110 Introductory Animal Agriculture
Fall, Spring. 4(3-2) SA: ANS 112
History of animal agriculture and its relationship to human needs, production systems, marketing, and environmental considerations. Current goals and limitations affecting U.S. farm animal production.

140 Fundamentals of Horsemanship
Spring. 2(0-4) A student may earn a maximum of 4 credits in all enrollments for this course.
Safe horse handling skills. Riding skills. Riding aids and working with the horse at the beginner, intermediate or advanced level.

141 Draft Horse Basics
Fall. Spring. 2(0-4)
Safe handling, hitching and driving of draft horses.
Care and maintenance of harness and horse drawn equipment.

200A Introductory Judging of Livestock or Carcasses
Spring. 1 to 2 credits.
A student may earn a maximum of 3 credits in all enrollments for this course. A student may earn a maximum of 8 credits from ANS 200A, ANS 200B, ANS 200C, ANS 200D, ANS 300A, ANS 300B, ANS 300C and ANS 300D. RB: ANS 211

200B Introductory Judging of Dairy Cattle
Fall. Spring. 2(0-4)
A student may earn a maximum of 3 credits in all enrollments for this course. A student may earn a maximum of 8 credits from ANS 200A, ANS 200B, ANS 200C, ANS 200D, ANS 300A, ANS 300B, ANS 300C and ANS 300D. SA: ANS 200B

200C Introductory Judging of Sheep
Fall. Spring. 2(0-4)
A student may earn a maximum of 3 credits in all enrollments for this course. A student may earn a maximum of 8 credits from ANS 200A, ANS 200B, ANS 200C, ANS 200D, ANS 300A, ANS 300B, ANS 300C and ANS 300D. SA: ANS 200B
Evaluation of functional conformation of sheep. Preparation for intercollegiate competition.

200D Introductory Judging of Horses
Spring. 1 to 2 credits.
A student may earn a maximum of 3 credits in all enrollments for this course. A student may earn a maximum of 8 credits from ANS 200A, ANS 200B, ANS 200C, ANS 200D, ANS 300A, ANS 300B, ANS 300C and ANS 300D. SA: ANS 200B

210 Animal Products
Fall. 4(3-2) R: Not open to freshmen.
Edible animal products. Processing, preservation, storage and distribution of dairy, meat, and egg products.

211 Animal and Product Evaluation
Fall. 3(1-4)
Evaluation of breeding stock, market animals and carcasses. Production records and soundness of breeding animals. Quality grading, yield grading and pricing of market animals and carcasses.

212 Merchandising Purebred Livestock
Spring of odd years. 2(1-2) RB: ANS 110 Purebred livestock industry. Private treaty and auction sales. Advertising, animal selection and budgeting of purebred livestock sales.

222 Introductory Beef Cattle Management
Spring. 3(2-2) RB: ANS 110 Not open to students with credit in ANS 422.
Management practices and systems for beef herds. Feed requirements, reproduction, breeding, performance testing, housing, and diseases. Costs and returns.

223 Introductory Dairy Cattle Management
Fall. 3(2-2) Not open to students with credit in ANS 432.
Principles and techniques of dairy herd management including calf and heifer care plus lactating and dry cow management.

242 Introductory Horse Management
Fall. 3(2-2) Not open to students with credit in ANS 442.
Principles of horse management. Reproduction, nutrition, herd health, genetics, economics, marketing.

252 Introduction to Management of Avian Species
Fall of odd years. 3(2-2)
Management of commercial poultry flocks and avian feed requirements, reproduction, breeding, housing and disease.

261 Principles of Animal Environments

262 Introductory Sheep Management
Spring. 3(2-2) R: Open only to sophomores or juniors or seniors.
Principles of sheep management: genetics, reproduction, nutrition, marketing, and economics.

272 Introductory Swine Management
Fall. 3(2-2) Not open to students with credit in ANS 472.
Swine production principles, practices, technologies, and systems.

275 Seafood Systems Management
Spring. 3(3-0) Interdepartmental with Food Science and Fisheries and Wildlife. Administration by Fisheries and Wildlife. Domestic and international perspectives on major aquatic foods. Cultural and nutritional value; wild harvest; aquaculture; processing technology; food handling and food safety.

300A Advanced Livestock Judging
Fall of even years. 2 credits. A student may earn a maximum of 8 credits from ANS 200A, ANS 200B, ANS 200C, ANS 200D, ANS 300A, ANS 300B, ANS 300C and ANS 300D. RB: ANS 200A R: Not open to freshmen.
Evaluation of conformation and performance records of beef cattle, swine and sheep. Represent MSU in intercollegiate competition.

300B Advanced Meat Evaluation and Grading
Fall. 2(0-4) A student may earn a maximum of 8 credits from ANS 200A, ANS 200B, ANS 200C, ANS 200D, ANS 300A, ANS 300B, ANS 300C and ANS 300D. RB: ANS 200A R: Not open to freshmen.
Evaluation of beef, pork, and lamb carcasses and wholesale cuts according to industry standards. Federal grading standards. Field trips to meat packing operations required. Represent MSU in intercollegiate competition.

300C Advanced Dairy Cattle Judging
Fall. 2 credits. A student may earn a maximum of 8 credits from ANS 432, ANS 200B, ANS 200C, ANS 200D, ANS 300A, ANS 300B, ANS 300C and ANS 300D. RB: ANS 200C R: Not open to freshmen.
Evaluation of conformation of various breeds of dairy cattle. Represent MSU in intercollegiate competition.

300D Advanced Horse Judging
Fall. 2 credits. A student may earn a maximum of 8 credits from ANS 200A, ANS 200B, ANS 200C, ANS 200D, ANS 300A, ANS 300B, ANS 300C and ANS 300D. RB: ANS 200D R: Not open to freshmen.
Evaluation of functional characteristics of horses. Represent MSU in intercollegiate competition.

305 Applied Animal Behavior
Spring. 3(2-2) P:M: BS 111
Techniques for assessing health and welfare of domestic animals based on their behavior.

313 Principles of Animal Feeding and Nutrition
Fall. 4(3-2) P:M: (IB 111) and completion of Tier I writing requirement and (CEM 143 or concurrently) or (CEM 251 or concurrently)

314 Genetic Improvement of Domestic Animals
Fall. 4(3-2) P:M: (IB 111) and completion of Tier I writing requirement and (MTH 103 or concurrently) or (MTH 116 or concurrently) or (MTH 110 or concurrently) or (MTH 124 or concurrently) or (LBS 117 or concurrently)
Molecular, Mendelian, population, and quantitative genetics of domestic animals.

315 Anatomy and Physiology of Farm Animals
Spring. 4(3-2) P:M: (BS 111) and completion of Tier I writing requirement. Gross and microanatomy of farm animals. Structure directed function of tissues. Endocrine integration for homeostasis. Regulation of growth, lactation, and reproduction. Homeotherms.
### Animal Science—ANS

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
<th>Catalog Number</th>
<th>Prerequisites</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Muscle Foods</td>
<td>3</td>
<td>320</td>
<td>Spring. 3(2-3) Interdepartmental with Food Science. Administered by Animal Science. P/M: ANS 210 or FSC 211 or HNF 150</td>
<td>Structure of muscle. Meat technology and merchandising concepts.</td>
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<tr>
<td>Issues in Animal Agriculture</td>
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<td>401</td>
<td>Spring. 1(2-9) RB: ANS 313 or ANS 314 or ANS 315 R: Open only to juniors or seniors. Societal issues related to local, national and international animal agriculture.</td>
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<tr>
<td>Advanced Genetics of Farm Animals</td>
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<td>404</td>
<td>Spring. 2(1-2) P/M: ANS 314 Application of molecular genetics techniques to animal breeding. Genome maps for domestic species. Incorporation of genotype data into selection programs.</td>
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<tr>
<td>Food and Animal Toxicology</td>
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<td>407</td>
<td>Fall. 3(3-0) P/M: (BMB 200 or BMB 401 or BMB 461) and PSL 250 R: Not open to freshmen or sophomores. Fate and effects of chemicals in the food chain. Impact on animal production. Residues in food products. Food safety assessment. Control methods. Digestive processes and nutrient metabolism in monogastric animals. Metabolic basis for nutrient requirements.</td>
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<tr>
<td>Monogastric Animal Nutrition</td>
<td></td>
<td>413</td>
<td>Spring. 3(3-0) P/M: ANS 313 RB: BMB 200 or BMB 401 R: Not open to freshmen or sophomores. Digestive processes and nutrient metabolism in monogastric animals. Metabolic basis for nutrient requirements.</td>
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<tr>
<td>Advanced Animal Breeding</td>
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<td>414</td>
<td>Spring. 2(2-0) P/M: ANS 314 R: Not open to freshmen or sophomores. Application of selection principles and mating systems within and among breeds of livestock. Selection index, expected progeny differences, animal models, crossbreeding systems, multiple ovulation and embryo transfer schemes, multiple trait selection, simulated populations.</td>
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<tr>
<td>Growth and Musculoskeletal Biology</td>
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<td>415</td>
<td>Spring. 3(3-0) RB: ANS 315 R: Not open to freshmen or sophomores. Principles of growth in mammalian and avian species. Regulation of bone, cartilage, connective tissue, fat, and muscle metabolism. Extracellular matrix proteins and their function. Introduction to musculoskeletal diseases.</td>
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<tr>
<td>Meat Science and Muscle Biology</td>
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<td>416</td>
<td>Fall. 2(2-0) RB: ANS 315 R: Not open to freshmen or sophomores. Structure, composition, development and function of muscle and its conversion to meat. Properties of fresh and processed meat. Microbiology, preservation, palatability, inspection and sanitation, nutritive value, and by-products.</td>
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<tr>
<td>Topics in Toxicology</td>
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<td>417</td>
<td>Spring. 1(1-0) RB: ANS 407 R: Not open to freshmen or sophomores. Selected topics including regulatory toxicology, risk assessment, environmental toxicology, food safety, and safe handling of toxic substances.</td>
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<tr>
<td>Advanced Beef Cattle Feedlot Management</td>
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<td>422</td>
<td>Fall. 3(2-2) P/M: ANS 222 Feedlot management systems and issues. Feed systems, manure management, health maintenance, and cattle marketing.</td>
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<tr>
<td>Principles of Animal Biotechnology</td>
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<td>425</td>
<td>Fall of odd years. 3(3-0) RB: BS 111 and (CSE 143 or concurrently) and (CEM 251 or concurrently) Application of molecular biology concepts to the improvement of domestic animals. Transgenic animal production, molecular genetics and marker assisted selection.</td>
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<tr>
<td>Environmental Toxicology and Society</td>
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<td>427</td>
<td>Spring of odd years. 3(3-0) Interdepartmental with Environmental Engineering and Sociology. Administered by Animal Science. RB: ISB 200 or ISB 202 or ISB 204 or ISB 206H or BMB 200 or BS 111 or BS 110 Impact of environmental chemicals on health and modern society. Cellular and organ functions and their interface with the environment. Limitations of scientific investigation and environmental regulations.</td>
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<tr>
<td>Advanced Dairy Cattle Management</td>
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<td>432</td>
<td>Fall. 3(2-2) P/M: ANS 232 RB: ANS 313 R: Not open to freshmen or sophomores. SA: ANS 498 Management techniques for operating a dairy herd. Mastitis control, reproductive and nutrition management, records, and general herd health.</td>
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<tr>
<td>Avian Physiology</td>
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<td>455</td>
<td>Spring. 4(3-3) RB: ANS 315 R: Open only to juniors or seniors or graduate students. Systemic and comparative physiology of birds: respiration, reproduction, endocrinology, digestion, urination, and the senses.</td>
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<tr>
<td>Statistics for Biologists</td>
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<td>464</td>
<td>Fall. 3(3-0) Interdepartmental with Crop and Soil Sciences and Statistics and Probability. Administered by Statistics and Probability. RB: STT 421</td>
<td>Biological random variables. Estimation of population parameters. Testing hypotheses. Linear correlation and regression. Analyses of counted and measured data to compare several biological groups including contingency tables and analysis of variance.</td>
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<tr>
<td>Advanced Swine Management</td>
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<td>472</td>
<td>Spring of even years. 3(2-2) P/M: ANS 272 R: Not open to freshmen or sophomores. SA: ANS 498 Management techniques for operating a swine herd. Management of reproduction and nutrition, records, and general herd health. Integration of husbandry and business principles for decision making.</td>
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<tr>
<td>Aquaculture</td>
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<td>475</td>
<td>Spring. 3(3-0) Interdepartmental with Fisheries and Wildlife. Administered by Fisheries and Wildlife. RB: ANS 313 or ZOL 355 Propagation and rearing of aquatic organisms used for food, bait and recreational fisheries management. Culture principles and techniques for important aquatic species. Commercial potential.</td>
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<tr>
<td>Animal Systems in International Development</td>
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<td>480</td>
<td>Fall, Spring, Summer. 3(3-0) A student may earn a maximum of 6 credits in all enrollments for this course. R: Not open to freshmen. Approval of department; application required. Animal systems in various global regions. Output, land and resource conservation, and socioeconomic factors.</td>
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<tr>
<td>Ruminant Nutrition</td>
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<td>483</td>
<td>Spring. 3(3-0) RB: ANS 313 and ANS 315 R: Not open to freshmen or sophomores. Physiology and metabolism in ruminants. Prefemoral, digestion, metabolism, absorption, and distribution of nutrients for productive functions. Feeding management strategies and diet formulation. Field trip may be required.</td>
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<tr>
<td>Independent Study</td>
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<td>490</td>
<td>Fall, Spring, Summer. 1 to 4 credits. A student may earn a maximum of 8 credits in all enrollments for this course. RB: ANS 210 and (ANS 313 and ANS 314 and ANS 315) R: Open only to juniors or seniors. Approval of department; application required. Independent study in genetics, nutrition, physiology, toxicology, meat science, or management of poultry, livestock, or horses.</td>
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<tr>
<td>Professional Internship in Animal Science</td>
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<td>493</td>
<td>Fall, Spring, Summer. 3 credits. A student may earn a maximum of 6 credits in all enrollments for this course. A student may earn a maximum of 6 credits in all enrollments for any or all of these courses: ABM 493, AEE 493, ANR 493, ANS 493, CSS 493, EEP 493, FIM 493, FW 493, HRT 493, PKG 493, PLP 493, PRR 493, and RD 493. R: Open only to juniors or seniors in the Animal Science major. Approval of department; application required. Supervised professional experience in the animal industry.</td>
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</table>
499 Senior Thesis in Animal Science
Fall, Spring, Summer. 3 to 9 credits. A student may earn a maximum of 9 credits in all enrollments for this course. RB: ANS 313 and ANS 314 and ANS 315 R: Open only to seniors. Approval of department; application required. Maximum of 10 credits may be earned in ANS 499 and ANS 490. Individual studies in an area of choice with both oral and written final communications. Topic to be determined by student and guidance committee.

511 Animal Science for Veterinarians
Fall. 2(2-0) R: Open only to graduate-professional students in the College of Veterinary Medicine. Husbandry of domestic, laboratory, and zoo animals. Managerial systems in animal agriculture. Production and management goals.

513 Animal Nutrition for Veterinarians
Spring. 2(2-0) R: Open only to graduate-professional students in the College of Veterinary Medicine. Nutrition for domestic animals and wildlife. Comparative nutrient digestion and metabolism. Nutritive requirements for maintenance, growth, reproduction, lactation, and work.

805 Animal Welfare Assessment
Fall. Spring. 3(3-0) Interdepartmental with Zoology. Administered by Animal Science. RB: (ANS 305 or ZOL 313) or background in animal science or zoology including exposure to topics such as animal behavior, physiology, management, and husbandry. Multidisciplinary online computer-based instruction in animal welfare science and related issues including physiology, behavior, human-animal interactions, suffering and pain, ethics, health, assessment and standards, and economics.

810 Gastrointestinal Microbiology of Domestic Animals
Fall. 3(3-0) Microbial ecology of gastrointestinal tract. Microbial role in nutrition, health, and productivity. Environmental applications. Livestock species emphasized.

811 Integrated Nutrient Metabolism
Fall of odd years. 3(3-0) Interdepartmental with Human Nutrition and Foods. Administered by Animal Science. RB: (BMB 200 or BMB 401) or approval of department. Comparative physiology of the absorption and metabolism of carbohydrates, lipids, proteins, minerals, and vitamins and their regulation and integration. Basis for applied nutrition of humans, livestock and companion animals.

814 Advanced Statistics for Biologists

818 Comprehensive Nutrient Management Planning
Fall. 3(2-2) Interdepartmental with Biosystems Engineering. Administered by Animal Science. Development of comprehensive nutrient management plans (CNMP) for animal feeding operations. Trends in animal production, environmental issues, and diet formulation and their impact on manure production. Development of CNMP for a specific animal feeding operation.

824 Methods of Quantitative and Molecular Genetics for Livestock
Spring of odd years. 3(2-2) R: ANS 404 Quantitative and molecular methods for animal geneticists. Identification and evaluation of molecular markers, genome maps, linkage and segregation analyses, optimal mating designs, and marker-quantitative trait loci associations in livestock species.

825 Animal Biotechnology
Spring of even years. 3(3-0) R: Approval of department; application required. Basic concepts in animal biotechnology. Application of molecular biology to animal studies. Current topics in animal biotechnology and use of animals in pharmaceutical development.

826 Livestock Immunogenetics
Fall of odd years. 4(3-2) R: ANS 404 or ANS 425 Evaluation and exploration of indicator traits and candidate genes of immune competence that contribute to resistance or susceptibility to infectious diseases of livestock.

827 Integrated Risk Assessment of Environmental Hazards
Spring of odd years. 3(3-0) Interdepartmental with Environmental Engineering. Administered by Animal Science. R: Open only to graduate students in the College of Agriculture and Natural Resources or College of Engineering or College of Human Medicine or College of Natural Science or College of Osteopathic Medicine or College of Veterinary Medicine. Alternative approaches to assessing environmental and health risk. Analyzing, interpreting, and using scientific data from ecology, agriculture, environmental chemodynamics, biology, geological sciences, and toxicology in the risk assessment process.

828 Population Genetics, Genealogy and Genomics
Fall. 3(3-0) Interdepartmental with Crop and Soil Sciences and Forestry and Fisheries and Wildlife and Genetics and Horticulture. Administered by Forestry. RB: Pre-calculus, basic genetics Population genetic processes underlying patterns of molecular genetic variation. Genealogical approaches to the study of genomic diversity, phylogenetic reconstruction, and molecular ecology.

830 Techniques of Analyzing Unbalanced Research Data
Spring. 4(4-0) Interdepartmental with Crop and Soil Sciences and Forestry and Fisheries and Wildlife and Horticulture. Administered by Animal Science. RB: STT 464 R: Open only to graduate students in the College of Agriculture and Natural Resources. SA: ANS 435 Linear model techniques to analyze biological research data characterized by missing and unequal number of observations in classes. Simultaneous consideration of multiple factors. Prediction of breeding values and estimation of population parameters from variance and covariance components.

831 Advanced Independent Study
Fall, Spring, Summer. 1 to 4 credits. A student may earn a maximum of 8 credits in all enrollments for this course. R: Approval of department; application required. Investigation of topics of special interest.

832 Master's Research
Fall, Spring, Summer. 1 to 6 credits. A student may earn a maximum of 10 credits in all enrollments for this course. R: Open only to master's students in the Department of Animal Science. Approval of department; application required. Scholarly project for non-thesis (Plan B) master's degree.

833 Master's Thesis Research
Fall, Spring, Summer. 1 to 2 credits. A student may earn a maximum of 6 credits in all enrollments for this course. Selected topics of current interest and importance in animal breeding and genetics.

834 Biology of the Extracellular Matrix
Spring of odd years. 2(2-0) RB: (BMB 461 and BMB 462) and (PSL 431 and PSL 432) Extracellular matrix (ECM) composition and structure. Role of ECM in regulation of cell phenotype. Regulation of ECM remodeling. Biochemical and physiological properties of ECM degrading proteases and their inhibitors. Integrins and cell signaling, ECM pathologies.

835 Nutrition: Lipid and Carbohydrate Metabolism
Fall of even years. 3(3-0) Interdepartmental with Human Nutrition and Foods. Administered by Human Nutrition and Foods. Regulatory aspect of lipid and carbohydrate metabolism as influenced by nutritional status.

836 Protein Nutrition and Metabolism
937  Mineral and Vitamin Nutrition and Metabolism
Spring of even years. 3(3-0) Interdepartmental with Human Nutrition and Foods. Administered by Animal Science. P:M: BMB 461 and BMB 462
Forms and locations of mineral elements in the body, metabolic functions, deficiencies, and toxicities, interrelationships and quantitative requirements. Significant vitamins and mineral interrelationships relative to bone metabolism, antioxidant health and erythropoiesis.

999  Doctoral Dissertation Research
Fall, Spring, Summer. 1 to 24 credits. A student may earn a maximum of 99 credits in all enrollments for this course. R: Open only to doctoral students in the Department of Animal Science. Approval of department.
Doctoral dissertation research.