Advanced study in animal science offers preparation for a future in teaching, research, extension, livestock and dairy production, and in industries involving food technology, livestock products and livestock management. Majors offered are:

- **Animal breeding:** MS and PhD
- **Animal science:** MS, MAgr and PhD
- **Equine industry management:** MEIM
- **Food science and technology:** MS, MAgr and PhD
- **Genetics:** MS and PhD
- **Nutrition:** MS and PhD
- **Physiology of reproduction:** MS and PhD

The animal science subject matter fields are strongly supported by coursework in agricultural economics, biochemistry, biophyscis, biology, genetics, statistics, and in veterinary anatomy, microbiology, parasitology, pathology, physiology, pharmacology and public health.

Laboratories available for graduate research include cytogenetics, genomics, food technology, meat science, nutrition, molecular biology and reproductive physiology. The Robert Justus Kleberg, Jr. Animal and Food Science Center provides 39 laboratories for research and graduate training. Special equipment available in these laboratories or in readily accessible facilities, such as at the Computing Services Center, offer a wide array of opportunities for study and research.

Dairy, beef, horse and swine herds and sheep and goat flocks at the main station or at research centers afford opportunities to study various problems in physiology, breeding, management, nutrition and production. The Rosenthal Meat Science and Technology Center, equipped to fabricate and process all meat foods on a semicommercial scale, is available for research problems. Texas A&M AgriLife Research projects in all subject matter fields offer opportunities for graduate students to participate in current research activities.

Support areas such as biochemistry and biophyscis, economics, genetics and statistics may be readily arranged. Food science and technology and nutrition courses are jointly listed.

There is no specific foreign language requirement for the Doctor of Philosophy degree. A student's advisory committee may require a foreign language or additional coursework in an unrelated area in lieu of a foreign language.

**Faculty**

- **Bazer, Fuller W, Distinguished Professor**
  Animal Science
  PHD, North Carolina State University, 1969

- **Carstens, Gordon E, Professor**
  Animal Science
  PHD, Colorado State University, 1998

- **Castillo, Alejandro, Associate Professor**
  Animal Science
  PHD, Texas A&M University, 1998

- **Cooke, Reinaldo F, Associate Professor**
  Animal Science
  PHD, University of Florida, 2008

- **Cross, H Russell, Professor**
  Animal Science
  PHD, Texas A&M University, 1972

- **Daigle, Courtney L, Assistant Professor**
  Animal Science
  PHD, Michigan State University, East Lansing, MI, 2013

- **De Carvalho Cardoso, Rodolfo, Assistant Professor**
  Animal Science
  PHD, Texas A&M University, 2014

- **DVM, Sao Paulo State University, 2005

- **Dunlap, Kathrin A, Assistant Professor**
  Animal Science
  PHD, Texas A&M University, 2006

- **Forrest, David W, Professor**
  Animal Science
  PHD, University of Wyoming, 1979

- **Garcia, Leslie L, Instructional Assistant Professor**
  Animal Science
  PHD, Texas A&M University, 2015

- **Gehring, Kerri B, Professor**
  Animal Science
  PHD, Texas A&M University, 1994

- **Gill, Clare A, Professor**
  Animal Science
  PHD, University of Adelaide, Australia, 2000

- **Gill, Jason J, Assistant Professor**
  Animal Science
  PhD, University of Guelph, 2006

- **Heird, James C, Executive Professor**
  Animal Science
  PHD, Texas Tech University, 1978

- **Herring, Andy D, Professor**
  Animal Science
  PHD, Texas A&M University, 1994

- **Ing, Nancy H, Professor**
  Animal Science
  PHD, University of Florida, 1988

- **Kerth, Christopher R, Associate Professor**
  Animal Science
  PHD, Texas Tech University, 1999
Department of Animal Science

Lamb, Graham C, Professor
Animal Science
PHD, Kansas State University, 1998

Leatherwood, Jessica L, Assistant Professor
Animal Science
PHD, Texas A&M University, 2013

Mies, William L, Visiting Professor
Animal Science
PHD, University of Missouri, 1971

Miller, Rhonda K, Professor
Animal Science
PHD, Colorado State University, 1983

Osburn, Wesley N, Associate Professor
Animal Science
PHD, University of Nebraska–Lincoln, 1996

Ramsey, W S, Professor
Animal Science
PHD, New Mexico State University, 1996

Riggs, Penny K, Associate Professor
Animal Science
PHD, Texas A&M University, 1996

Riley, David G, Professor
Animal Science
PHD, Texas A&M University, 2000

Sanders, James O, Professor
Animal Science
PHD, Texas A&M University, 1977

Satterfield, Michael C, Associate Professor
Animal Science
PHD, Texas A&M University, 2008

Savell, Jeffrey W, Professor
Animal Science
PHD, Texas A&M University, 1978

Sawyer, Jason E, Associate Professor
Animal Science
PHD, New Mexico State University, 2000

Skaggs, Chris L, Professor
Animal Science
PHD, Iowa State University, 1992

Smith, Gary C, Visiting Professor
Animal Science
PHD, Texas A&M University, 1968

Smith, Stephen B, Professor
Animal Science
PHD, University of California, Davis, 1980

Taylor, Thomas M, Associate Professor
Animal Science
PHD, University of Tennessee, Knoxville, 2006

Tedeschi, Luis O, Professor
Animal Science
PHD, Cornell University, 2001

Tomaszewski, Michael A, Visiting Professor
Animal Science
PHD, North Carolina State University, 1972

Vogelsang, Martha M, Senior Lecturer
Animal Science
PHD, Texas A&M University, 1986

Welsh Jr, Thomas H, Professor
Animal Science
PHD, North Carolina State University, 1980

White, Sarah H, Assistant Professor
Animal Science
PHD, University of Florida, 2014

Wickersham, Tryon A, Associate Professor
Animal Science
PHD, Kansas State University, 2006

Wu, Guoyao, Professor
Animal Science
PHD, University of Alberta, Canada, 1989

Masters

- Master of Agriculture in Animal Science (http://catalog.tamu.edu/graduate/colleges-schools-interdisciplinary/agriculture-life-sciences/animal-science/magr)
- Master of Equine Industry Management in Equine Industry Management (http://catalog.tamu.edu/graduate/colleges-schools-interdisciplinary/agriculture-life-sciences/animal-science/equine-industry-reproduction-ms)
- Master of Science in Animal Breeding (http://catalog.tamu.edu/graduate/colleges-schools-interdisciplinary/agriculture-life-sciences/animal-science/animal-breeding-ms)
- Master of Science in Animal Science (http://catalog.tamu.edu/graduate/colleges-schools-interdisciplinary/agriculture-life-sciences/animal-science/ms)
- Master of Science in Physiology of Reproduction (http://catalog.tamu.edu/graduate/colleges-schools-interdisciplinary/agriculture-life-sciences/animal-science/physiology-reproduction-ms)

Doctoral

- Doctor of Philosophy in Animal Breeding (http://catalog.tamu.edu/graduate/colleges-schools-interdisciplinary/agriculture-life-sciences/animal-science/animal-breeding-phd)
- Doctor of Philosophy in Animal Science (http://catalog.tamu.edu/graduate/colleges-schools-interdisciplinary/agriculture-life-sciences/animal-science/phd)
- Doctor of Philosophy in Physiology of Reproduction (http://catalog.tamu.edu/graduate/colleges-schools-interdisciplinary/agriculture-life-sciences/animal-science/physiology-reproduction-phd)
Certificates

- Meat Science Certificate (http://catalog.tamu.edu/graduate/colleges-schools-interdisciplinary/agriculture-life-sciences/animal-science/meat-science-certificate)

Courses

ANSC 601/NFSC 601 General Animal Nutrition
Credits 3.3 Lecture Hours.
Comparative nutrition of animal species contrasting digestive, metabolic and physiological functions involved in processing and using nutrients.
Prerequisite: ANSC 303/NFSC 303 or ANSC 318 or equivalent.
Cross Listing: NFSC 601/ANSC 601.

ANSC 602/NFSC 602 Energetics of Metabolism and Growth
Credits 3.3 Lecture Hours.
Current fundamental concepts in protein and energy metabolism relating to nutrients required for maintenance, growth and development of animals.
Prerequisite: BICH 410 or approval of instructor.
Cross Listing: NFSC 602/ANSC 602.

ANSC 604 Ruminant Nutrition
Credits 3.3 Lecture Hours.
Current concepts in anatomy, physiology of digestion and metabolism in ruminant nutrition and their relationships to nutrition practice and research with emphasis on ruminants.
Prerequisites: ANSC 601/NFSC 601 or ANSC 602/NFSC 602; BICH 411 or BICH 603 and/or approval of department head.

ANSC 605 Advancements in Beef Cattle Production
Credits 3.3 Lecture Hours.
Current knowledge and concepts in production of lean beef; review of research in beef cattle production, breeding, nutrition, reproduction and economics.
Prerequisites: ANSC 305, ANSC 318 and ANSC 406 or approval of department head.

ANSC 607/NFSC 607 Physiology and Biochemistry of Muscle as a Food
Credits 3.3 Lecture Hours.
Biochemical, histological, anatomical and physical characteristics of muscle cells and factors associated with transformation of muscle cells into meat.
Prerequisite: BICH 410 or approval of department head.
Cross Listing: NFSC 607/ANSC 607.

ANSC 608 Beef Cattle Management
Credits 3.3 Lecture Hours.
Current knowledge of beef cattle ranch and feedlot production systems; nutrition, management, breeding, body composition, economics, health, pollution and sanitation control.
Prerequisite: ANSC 406 or ANSC 408.

ANSC 609 Physiology of Growth and Stress in Livestock
Credits 3.3 Lecture Hours.
Basic biochemical, physiological and endocrine mechanisms involved in processes regulating metabolism, growth and stress in livestock; current research and management principles/concepts useful to study growth and stress physiology; anabolic agents, anti-stress agents, immunoneutralization; transgenic livestock.
Prerequisites: BICH 410 and BICH 411 or approval of instructor.

ANSC 610 Applied Animal Ethology
Credits 3.2 Lecture Hours. 2 Lab Hours.
Review and evaluation of ethological research and principles as they relate to the management of animals; research principles and techniques used in studying animal behavior; psychological and physiological aspects of stress; topics of interest to students; visits to laboratories of researchers studying aspects of animal behavior/ethology.

ANSC 611 Equine Nutrition
Credits 3.3 Lecture Hours.
Review and evaluation of current research in equine nutrition; principles of digestive physiology and nutrition unique to equine species; comparative digestion; integration of scientific principles into feeding management systems to enhance productivity, health and longevity of the equine.
Prerequisite: ANSC 601/NFSC 601 or approval of department head.

ANSC 612 Equine Reproduction
Credits 3.3 Lecture Hours.
Review of current research relating to equine reproductive physiology and endocrinology; concepts from current research in equine reproduction to develop integrated reproductive management systems for horses.
Prerequisites: ANSC 433; graduate classification.

ANSC 613/NFSC 613 Protein Metabolism
Credits 3.3 Lecture Hours.
Basic concepts and recent advances in protein metabolism in animals with emphasis on physiological and nutritional significances; discussion of protein digestion; absorption of peptides; absorption, synthesis and degradation of amino acids; hormonal and nutritional regulation of protein turnover; determination of protein quality and requirements.
Prerequisite: BICH 411 or BICH 601 or approval of instructor.
Cross Listing: NFSC 613/ANSC 613.

ANSC 614/GENE 614 Maximum Likelihood Estimation of Genetics
Credits 3.3 Lecture Hours.
Theoretical and analytical approaches to the application of maximum likelihood for the estimation of parameters under linear and nonlinear models; single and polygene genetic models including Hardy-Weinberg equilibrium, linkage analysis and quantitative trait loci detection.
Prerequisites: GENE 603; STAT 651 and STAT 652 or STAT 601.
Cross Listing: GENE 614/ANSC 614.

ANSC 615 Brazil: Comparative Ruminant Animal Nutrition
Credits 3.3 Lecture Hours.
Contrast two scenarios of ruminant production in Brazil; the effects of globalization on the two different production systems.
Prerequisites: ANSC 603 or ANSC 604, or approval of instructor.

ANSC 616 Equine Exercise Science
Credits 3.3 Lecture Hours.
Review and evaluation of current research in equine exercise science; physical, physiologic and metabolic adaptation to physical training in the horse; bioenergetics; nutritional requirements; problems in the hard-working horse; management and training approaches to delay fatigue in race/performance horses.
Prerequisites: ANSC 420; BICH 411; graduate classification.

ANSC 617/NFSC 617 Experimental Techniques in Meat Science
Credits 3.1 Lecture Hour. 6 Lab Hours.
Methods used in separating and identifying muscle proteins and fats; techniques for determining postmortem changes of muscle tissue as a result of antemortem treatments.
Prerequisites: ANSC 607/NFSC 607; BICH 411.
Cross Listing: NFSC 617/ANSC 617.
ANSC 618/NFSC 618 Lipids and Lipid Metabolism
Credits 3. 3 Lecture Hours.
Chemical nature of various classes of lipids and lipid-derived hormones; absorption and metabolism of fatty-acids and lipids; regulation of lipid biosynthesis and obesity; relationship between lipid metabolism and cholesterol homeostasis; lipids as hormones.
Prerequisite: BICH 410 or approval of instructor.
Cross Listing: NFSC 618/ANSC 618.

ANSC 619 Physiological Chemistry of Livestock Species
Credits 3. 3 Lecture Hours.
Integration of biochemical concepts with physiological chemistry and intermediary metabolism of livestock species; unique aspects of absorption and cellular metabolism of carbohydrates, lipids and proteins in livestock species; regulation of cellular nutrient metabolism in livestock species.
Prerequisite: BICH 410 or approval of instructor.

ANSC 620 Issues in the Equine Industry
Credits 3. 3 Lecture Hours.
Integration of cumulative knowledge acquired in the equine science curriculum to demonstrate critical thinking and communication skills to address critical issues in the equine industry.
Prerequisite: Approval of instructor or enrollment in master of equine industry management program.

ANSC 621 Research Methods in Animal Science
Credits 2. 2 Lecture Hours.
Development of the conceptual framework of research; study of software programs for data recording, management, and analysis; evaluation of specific experimental designs historically used in animal experiments; discussion of interpretations found in peer-reviewed research publications; data presentation for scientific meetings and publication; the peer review process and publication in technical journals.
Prerequisite: STAT 651; or STAT 652.

ANSC 623/POSC 625 Precision Diet Formula
Credits 2. 2 Lecture Hours. 2 Lab Hours.
Theoretical and applied principles associated with precision feeding and diet formulation to optimize nutrient requirements; optimization using least-cost formulation, ingredient inventory, farm and feed mill management, and nutrient management of non-ruminants (poultry, swine, horse, and fish) and ruminant animals (beef and dairy).
Prerequisite: POSE 411 or ANSC 318.
Cross Listing: POSE 625/ANSC 623.

ANSC 624 Mammalian Developmental Genetics
Credits 3. 3 Lecture Hours.
Genetic control of developmental pathways responsible for pattern formation and morphogenesis in mammals; genetic networks and genome organization; significance of genetic regulatory networks as a source of evolutionary diversity.
Prerequisites: GENE 301 or GENE 320/BIMS 320; BICH 410/411 or equivalent.

ANSC 626/GENE 626 Analyses of Gene Expression
Credits 2. 1 Lecture Hour. 3 Lab Hours.
Proficiency in handling DNA and RNA gained during exercises used routinely in analyses of gene expression; RNA preparation and analysis on Northern blots; in vitro transcription and polyacrylamide gel analysis of nucleic acids; sub-cloning and mRNA quantitation using polymerase chain reaction.
Prerequisites: GENE 450 or approval of instructor; radiation safety training.
Cross Listing: GENE 626/ANSC 626.

ANSC 627 Carcass Composition and Quality
Credits 3. 3 Lecture Hours.
Survey of scientific literature regarding carcass composition; quality and palatability of meat animals; factors that affect differences among animals of the same specie; impact on value and usefulness.
Prerequisite: Graduate classification.

ANSC 628 Animal Breeding
Credits 3. 2 Lecture Hours. 2 Lab Hours.
Concepts from Mendelian, population and quantitative genetics; heritability, selection response, selection criteria, selection index, genetic relationship, inbreeding, mating systems, hybrid vigor and genetic-environmental interaction applied to livestock breeding and to production systems; interactions between genetics and nutrition, reproduction, production and management for both established concepts and recent trends emphasized according to special interests of students.
Prerequisite: ANSC 305 or POSC 414.

ANSC 629 Applied Animal Genomics
Credits 3. 3 Lecture Hours.
Theory and application of genomics by livestock industries; consideration of genetic markers, gene mapping methods, genome analysis and emerging technologies such as microarrays, transgenesis, cloning and marker assisted selection; exposure to bioinformatic tools for genomics.
Prerequisite: GENE 603.
Cross Listing: GENE 629 and POSC 630.

ANSC 630 Reproductive Biology I
Credits 4. 4 Lecture Hours.
Embryological, physiological, hormonal, cellular and molecular mechanisms involving the endocrine and reproductive systems of mammals; emphasis on domestic livestock, rodents and humans; current theories evaluated and discussed using information from recent scientific publications.
Prerequisites: ANSC 433; BICH 411 or equivalent.

ANSC 631 Reproductive Biology II
Credits 4. 4 Lecture Hours.
Embryological, physiological, hormonal, cellular and molecular mechanisms involving the endocrine and reproductive systems of mammals; emphasis on domestic livestock, rodents and humans; current theories evaluated and discussed using information from recent scientific publications.
Prerequisite: ANSC 630 or approval of instructor.

ANSC 633 Concepts in Reproduction
Credits 3. 3 Lecture Hours.
Concepts from current research in physiology of reproduction evaluated and applied for enhancement of livestock production efficiency; ovulation control, embryo transfer, multiple births and control of parturition.
Prerequisite: ANSC 433 or equivalent or approval of department head.

ANSC 636 Texas Panhandle Beef Production Tour
Credits 2. 2 Lecture Hours.
Covers all facets of beef production from cow/calf operation to retail product; experiential knowledge of technologies and practices to enhance efficiency; enlightens the array of career opportunities in the beef production industry.
Prerequisite: Approval of instructor.
ANSC 637 Food Safety: Policy, Regulations and Issues
Credits 3. 2 Lecture Hours. 1 Lab Hour.
Designed to explore the complexities of the regulations governing the production of foods of animal origin in the United States; requirements for countries importing products into the United States; federal, state and local requirement will be addressed.
Prerequisites: ANSC/FTSC 457/657 or approval of instructor.

ANSC 638 Prediction of Genetic Merit
Credits 3. 3 Lecture Hours.
Mixed linear models and best linear unbiased prediction for genetic evaluation.
Prerequisite: GENE 613.
Cross Listing: GENE 638/ANSC 638.

ANSC 647/NFSC 647 Technology of Meat Processing and Distribution
Credits 3. 3 Lecture Hours.
Quantitative and qualitative characteristics of meat and meat products as related to food technology processing operations; manufacturing, preservation, packaging and merchandising.
Cross Listing: NFSC 647/ANSC 647.

ANSC 651 Current Issues in Animal Agriculture
Credits 3. 3 Lecture Hours.
Projecting a professional image and utilizing communication skills to describe animal agriculture; strengths and weaknesses of animal agriculture.
Prerequisite: Graduate classification.

ANSC 657/NFSC 657 Hazard Analysis and Critical Control Point System
Credits 3. 3 Lecture Hours.
Examination of the Hazard Analysis and Critical Control Point (HACCP) principles specifically related to meat and poultry; microbiological and process overviews; good manufacturing practices (GMP) and standard operating procedures (SOP) development; team-building and implementation into industry operations. This class is designed for the production of food and fulfills the training requirements of USDA's HACCP regulation for meat and poultry (9 CFR Part 417), and FDA's HACCP regulations for fish and fishery products (21 CFR Part 123 and 1240) and for juice (21 CFR Part 120).
Cross Listing: NFSC 657/ANSC 657.

ANSC 667/NFSC 667 Industrial Processed Meat Operations
Credits 3. 2 Lecture Hours. 2 Lab Hours.
Application of scientific principles and business practices to manufactured meat products; interrelationships among marketing, manufacturing, product development, regulatory compliance and quality assurance in commercial processed meat operations.
Prerequisite: Approval of instructor.
Cross Listing: NFSC 667/ANSC 667.

ANSC 670/NFSC 670 Quality Assurance for the Food Industry
Credits 3. 3 Lecture Hours.
Principles of food system process control; statistical process control (SPC); tools required to assure uniform communication and understanding of quality assurance systems.
Prerequisite: Graduate classification.
Cross Listing: NFSC 670/ANSC 670.

ANSC 680 Applied Concepts of Meat Animal Myology
Credits 3. 2 Lecture Hours. 2 Lab Hours.
Introduction to fundamental concepts of meat animal myology as they pertain to industrial meat science; standard formats for scientific nomenclature in the context of meat science and industry related terminology; fabricated cuts used to illustrate myology concepts.
Prerequisite: Graduate classification.

ANSC 681 Seminar
Credit 1. 1 Lecture Hour.
Important current developments in field of animal science; review of current literature and presentation of papers on selected animal science topics.
Prerequisite: Graduate classification in animal science.

ANSC 684 Professional Internship
Credits 1 to 16. 1 to 16 Other Hours.
Experience in the application of formal training to a commercial operation under supervision of the operations manager and a designated faculty member. The student will investigate a matter of mutual interest to the enterprise manager and to Texas A&M University; will collect, analyze and interpret the data and report the results in a professional paper approved by his or her graduate committee.

ANSC 685 Directed Studies
Credits 1 to 4. 1 to 4 Other Hours.
Advanced studies in animal science problems and procedures. Problems assigned according to experience, interest and needs of individual student.
Prerequisite: Approval of department head.

ANSC 687/NFSC 687 Sensory Evaluation of Foods
Credits 3. 2 Lecture Hours. 2 Lab Hours.
Application of sensory science principles and practices to food systems including an understanding of discriminative, descriptive and consumer sensory techniques.
Prerequisite: CHEM 222 or CHEM 228.
Cross Listing: NFSC 687/ANSC 687.

ANSC 689 Special Topics in...
Credits 1 to 4. 1 to 4 Lecture Hours. 0 to 4 Lab Hours.
Special topics in an identified area of animal science. May be repeated for credit.
Prerequisite: Approval of department head.

ANSC 691 Research
Credits 1 to 23. 1 to 23 Other Hours.
Investigations leading to student's thesis or dissertation in fields of animal production, meats, wool and mohair, nutrition, inheritance of farm animals and physiology of reproduction.

ANSC 697/NFSC 697 Applied Microbiology for Foods of Animal Origin: Processing, Sanitation and Sanitary Design
Credits 3. 3 Lecture Hours.
Application of basic food microbiology knowledge and principles to food production processes and products; sources of microbiological contamination and their impact on food safety and spoilage; application of sanitary design and validation; testing and auditing to monitor and trouble-shoot the process.
Prerequisites: DASC 326/NFSC 326 or NFSC 326/DASC 326, or NFSC 606/DASC 606, or equivalent.
Cross Listing: NFSC 697/ANSC 697.

DASC 606/NFSC 606 Microbiology of Foods
Credits 3. 3 Lecture Hours.
Nature and function of beneficial and defect-producing bacteria in foods; food-borne illness, effects of processing, storage and distribution; techniques for isolation and identification from foods.
Cross Listing: NFSC 606/DASC 606.
DASC 685 Directed Studies  
Credits 1 to 4. 1 to 4 Other Hours.  
Research methods and review of scientific literature dealing with individually selected problems in production or manufacturing and not pertaining to thesis or dissertation.

DASC 691 Research  
Credits 1 to 23. 1 to 23 Other Hours.  
Research leading to thesis or dissertation in respective fields of dairy production and dairy manufacturing.