rangeland plants. May be repeated up to 3 credits.
Learning Outcomes

1. Describe the physical characteristics of plants within key Representative Rangeland Plant Groups.
2. Explain the scientific classification system and accurately place plants within the correct taxonomic hierarchy (kingdom to species).
3. Apply plant morphology and classification knowledge to identify rangeland plants using field guides, dichotomous keys, and other botanical tools.
4. Demonstrate proficiency in field methods through plant surveys and specimen collection, connecting practical skills with theoretical concepts.
5. Analyze selected rangeland plant species for their unique traits, ecological roles, and potential uses in land management or restoration.

RGSC 317. Rangeland Communities
3 Credits (3)
Rangeland associations and communities, their plant species composition, and ecological factors affecting management of communities.
Learning Outcomes

1. Identify and distinguish the major rangeland associations and plant communities found across different regions of the United States.
2. Explain the ecological and geographical characteristics (ecogeographic) of rangeland communities and evaluate the primary management challenges associated with each.
3. Recognize and describe key plant and wildlife species that characterize each rangeland community, highlighting their ecological roles and interactions.

RGSC 318. Watershed Management
3 Credits (2+2P)
Management of rangeland and forest watersheds with emphasis on hydrologic cycle and land use effects on runoff and water quality. May be repeated up to 3 credits.
Learning Outcomes

1. Understand impacts of land use on water quantity and quality.
2. Quantify components of the hydrologic cycle.
3. Learn watershed management techniques and practices.
4. Apply scientific principles to evaluate current issues in watershed management.

RGSC 325. Rangeland Restoration Ecology
3 Credits (3)
Principles and practices of vegetation management and ecological restoration. Course emphasizes problems associated with rangeland degradation, and implementation of rangeland restoration and improvements.
Prerequisite: Sophomore standing or consent of instructor.
Learning Outcomes

1. Use fundamental knowledge of plants, soils, and climate to explain how changes in the structure and function of ecological systems can cause ecological degradation, and how management actions can implement changes to facilitate ecological restoration.
2. Compare and contrast the four major plant control methods (mechanical, chemical, fire, and biological) in terms of their effects on vegetation and soils and demonstrate how this knowledge informs management decisions.

3. Describe the biotic and abiotic factors that must be considered to design and implement feasible revegetation and restoration plans and explain the importance of these factors in an ecological context.
4. Apply the concepts and principles learned in this course to predict the effect of vegetation management activities on common North American rangeland plant communities.
5. Effectively communicate understanding of land degradation and restoration practices via writing and oral presentations.

RGSC 350. Special Topics
1-4 Credits
Specific subjects and credits announced in the Schedule of Classes. Maximum of 4 credits per semester and a grand total of 9 credits.

RGSC 357. Grass Taxonomy and Identification
3 Credits (1+4P)
Taxonomy of grasses; grass anatomy, variation in reproductive structures, and identification of grasses by sight and through the use of dichotomous keys. Students must be Junior standing to enroll in this course. May be repeated up to 3 credits.
Learning Outcomes
1. Use terminology to describe and identify grasses.
2. Apply dichotomous keys to unknown grass species so they can be identified.
3. Recognize numerous important rangeland grasses.
4. Understand the taxonomic classification of grasses.
5. Describe the important characteristics of grasses for disciplines related to range science, wildlife management, and natural history.

RGSC 390. Internship
1-3 Credits
Professional work experience under the joint supervision of the employer and a faculty member. A written report is required. No more than 3 credits toward a degree. May be repeated up to 3 credits.
Learning Outcomes
1. Apply foundational knowledge of rangeland science to practical field and management settings.
2. Gain firsthand experience working with professionals in the rangeland ecology and management field and develop key workplace skills such as communication, collaboration, and time management.
3. Describe the goals, roles, and daily operations of the host agency or organization, and reflect on how the internship experience informs their career interests and personal development.
4. Through documentation and final reporting, students will demonstrate an ability to communicate the value of their internship work and articulate how it connects to broader concepts in rangeland ecology and management.

RGSC 402. Seminar
1 Credit (1)
A seminar course designed to inform students of the career opportunities, develop their interviewing and other interpersonal skills may also include reading, discussions, written reports, and seminar presentations of current relevant literature.
Prerequisite(s): Senior standing.

RGSC 402 H. Range Science Seminar
1 Credit (1)
Taught with RGSC 402 with additional work.
Prerequisite(s): Meets Honors eligibility and/or Crimson Scholar status and senior standing.

RGSC 440. Rangeland Resource Ecology
3 Credits (3)
Plant adaptations to arid environments. Life histories of arid land plants. Biotic interactions among rangeland organisms. Arid land plant communities: their physiognomy, diversity, productivity, and response to disturbance. Arid land ecosystem dynamics.
Learning Outcomes
1. Students who complete this course will have a better understanding of mechanisms that determine how rangeland plant communities and ecosystems respond to natural and human-induced disturbance regimes.

RGSC 440 L. Rangeland Resource Ecology Lab
1 Credit (2P)
Living and nonliving factors of the range environment, the life forms and role of range plants and animals on succession and interactions in range ecosystems. Corerequisite(s): RGSC 440. May be repeated up to 1 credit.
Learning Outcomes
1. Students who complete this course will gain a comprehensive understanding of the interplay between abiotic and biotic factors in shaping rangeland plant communities.
2. Learn how rangeland ecosystems adapt and respond to both natural and human-induced disturbances and change.
3. Students will apply field measurement techniques and remote sensing to develop and evaluate rangeland monitoring assessment plans.

RGSC 448. Problems
1-4 Credits (1-4)
Individual investigation in a specific area of range science. Maximum of 4 credits per semester and a grand total of 6 credits. Consent of Instructor required.

RGSC 452. Vegetation Measurements for Rangeland Assessment
4 Credits (2+4P)
Sampling principles, sampling design, and measurement methods used to quantify vegetation attributes and to assess the structure and function of rangeland ecosystems. Laboratory emphasizes practical field techniques, quantitative analysis, and interpretation of results. May be repeated up to 4 credits.
Prerequisite: RGSC 294 and A ST 311.
Learning Outcomes
1. Choose from many available tools and methods for measuring and quantifying vegetation.
2. Design appropriate sampling protocols to meet monitoring objectives in various types of vegetation.
3. Measure vegetation cover, density, frequency, species inventory and production on rangelands.
4. Estimate utilization of forage.
5. Explain advantages and disadvantages of different sampling and measurement methods.
6. Use standard approaches to land classification and evaluation to interpret results in the context of resource management decisions.
7. Clearly communicate results through graphics as well as writing.

RGSC 458. Livestock Behavior, Welfare and Handling
3 Credits (2+3P)
Principles of animal behavior and evaluation of management practices on animal welfare in confined and rangeland livestock operations. Low stress livestock handling techniques. Design of livestock handling facilities. Crosslisted with: ANSC 458

Prerequisite(s): RGSC 2110 or ANSC 1120.

RGSC 460. Rangeland and Natural Resource Planning and Management
4 Credits (3+3P)
Planning and problem solving in rangeland and natural resource management. Public land planning and policy. Application of land management principles to resolve rangeland, riparian and habitat issues. May be repeated up to 4 credits.
Prerequisite: Senior or graduate student standing.
Learning Outcomes
1. Apply previous course work and skills to evaluate approaches to rangeland management issues.
2. Prepare a proposal for a practitioner-scientist research and management project which will include a comprehensive literature review of a specific topic, a directed research and project objective, partnerships among stakeholders, a project budget and timeline, and a monitoring and evaluation plan.

RGSC 485. Land Cover Analysis for Natural Resources
3 Credits (3)
This course is designed to help students understand, manipulate and extract Earth Observation (EO) data and to conduct land cover analysis related to natural resources including water and vegetation. The course provides and highlights means to identify and access EO data in different formats, extract meaningful information, and to help students developing critical thinking skills. The course introduces tools such as python and ArcGIS Pro to handle different data formats (e.g. hdf) efficiently; develop and present creative maps. The course provides basic information about how to conduct land use, land cover change analysis, mapping vegetation, water related variables and plant and animal distribution analysis.
Learning Outcomes
1. Identify sources of and obtain land cover GIS data.
2. Handle GIS data in different formats.
3. Extract meaningful information.
4. Development of qualitative reasoning and analytical thinking skills to address research questions related to natural resources.

RGSC 509. Approaches to Rangeland Research
3 Credits (3)
Experimental design and statistical analysis of experimental results.
Prerequisite: A ST 505 or consent of instructor.
Learning Outcomes
1. Define and articulate problems related to rangeland resources with clarity and relevance.
2. Formulate researchable questions based on clearly defined problems.
3. Identify and justify key variables relevant to addressing specific research questions.
4. Develop testable hypotheses and clearly defined research objectives.
5. Evaluate and compare alternative sampling methods for rangeland data collection.
6. Assess the strengths and limitations of various experimental designs in rangeland research.
7. Use statistical software tools, including Excel and SAS, to organize, analyze, and interpret data.
8. Critically analyze research publications and ongoing projects, including those of peers and professionals, for methodological rigor and scientific validity.

RGSC 513. Advanced Rangeland Ecology
3 Credits (3)
Overview of the current state of knowledge in selected areas of rangeland ecology, with emphasis on currently developing ideas and issues relevant to rangeland management.
Prerequisite: RGSC 440 or equivalent.
Learning Outcomes
1. Define rangelands and describe their global distribution, ecological characteristics, and historical context within the field of natural resource management.
2. Explain key ecological principles and functional traits (morphology and physiology) that influence rangeland ecosystem structure, function, and response to disturbance.
3. Apply foundational methods for rangeland inventory, monitoring, and assessment, including techniques for evaluating vegetation, soil condition, and ecosystem health.
4. Evaluate strategies for sustainable rangeland management, including livestock grazing systems, vegetation management, restoration practices, and watershed/riparian area protection.

RGSC 515. Graduate Seminar
1 Credit (1)
Current topics. Graded S/U.

RGSC 516. Arid Land Management
3 Credits (3)
Survey of seminal and current literature dealing with management of arid and semiarid lands including soil-plant-animal interactions, plant community ecology, arid land assessment methods, and arid land hydrology.
Learning Outcomes
1. Gain a better understanding of the basic science underlying the management of semi-arid and arid range lands.
2. Have an increased appreciation of relevant topics, seminal papers, as well as key researchers in each of the areas of arid land management mentioned above.
3. Become familiarized with the history, academic traditions, and current issues in arid land management in the western United States.

RGSC 518. Watershed Methods and Management
3 Credits (3)
Management of rangeland and forest watersheds with emphasis on the hydrologic cycle and land use effects on runoff and water quality. Hydrologic monitoring methods problem sets required for graduate credit.
Learning Outcomes
1. Understand impacts of land use on water quantity and quality.
2. Quantify components of the hydrologic cycle.
3. Learn watershed management techniques and practices.
4. Apply scientific principles to evaluate current issues in watershed management.

RGSC 520. Arid Land Plant Herbivore Interactions
3 Credits (3)
Survey of seminal and current literature dealing with plant- and animal-related factors that influence herbivory patterns in arid landscapes. Although ungulate herbivory is a central focus of the course, the role of plant defenses in deterring both vertebrate and invertebrate herbivores is discussed in detail.
Learning Outcomes
1. To develop a holistic systems thinking and problem-solving approach to understanding plant and animal interrelationships, as well as addressing issues relevant to both managed and natural ecosystems.

2. Students who complete this course will develop a comprehensive understanding of these dynamics and be equipped with the skills to apply this knowledge in practical scenarios.
3. Students will deepen their understanding of how to read, review, and present scientific literature, and conduct scientific paper annotations.
4. Develop a first draft of a scientific paper reporting either experimental results, a meta-analysis of existing data, or an in-depth literature review on a topic related to the student's dissertation.

RGSC 525. Advanced Rangeland Restoration Ecology
3 Credits (3)
Theory and application of restoration ecology and the principles and practices of ecological restoration. Course emphasizes problems associated with rangeland degradation and highlights current restoration management actions.
Learning Outcomes
1. Use fundamental knowledge of plants, soils, and climate to explain how changes in the structure and function of ecological systems can cause ecological degradation, and how management actions can implement changes to facilitate ecological restoration.
2. Compare and contrast the four major plant control methods (mechanical, chemical, fire, and biological) in terms of their effects on vegetation and soils and demonstrate how this knowledge informs management decisions.
3. Describe the biotic and abiotic factors that must be considered to design and implement feasible revegetation and restoration plans and explain the importance of these factors in an ecological context.
4. Apply the concepts and principles learned in this course to predict the effect of vegetation management activities on common North American rangeland plant communities.
5. Effectively communicate understanding of land degradation and restoration practices via writing and oral presentations.

RGSC 550. Special Topics
1-4 Credits
Specific subjects to be announced in the Schedule of Classes. Maximum of 4 credits per semester. No more than 9 credits toward a degree.

RGSC 551. Earth Data Retrieval
3 Credits (3)
This course covers topics related to identifying sources, preprocessing, utilizing earth data that can be used to monitor some hydrological and water related variables, vegetation growth and related biophysical properties. The course focuses on developing students' skills on how to handle and analyze high-level large amounts of research data in different formats (i.e. .hdf). The course highlights the use of remote sensing and land surface models-based (NLDAS) earth observation datasets (e.g. NDVI, LST, Ta, and ET). The course uses some open-source tools including Python, API as well as MATLAB. Crosslisted with: WSAM 551.
Learning Outcomes
1. Identify, retrieve, and visualize earth observation datasets that are relevant to individual research activities.
2. Understand the nature and formats of earth observation data.
3. Handle, process, and conduct quantitative analysis of earth observation datasets using python, MATLAB, and cloud computing (GEE).
4. Development of qualitative reasoning and analytical thinking skills to address research questions related to earth observation datasets.

RGSC 557. Advanced Grass Taxonomy and Identification
3 Credits (1+4P)
Taxonomy of grasses; grass anatomy, variation in reproductive structures, and identification of grasses by sight and through the use of dichotomous keys. Additional writing and grass identification assignments are required for graduate credit. May be repeated up to 3 credits.
Learning Outcomes
1. Use terminology to describe and identify grasses.
2. Apply dichotomous keys to unknown grass species so they can be identified.
3. Recognize numerous important rangeland grasses.
4. Understand the taxonomic classification of grasses.
5. Describe the important characteristics of grasses for disciplines related to range science, wildlife management, and natural history.

RGSC 575. Climate Studies, Water and Society
3 Credits (3)
The course provides a brief description of the Earth's climate system, an in-depth review and methodologies used to investigate climate change and variability, evidence of climate change on natural systems (water availability) vulnerability of human systems (e.g. agriculture) to climate change, and mitigation and adaptation strategies.
Learning Outcomes
1. Know, identify, and interrogate Earth's climate observation datasets.
2. Evaluate and understand Earth's climate systems.
3. Conduct meaningful investigations, prediction, and inferencing.
4. Critical thinking about climate change impacts on human and natural resources.

RGSC 585. Land Cover Analysis for Natural Resources
3 Credits (3)
This course is designed to help students understand, manipulate and extract Earth Observation (EO) data and to conduct land cover analysis related to natural resources including water and vegetation. The course provides and highlights means to identify and access EO data in different formats, extract meaningful information, and to help students developing critical thinking skills. The course introduces tools such as python and ArcGIS Pro to handle different data formats (e.g. hdf) efficiently; develop and present creative maps. The course provides basic information about how to conduct land use, land cover change analysis, mapping vegetation, water related variables and plant and animal distribution analysis. Crosslisted with: WSAM 585.
Learning Outcomes
1. Identify sources of and obtain land cover GIS data.
2. Handle GIS data in different formats.
3. Extract meaningful information.
4. Development of qualitative reasoning and analytical thinking skills to address research questions related to natural resources.

RGSC 589. Landscape Hydrology Modeling
3 Credits (3)
The course "Landscape Hydrology Modeling" offers topics related to the physical hydrological processes that occur at different spatial and temporal scales in terms of understanding, quantitative evaluation, modeling, and visualization. It addresses precipitation, runoff, infiltration, and evaporation, as well as understanding impact of land use change on these processes. The course highlights and provide training on the use of hydrological modeling tools including WMS software, HydroVIS and ArcGIS software to help students understand, model, manipulate, and visualize hydrological data processes. The course offers hands-on learning experience on the use of these tools.

Learning Outcomes

1. Identify the different components of a landscape scale hydrologic system and quantitatively evaluate the associated physical processes including precipitation, runoff, streamflow, infiltration, evapotranspiration.
2. Retrieve and visualize a hydrologic system data along with the associated datasets.
3. Be able to model hydrological processes within a watershed and understand the streamflow generation process and the effect of vegetation and topography on streamflow generation.
4. Gain knowledge about, and be able to use, some of the available tools that can be used in spatial and temporal hydrological process modeling.

RGSC 598. Special Research Program
1-4 Credits
Individual investigations, either analytical or experimental. Maximum of 4 credits per semester. No more than 6 credits toward a degree. Consent of Instructor required.

RGSC 599. Master's Thesis
15 Credits
Thesis. Consent of Instructor required. Thesis/Dissertation Grading.

RGSC 600. Doctoral Research
1-15 Credits
Research. Consent of Instructor required. Thesis/Dissertation Grading.

RGSC 616. Advanced Arid Land Management
3 Credits (3)
In depth discussion of seminal and current literature dealing with management of arid and semiarid lands including land tenure systems, soil-plant-animal interactions (emphasis on livestock grazing), plant community ecology and assessment methods, and arid land hydrology.

RGSC 620. Advanced Arid Land Plant-Herbivore Interactions
3 Credits (3)
In depth discussion of seminal work dealing with plant- and animal-related factors that influence herbivory patterns in arid landscapes. Although ungulate herbivory is a central focus of the course, the role of plant defenses in deterring both vertebrate and invertebrate herbivores is discussed in detail.

Learning Outcomes

1. To develop a holistic systems thinking and problem-solving approach to understanding plant and animal interrelationships, as well as addressing issues relevant to both managed and natural ecosystems.
2. Students will deepen their understanding of how to read, review, and present scientific literature, and conduct scientific paper annotations.
3. Develop a first draft of a scientific paper reporting either experimental results, a meta-analysis of existing data, or an in-depth literature review on a topic related to the student's dissertation.
4. Students who complete this course will develop a comprehensive understanding of these dynamics and be equipped with the skills to apply this knowledge in practical scenarios.

RGSC 698. Special Research Programs
1-4 Credits (1-4)
Advanced individual investigations, either analytical or experimental. Maximum of 4 credits per semester. No more than 6 credits toward a degree. Consent of Instructor required.

RGSC 700. Doctoral Dissertation
15 Credits
Dissertation. Consent of Instructor required. Thesis/Dissertation Grading.

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