

# ANIMAL SCIENCE

The Department of Animal Science Undergraduate Program intends for its graduates to be able to explain the symbiotic relationship of animals and humans, to contribute to the solution of complex problems of animal enterprise management, and to apply their knowledge and skills in a technically demanding global community. Graduates of our program will be knowledgeable about sustainable animal production practices that also ensure animal health and well-being and stewardship of natural resources.

To enable learners to pursue a wide array of career interests, the department offers learning experiences ranging from the basic to the applied sciences. The overarching goals of the degree program are to provide a comprehensive animal science education in: science, animal management, and agri-business. Faculty in our program strive to create an environment for students to develop effective communication skills, develop skills that enable students to gather and integrate information to solve problems, become self-learners, become leaders and team builders, and to become aware of domestic and global issues driving changes in the animal industries. Learner outcomes for these goals, for each of our courses, and other information defining the program can be found at our web site: <http://www.ans.iastate.edu/stud/ugrad/>. Our program is designed to provide career skills appropriate to job market needs. Our faculty goals include providing superior academic advising to enable students to fulfill their objectives.

The department offers the degrees bachelor of science in animal science and bachelor of science in dairy science. A double major in animal and dairy science is not permitted. However, combining either the animal science or dairy science majors with other curricula is permitted. A limit of 6 credits each in Intercollegiate Judging (Animal Science 475), or any independent study course (490 courses) can be applied toward a degree. A limit of 4 credits of Undergraduate Teaching Experience (Animal Science 497) can be applied toward a degree.

Within the animal science major, specialized options in animal products, companion animal management, equine management, livestock management, pre-professional studies, and pre-veterinary medicine are available. The department offers a minor in Animal Science and a minor in Meat Science. Both the animal science curricula and dairy science curricula allow complementary work toward admission to veterinary medical school and other professional schools, which may be done while satisfying requirements for the bachelor of science degree. A program that combines bachelor of science and master of science in animal science is offered. In addition, a program that combines a bachelor of science and master of business administration is offered. The Department facilitates student participation in the Midwest Poultry

Consortium and the Swine Science Online program to offer additional training in poultry and swine production, respectively.

## Curriculum in Animal Science

Students majoring in animal science will complete the degree requirements listed below. If desired, a student may also choose a specialized option. To earn a degree in Animal Science from Iowa State University a minimum of 15 credits in Animal Science must be earned from courses taught in the Animal Science department at ISU. A minimum of 15 credits of animal science coursework must be earned at Iowa State University. A minimum of 15 credits must be completed from the courses listed to meet the Ethics, International Perspectives, U.S. Diversity, and Humanities and Social Sciences requirements.

### Total Degree Requirement: 128 cr.

Only 65 cr. from a two-year institution may apply which may include up to 16 technical cr.; 9 P-NP cr. of free electives; 2.00 minimum GPA.

### International Perspectives

Approved International Perspectives course	3
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### U.S. Diversity

Approved U. S. Diversity course	3
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### Communications Proficiency (with a C or better)

English composition	6
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Speech fundamentals	3
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<b>Total Credits</b>	<b>9</b>
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### Communication/Library

ENGL 150	Critical Thinking and Communication	3
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ENGL 250	Written, Oral, Visual, and Electronic Composition	3
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LIB 160	Information Literacy	1
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One course from the following:	3
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SP CM 212	Fundamentals of Public Speaking
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AGEDS 311	Presentation and Sales Strategies for Agricultural Audiences
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AGEDS 327	Survey of Agriculture and Life Sciences Communication
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COMST 214	Professional Communication
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One course from the following:	3
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ENGL 302	Business Communication
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ENGL 309	Proposal and Report Writing
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ENGL 312	Biological Communication
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ENGL 314	Technical Communication
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<b>Total Credits</b>	<b>13</b>
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**Humanities and Social Sciences**

Approved Humanities course	3
Approved Social Science course	3

**Total Credits** 6

**Ethics**

Approved Ethics course	3
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**Mathematical Sciences**

One course from the following: 3-4

MATH 140	College Algebra
MATH 150	Discrete Mathematics for Business and Social Sciences
MATH 160	Survey of Calculus
MATH 165	Calculus I

One course from the following: 3-4

STAT 101	Principles of Statistics
STAT 104	Introduction to Statistics
STAT 226	Introduction to Business Statistics I

**Total Credits** 6-8

**Physical Sciences**

A minimum of 8 credits are required. These requirements are specific to option and are listed with each option below.

**Biological Sciences**

BIOL 211	Principles of Biology I	3
BIOL 211L	Principles of Biology Laboratory I	1
BIOL 212	Principles of Biology II	3
BIOL 212L	Principles of Biology Laboratory II	1
BIOL 313	Principles of Genetics	3
or GEN 320	Genetics, Agriculture and Biotechnology	
MICRO 201 & 201L	Introduction to Microbiology and Introductory Microbiology Laboratory	3-4
or MICRO 302 & 302L	Biology of Microorganisms and Microbiology Laboratory	

**Total Credits** 14-15

**Business**

One course from the following: 3

ACCT 284	Financial Accounting
ECON 101	Principles of Microeconomics
ECON 102	Principles of Macroeconomics

**Total Credits** 3

**Animal Science Core**

AN S 101	Working with Animals	2
AN S 110	Orientation in Animal Science and ISU	1

AN S 114	Survey of the Animal Industry	2
AN S 210	Career Preparation in Animal Science	1
AN S 211	Issues Facing Animal Science	1
AN S 214	Domestic Animal Physiology	3
AN S 214L	Domestic Animal Anatomy and Physiology Lab	1
AN S 319	Animal Nutrition	3
AN S 320	Animal Feeds and Feeding	3
AN S 331	Domestic Animal Reproduction	3
AN S 352	Genetic Improvement of Domestic Animals	3
AN S 411	Addressing Issues in Animal Science	1

**Total Credits** 24

**General Animal Science**

CHEM 163 & 163L	College Chemistry and Laboratory in College Chemistry	5
or CHEM 177 & 177L	General Chemistry I and Laboratory in General Chemistry I	

CHEM 331	Organic Chemistry I	3
or BBMB 221	Structure and Reactions in Biochemical Processes	

Three courses from the following: 9

AN S 216	Equine Science
AN S 223	Poultry Science
AN S 224	Companion Animal Science
AN S 225	Swine Science
AN S 226	Beef Cattle Science
AN S 228	Laboratory Animal Science
AN S 229	Sheep Science
AN S 235	Dairy Cattle Science
AN S 270 & 270L	Foods of Animal Origin and Foods of Animal Origin Laboratory

One course from the following: 2-4

AN S 313	Exercise Physiology of Animals
AN S 324	Food Processing for Companion Animals
AN S 336	Domestic Animal Behavior and Well-Being
AN S 337	Lactation
AN S 345	Growth and Development of Domestic Animals
AN S 360	Fresh Meat Science and Applied Muscle Biology
BIOL 314	Principles of Molecular Cell Biology
BIOL 352	Vertebrate Histology
BIOL 353	Introductory Parasitology
ENT 372	Livestock Entomology
ENT 374	Insects and Our Health
MICRO 310	Medical Microbiology

VDPAM 487	Livestock Disease Prevention	
TSM 327	Animal Production Systems	
AGRON 334	Forage Crop Management	
One course from the following:		3
AN S 415	Equine Systems Management	
AN S 424	Companion Animal Systems Management	
AN S 425	Swine Systems Management	
AN S 426	Beef Cattle Systems Management	
AN S 429	Sheep Systems Management	
AN S 434	Dairy Systems Management	
One course from the following:		2-3
AN S 415	Equine Systems Management	
AN S 419	Advanced Animal Nutrition	
AN S 424	Companion Animal Systems Management	
AN S 425	Swine Systems Management	
AN S 426	Beef Cattle Systems Management	
AN S 429	Sheep Systems Management	
AN S 434	Dairy Systems Management	
AN S 460	Science and Technology of Value Added Meat Products	
FS HN 410	Food Analysis	
FS HN 420	Food Microbiology	
MICRO 407	Microbiological Safety of Foods of Animal Origins	

**Total Credits** **24-27**

Additional free electives required for Animal Science 23-29

### Pre-Veterinary Medicine Option

BBMB 301	Survey of Biochemistry	3
or BBMB 316	Principles of Biochemistry	
or BBMB 404	Biochemistry I	
or BBMB 420	Mammalian Biochemistry	
CHEM 177	General Chemistry I	4
CHEM 177L	Laboratory in General Chemistry I	1
CHEM 178	General Chemistry II	3
CHEM 331	Organic Chemistry I	3
CHEM 331L	Laboratory in Organic Chemistry I	1
PHYS 111	General Physics	5
Three courses from the following:		9
AN S 216	Equine Science	
AN S 223	Poultry Science	
AN S 224	Companion Animal Science	
AN S 225	Swine Science	
AN S 226	Beef Cattle Science	

AN S 228	Laboratory Animal Science	
AN S 229	Sheep Science	
AN S 235	Dairy Cattle Science	
AN S 270	Foods of Animal Origin	
& 270L	and Foods of Animal Origin Laboratory	
One course from the following:		2-4
AN S 313	Exercise Physiology of Animals	
AN S 324	Food Processing for Companion Animals	
AN S 336	Domestic Animal Behavior and Well-Being	
AN S 337	Lactation	
AN S 345	Growth and Development of Domestic Animals	
AN S 360	Fresh Meat Science and Applied Muscle Biology	
BIOL 314	Principles of Molecular Cell Biology	
BIOL 352	Vertebrate Histology	
BIOL 353	Introductory Parasitology	
ENT 372	Livestock Entomology	
ENT 374	Insects and Our Health	
MICRO 310	Medical Microbiology	
VDPAM 487	Livestock Disease Prevention	
TSM 327	Animal Production Systems	
AGRON 334	Forage Crop Management	
One course from the following:		3
AN S 415	Equine Systems Management	
AN S 424	Companion Animal Systems Management	
AN S 425	Swine Systems Management	
AN S 426	Beef Cattle Systems Management	
AN S 429	Sheep Systems Management	
AN S 434	Dairy Systems Management	
One course from the following:		2-3
AN S 415	Equine Systems Management	
AN S 419	Advanced Animal Nutrition	
AN S 424	Companion Animal Systems Management	
AN S 425	Swine Systems Management	
AN S 426	Beef Cattle Systems Management	
AN S 429	Sheep Systems Management	
AN S 434	Dairy Systems Management	
AN S 460	Science and Technology of Value Added Meat Products	
FS HN 410	Food Analysis	
FS HN 420	Food Microbiology	
MICRO 407	Microbiological Safety of Foods of Animal Origins	

**Total Credits** **36-39**

Additional free electives required for the Pre-veterinary Medicine Option 8-14

\* The Iowa State University College of Veterinary Medicine academic requirements are met by completion of this option (<http://vetmed.iastate.edu/academics/prospective-students/admissions/academic-requirements>).

## Minors: Animal Science and Meat Science

All minors require at least 15 credits, including at least 6 credits in courses numbered 300 or above taken at Iowa State University. The minor must include at least 9 credits that are not used to meet any other department, college, or university requirement.

The department offers a minor in Animal Science. The minor requires:

AN S 101	Working with Animals	2
AN S 114	Survey of the Animal Industry	2
AN S 214	Domestic Animal Physiology	3
AN S 214L	Domestic Animal Anatomy and Physiology Lab	1
One course from the following:		3
AN S 216	Equine Science	
AN S 223	Poultry Science	
AN S 224	Companion Animal Science	
AN S 225	Swine Science	
AN S 226	Beef Cattle Science	
AN S 229	Sheep Science	
AN S 235	Dairy Cattle Science	
AN S 270 & 270L	Foods of Animal Origin and Foods of Animal Origin Laboratory	
One course from the following:		3
AN S 313	Exercise Physiology of Animals	
AN S 319	Animal Nutrition	
AN S 331	Domestic Animal Reproduction	
AN S 345	Growth and Development of Domestic Animals	
AN S 352	Genetic Improvement of Domestic Animals	
One course from the following:		2-3
AN S 319	Animal Nutrition	
AN S 320	Animal Feeds and Feeding	
AN S 331	Domestic Animal Reproduction	
AN S 324	Food Processing for Companion Animals	
AN S 336	Domestic Animal Behavior and Well-Being	
AN S 337	Lactation	
AN S 345	Growth and Development of Domestic Animals	
AN S 352	Genetic Improvement of Domestic Animals	
AN S 360	Fresh Meat Science and Applied Muscle Biology	

AN S 419	Advanced Animal Nutrition	
<b>Total Credits</b>		<b>16-17</b>

A total of 9 credits must be earned at Iowa State University in animal science coursework that meets a degree requirement for the B.S. degree in animal science. Students interested in the Animal Science minor should contact an Animal Science advisor.

## Minor - Meat Science

The department offers a minor in Meat Science. The minor requires:

AN S 270	Foods of Animal Origin	2
AN S 270L	Foods of Animal Origin Laboratory	1
AN S 360	Fresh Meat Science and Applied Muscle Biology	3
AN S 460	Science and Technology of Value Added Meat Products	3
One course from the following:		1
AN S 489	Issues in Food Safety	
AN S 490C	Independent Study: Meat Science	
Two courses from the following:		5-6
FS HN 311	Food Chemistry	
FS HN 403	Food Laws and Regulations	
FS HN 406	Sensory Evaluation of Food	
FS HN 305	Food Quality Management and Control	
FS HN 410	Food Analysis	
FS HN 412	Food Product Development	
FS HN 420	Food Microbiology	
AN S 324	Food Processing for Companion Animals	
FS HN 471	Food Processing	
MICRO 407	Microbiological Safety of Foods of Animal Origins	
<b>Total Credits</b>		<b>15-16</b>

Students majoring in Animal Science will not be allowed to count the 9 required credits (270, 270L, 360, 460) toward their Animal Science degree. Students interested in the Meat Science minor should contact an Animal Science advisor.

The Department of Animal Science offers certificates in:

- Beef Cattle Production Management
- Equine Science and Management
- Poultry Production Management
- Swine Production Management

All certificates require at least 24 credits, including at least 18 credits at the 300 or 400 level. At least 9 credits must be unique to the certificate and will not be applied to a major, minor, or another certificate. All courses

applied to the certificate must be taken for a grade. A cumulative GPA of 2.0 is required to complete the program and receive the certificate.

## Beef Cattle Production Management

### Foundation Course (3 credits)

AN S 226	Beef Cattle Science	3
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### Fundamental Disciplines in Animal Science (9 credits)

AN S 320	Animal Feeds and Feeding	3
AN S 331	Domestic Animal Reproduction	3
AN S 352	Genetic Improvement of Domestic Animals	3

### Expertise Expansion (3 credits)

AGRON 280	Crop Development, Production and Management	3
AGRON 334	Forage Crop Management	3
AN S 333	Embryo Transfer and Related Technologies	3
AN S 336	Domestic Animal Behavior and Well-Being *	3
AN S 345	Growth and Development of Domestic Animals *	3
AN S 360	Fresh Meat Science and Applied Muscle Biology *	3
TSM 327	Animal Production Systems *	3
TSM 455	Feed Processing and Technology	3
TSM 457	Feed Safety, Ingredient Quality and Analytics	3
VDPAM 487	Livestock Disease Prevention *	3

\* Course fulfills the Animal Science degree discipline expansion requirement unless designated as a unique course in the certificate

### Enterprise Management (3 credits)

AGEDS 451	Agricultural Law	3
ECON 230	Farm Business Management ^	3
ECON 235	Introduction to Agricultural Markets	3
ECON 332	Cooperatives	3
ECON 334	Entrepreneurship in Agriculture	3

^ Course is a prerequisite for AN S 426

### Beef Cattle Production Emphasis (6 credits)

AN S 426	Beef Cattle Systems Management	3
AN S 399A	Animal Science Internship: Graded Internship Experience	3

## Equine Science and Management Certificate

### Foundation Course (3 credits)

AN S 216	Equine Science	3
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### Fundamental Disciplines in Animal Science (6 credits)

AN S 320	Animal Feeds and Feeding	3
AN S 331	Domestic Animal Reproduction	3

### Equine Expertise Expansion (6 credits)

AN S 217	Equine Farm Practicum	2
AN S 306	Equine Evaluation	3
AN S 313	Exercise Physiology of Animals *	2
AN S 317A	Fundamentals of Equine Behavior and Training: Young Horses at Halter	1
AN S 317B	Fundamentals of Equine Behavior and Training: Yearlings	3
AN S 332E	Laboratory Methods in Animal Reproduction: Equine	1

\* Courses fulfill the Animal Science degree discipline expansion requirement unless designated as a unique course in the certificate

### Expertise Expansion (3 credits)

ACCT 215	Legal Environment of Business	3
AGEDS 451	Agricultural Law	3
AGRON 334	Forage Crop Management	3
AN S 333	Embryo Transfer and Related Technologies	3
AN S 336	Domestic Animal Behavior and Well-Being *	3
AN S 337	Lactation	3
AN S 345	Growth and Development of Domestic Animals *	3
ECON 320	Labor Economics	3
ECON 334	Entrepreneurship in Agriculture	3

\* Courses fulfill the Animal Science degree discipline expansion requirement unless designated as a unique course in the certificate

### Equine Management Emphasis (6 credits)

AN S 415	Equine Systems Management	3
AN S 399A	Animal Science Internship: Graded Internship Experience	3

## Poultry Production Management Certificate

### Foundation Course (3 credits)

AN S 223	Poultry Science	3
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### Fundamental Disciplines in Animal Science (9 credits)

AN S 320	Animal Feeds and Feeding	3
AN S 331	Domestic Animal Reproduction	3
AN S 352	Genetic Improvement of Domestic Animals	3

**Expertise Expansion (3 credits)**

AN S 336	Domestic Animal Behavior and Well-Being *	3
AN S 345	Growth and Development of Domestic Animals *	3
AN S 360	Fresh Meat Science and Applied Muscle Biology *	3
TSM 327	Animal Production Systems *	3
TSM 455	Feed Processing and Technology	3
TSM 457	Feed Safety, Ingredient Quality and Analytics	3
VDPAM 487	Livestock Disease Prevention *	3
AN S 373AX	Poultry Products Technology #	3
AN S 373BX	Applied Avian Physiology #	3
AN S 373CX	Avian Health #	3
AN S 373DX	Poultry Nutrition #	3

\* Courses fulfill the Animal Science degree discipline expansion requirement unless designated as a unique course in the certificate

# Courses are held as part of the Midwest Poultry Consortium COE courses during the summer

**Enterprise Management (3 credits)**

AGEDS 451	Agricultural Law	3
ECON 230	Farm Business Management	3
ECON 235	Introduction to Agricultural Markets	3
ECON 332	Cooperatives	3
ECON 334	Entrepreneurship in Agriculture	3

**Poultry Production Emphasis (6 credits, to include AN S 399 and choice of one 400-level management)**

AN S 399A	Animal Science Internship: Graded Internship Experience	3
AN S 473AX	Poultry Enterprise Management #	3
AN S 473BX	Breeder Flock and Hatchery Management #	3

# Courses are held as part of the Midwest Poultry Consortium COE courses during the summer

**Swine Production Management Certificate****Foundation Course (3 credits)**

AN S 225	Swine Science	3
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**Fundamental Disciplines in Animal Science (9 credits)**

AN S 320	Animal Feeds and Feeding	3
AN S 331	Domestic Animal Reproduction	3
AN S 352	Genetic Improvement of Domestic Animals	3

**Expertise Expansion (3 credits)**

AGRON 280	Crop Development, Production and Management	3
AN S 333	Embryo Transfer and Related Technologies	3
AN S 336	Domestic Animal Behavior and Well-Being *	3
AN S 345	Growth and Development of Domestic Animals *	3
AN S 360	Fresh Meat Science and Applied Muscle Biology *	3
AN S 380C	Employee Management for the Swine Industry	1
AN S 380D	Farrowing Management	1
AN S 380E	Swine Feed Mill Management	1
AN S 380F	Marketing and Risk Management in the Swine Industry	1
AN S 380G	Swine Nursery and Finishing Management	1
AN S 382	Swine Environment Management	1
AN S 383	Swine Manure and Nutrient Management	1
AN S 384	Swine Health and Biosecurity	1
TSM 327	Animal Production Systems *	3
TSM 455	Feed Processing and Technology	3
TSM 457	Feed Safety, Ingredient Quality and Analytics	3
VDPAM 487	Livestock Disease Prevention *	3

\* Courses fulfill the Animal Science degree discipline expansion requirement unless designated as a unique course in the certificate

**Enterprise Management (3 credits)**

AGEDS 451	Agricultural Law	3
ECON 230	Farm Business Management	3
ECON 235	Introduction to Agricultural Markets	3
ECON 332	Cooperatives	3
ECON 334	Entrepreneurship in Agriculture	3

**Swine Production Emphasis (6 credits)**

AN S 425	Swine Systems Management	3
AN S 399A	Animal Science Internship: Graded Internship Experience	3

**Animal Science, B.S. - GENERAL**

<b>Freshman</b>		
<b>Fall</b>	<b>Credits Spring</b>	<b>Credits</b>
AN S 110	1 AN S 114	2
AN S 101	2 CHEM 177 & 177L or CHEM 163 & 163L	5
BIOL 211	3 Humanities - elective list	3
BIOL 211L	1 SP CM 212, AGEDS 311, AGEDS 327, or COMST 214	3
ENGL 150	3 STAT 101, 104, or 226	3-4
LIB 160	1	
MATH 140, 150, 160, or 165	3-4	
Soc. Sci. - elective list	3	
<b>17-18</b>		<b>16-17</b>

<b>Sophomore</b>		
<b>Fall</b>	<b>Credits Spring</b>	<b>Credits</b>
AN S 211	1 AN S 210	1
AN S 200 - elective list	3 AN S 214	3
AN S 200 - elective list	3 AN S 214L	1
BIOL 212	3 AN S 200 - elective list	3
BIOL 212L	1 ENGL 250	3
BBMB 221	3 MICRO 201 & 201L or MICRO 302 & 302L	3-4
ECON 101, 102, or ACCT 284	3 Free elective	3
<b>17</b>		<b>17-18</b>

<b>Junior</b>		
<b>Fall</b>	<b>Credits Spring</b>	<b>Credits</b>
AN S 319	3 AN S 320	3
AN S 331	3 AN S 352	3
GEN 320 or BIOL 313	3 AN S 300 - elective list	3
U.S. Diversity - elective list	3 Ethics -elective list	3
Free elective	3 Free elective	3
<b>15</b>		<b>15</b>

<b>Senior</b>		
<b>Fall</b>	<b>Credits Spring</b>	<b>Credits</b>
AN S 411	1 AN S 400 - Option 2	3
AN S 400 - Option 1	3 International Perspective - elective list	3
ENGL 302, 309, 312, or 314	3 Free elective	3
Free elective	3 Free elective	3
Free elective	3 Free elective	4

Free elective	3	
<b>16</b>		<b>16</b>

Important: This is only one of many equally-sound schedule sequences. Note:

Free electives and specified group electives are often chosen to complement the student's career focus. The student's academic advisor assists with developing scheduling schemes that prepare students individually for careers in the animal industry. They are explained fully in AN S 110 and through appointments with the student's advisor.

**Animal Science, B.S. - pre-veterinary medicine**

<b>Freshman</b>		
<b>Fall</b>	<b>Credits Spring</b>	<b>Credits</b>
AN S 110	1 AN S 114	2
AN S 101	2 CHEM 177	4
BIOL 211	3 CHEM 177L	1
BIOL 211L	1 Humanities - elective list	3
ENGL 150	3 SP CM 212, AGEDS 311, AGEDS 327, or COMST 214	3
LIB 160	1 STAT 101, 104, or 226	3-4
MATH 140, 150, 160, or 165	3-4	
Soc. Sci. - elective list	3	
<b>17-18</b>		<b>16-17</b>

<b>Sophomore</b>		
<b>Fall</b>	<b>Credits Spring</b>	<b>Credits</b>
AN S 211	1 AN S 214	3
AN S 200 - elective list	3 AN S 214L	1
AN S 200 - elective list	3 AN S 200 - elective list	3
BIOL 212	3 CHEM 331	3
BIOL 212L	1 CHEM 331L	1
CHEM 178	3 ENGL 250	3
ECON 101, 102, or ACCT 284	3 Ethics - elective list	3
<b>17</b>		<b>17</b>

<b>Junior</b>		
<b>Fall</b>	<b>Credits Spring</b>	<b>Credits</b>
AN S 210	1 AN S 320	3
AN S 319	3 AN S 352	3
AN S 331	3 AN S 300 - elective list	3
GEN 320 or BIOL 313	3 BBMB 301, 316, 404, or 420	3
CHEM 332	3 US Diversity - elective list	3
MICRO 201 & 201L or MICRO 302 & 302L	3-4	
<b>16-17</b>		<b>15</b>

Senior		
Fall	Credits Spring	Credits
AN S 411	1 AN S 400 - Option 2	3
AN S 400 - Option 1	3 International Perspective - elective list	3
ENGL 302, 309, 312, or 314	3 Free elective	3
PHYS 111	5 Free elective	3
Free elective	3 Free elective	3
Free elective	2	
<b>17</b>		<b>15</b>

Important: This is only one of many equally-sound schedule sequences.

Note:

\* Credits currently required for application to Veterinary Medicine program at ISU (55 credits)

General Chemistry with lab (7)

Organic Chemistry with lab (4)

Biochemistry (3)

General Physics with lab (4)

General Biology with lab (8)

Genetics/Animal Breeding (3)

Mammalian Anatomy and/or Physiology (3)

English Composition (6)

Oral Communication (3)

Humanities and/or Social Sciences (6)

Other Electives (8)

## Graduate Study

The department offers work for the degrees master of science and doctor of philosophy with majors in animal breeding and genetics; meat science; animal physiology; animal science; and an interdepartmental program in nutritional sciences which has an option in animal nutrition. Minor work is offered in these areas to students taking major work in other departments.

A strong undergraduate program is required for students interested in graduate study. Fundamental training in biology, chemistry, mathematics, and statistics is requisite to a satisfactory graduate program. Graduate programs in animal science include supporting work in areas such as agricultural engineering, agronomy; anatomy; biochemistry; chemistry; economics; environmental science; food science and human nutrition; genetics; microbiology; physics; physiology; and statistics. Students may choose graduate programs involving a co-major with one of these areas. Graduate work in meat science is offered as a co-major in animal science and food science and human nutrition.

The department also cooperates in the interdepartmental program in professional agriculture and interdepartmental majors

in genetics, immunobiology, microbiology, MCDB (molecular, cellular, and developmental biology), neuroscience, nutritional sciences, and toxicology (see Index (<http://catalog.iastate.edu/previouscatalogs/2021-2022/azindex/>)).

The foreign language requirement, if any, is established on an individual basis by the program-of-study committee appointed to guide the work of the student.

### Courses primarily for undergraduates:

#### AN S 101: Working with Animals

(1-2) Cr. 2. F.S.SS.

An introductory course in skills for proper care, handling, and management of domestic animals. Terminology and skills in working with animals, identification, life-cycle management practices, and animal health management are introduced and examined.

#### AN S 110: Orientation in Animal Science and ISU

(2-0) Cr. 1. F.S.

Orientation to the university and Department of Animal Science. Challenges and opportunities available to the professional animal agriculturalist. Professional goal setting, portfolio development, and development of interpersonal skills in the context of pursuing a career in animal science.

#### AN S 114: Survey of the Animal Industry

(2-0) Cr. 2. F.S.

Principles of management and care of domestic animals, including genetics, nutrition, and reproduction. Service of domestic animals to society in terms of food, shelter, protection, fuel and emotional well-being. Basic biology, industry structure, management practices and production systems.

#### AN S 116: Practicum in Safe Equine Handling and Welfare

(0-3) Cr. 1. F.SS.

Development of best practices for safe horse handling and practical equine health care tasks. Course will focus on equine welfare and human safety as well as provide training in necessary every day skills needed to own a horse or to work at a horse farm. Certificate of Safe Equine Handling and Welfare available upon course completion. Offered on satisfactory - fail grading basis only. Offered on a satisfactory-fail basis only.

**AN S 190: Livestock Handling, Safety and Welfare**

Cr. 2.

*Prereq: AN S 101*

Understanding of animal perception to develop best care practices involved in handling of livestock species (beef, sheep, swine, dairy, equine, poultry). Intensive development of skills associated with handling and moving healthy and compromised livestock in respect to human and animal welfare. Integration of scientific and theoretical knowledge of biosecurity and animal-human interactions as it related to livestock handling and movement.

**AN S 199: Marketing and Management of Livestock Events**

(0-2) Cr. 1. Repeatable. F.S.

*Prereq: Credit or enrollment in AN S 101 or AN S 114*

Management and coordination of livestock shows, sales and events, including program planning, staff and volunteer management, time management, publicity and promotion for fairs, shows, clinics, expos, and other events. Offered on a satisfactory-fail basis only. A maximum of two credits of AnS 199 may be applied toward the total credits required for graduation.

**AN S 199A: Marketing and Management of Livestock Events: Beef**

(0-2) Cr. 1. Repeatable. F.S.

*Prereq: Credit or enrollment in AN S 101 or AN S 114*

Management and coordination of livestock shows, sales and events, including program planning, staff and volunteer management, time management, publicity and promotion for fairs, shows, clinics, expos, and other events. Offered on a satisfactory-fail basis only. A maximum of two credits of AnS 199 may be applied toward the total credits required for graduation.

**AN S 199E: Marketing and Management of Livestock Events: Horses**

(0-2) Cr. 1. Repeatable. F.S.

*Prereq: Credit or enrollment in AN S 101 or AN S 114*

Management and coordination of livestock shows, sales and events, including program planning, staff and volunteer management, time management, publicity and promotion for fairs, shows, clinics, expos, and other events. Offered on a satisfactory-fail basis only. A maximum of two credits of AnS 199 may be applied toward the total credits required for graduation.

**AN S 207: The Art and Heritage of Livestock**

(3-0) Cr. 3.

Using art as a venue to understand the legacy and heritage of livestock production and livestock's contribution to civilization and society; livestock's contributions to warfare, social class, industry, economies, etc.; history of the impact of livestock on painting, poetry, music, sculpture, advertising, pop culture, movies, religion and sports in society.

**AN S 210: Career Preparation in Animal Science**

(0-2) Cr. 1. F.S.

*Prereq: Sophomore classification in An S*

Life skill development emphasized in the context of career preparation. Assist students with career goal clarification, interview skills, resume and cover letter preparation. Internship development, job shadowing, and exploration of career option.

**AN S 211: Issues Facing Animal Science**

(0-2) Cr. 1. F.S.

*Prereq: AN S 114, sophomore classification*

Overview of the factors that define contemporary ethical and scientifically based issues facing animal agriculture. Life skill development (including interactive skills, communication ability, organization, information gathering, and leadership skills) emphasized in the context of issues study. Offered on a satisfactory-fail basis only.

**AN S 214: Domestic Animal Physiology**

(3-0) Cr. 3. F.S.

*Prereq: BIOL 212, CHEM 163 or CHEM 177*

Introduction to anatomy and physiology of the muscular, renal, skeletal, neural, mammary, cardiovascular, respiratory, immune, endocrine, reproductive, and digestive systems of domestic animals.

**AN S 214L: Domestic Animal Anatomy and Physiology Lab**

(0-2) Cr. 1. F.S.

Basic anatomy of domestic animals.

**AN S 216: Equine Science**

(2-2) Cr. 3. F.S.SS.

*Prereq: AN S 101 or AN S 114; one course in biology*

Introduction to contemporary concepts, and basic practices and decisions necessary when managing horses through stages of their lives.

**AN S 217: Equine Farm Practicum**

(1-2) Cr. 2. F.

*Prereq: Credit or experience equivalent to AnS 116 and credit or concurrent enrollment in AN S 216.*

Intensified management of the equine farm. Provide students with experiential learning in all phases of horse production and management. Students assist with general farm management, horse health care, weekly farm management, and related topics.

**AN S 223: Poultry Science**

(2-2) Cr. 3. F.

*Prereq: AN S 101, AN S 114*

Introduction to modern production trends with a focus on broiler, layer, and turkey industries. Topics covered include breeds, handling, management, physiology, nutrition, genetics, health & disease, and products. Weekly labs meet off campus.

**AN S 224: Companion Animal Science**

(2-2) Cr. 3. S.

*Prereq: Course in biology*

Introduction of students to contemporary concepts, and basic practices and decisions necessary when caring for the companion animal through stages of its life.

**AN S 225: Swine Science**

(2-2) Cr. 3. F.S.

*Prereq: AN S 101, AN S 114*

Introduction to principles, practices and decisions necessary when raising swine through the vertically integrated production cycle. Only AN S 280 and AN S 280L or AN S 225 may count toward graduation.

**AN S 226: Beef Cattle Science**

(2-2) Cr. 3. F.S.

*Prereq: AN S 101, AN S 114*

Introduction to principles, practices and decisions necessary when raising beef cattle through the vertically integrated production cycle.

**AN S 228: Laboratory Animal Science**

Cr. 3. F.

*Prereq: AN S 101, AN S 114; recommended: AN S 214.*

Introduction to the species, uses, biology, facilities, care, and diseases of animals used in research.

**AN S 229: Sheep Science**

(2-2) Cr. 3. S.

*Prereq: AN S 101, AN S 114*

Introduction to principles, practices and decisions necessary when raising sheep through their production cycle.

**AN S 235: Dairy Cattle Science**

(2-2) Cr. 3. F.

*Prereq: AN S 101, AN S 114*

Introduction to principles, practices and decisions necessary when raising dairy cattle through the vertically integrated production cycle.

**AN S 270: Foods of Animal Origin**

(2-0) Cr. 2. F.S.SS.

*Prereq: BIOL 212, CHEM 163 or CHEM 177*

Principles, practices and issues impacting the production, processing and preservation of safe, wholesome, nutritious, and palatable meat, dairy, and egg products. Product evaluation, classification, value, and utilization.

**AN S 270L: Foods of Animal Origin Laboratory**

(0-2) Cr. 1. F.S.

*Prereq: Credit or current enrollment in AN S 270*

Determination of composition and quality of meat, eggs and milk based on industry and USDA standards. Fundamentals of processing foods of animal origin to add value, maintain quality and ensure safety.

**AN S 280: Basic Swine Science**

(2-0) Cr. 2.

*Prereq: AN S 101 AN S 114*

Basic disciplines and concepts involved in swine production including; industry structure, trends and statistics; production phases and buildings; genetic improvement; reproduction; nutrition; health and biosecurity; nutrient management; marketing and meat quality and career opportunities in the swine industry. Only AN S 280 and AN S 280L or AN S 225 may count toward graduation.

**AN S 305: Livestock Evaluation**

(0-6) Cr. 3. F.

*Prereq: Junior classification; AN S 270L recommended*

Fall semester leads to 475A or D. Breeding animal and market animal evaluation of beef, swine and sheep using contemporary techniques and tools. Communication and decision-making skills are practiced in the context of making selection decisions.

**AN S 306: Equine Evaluation**

(0-6) Cr. 3. F.

*Prereq: sophomore classification or permission of instructor*

Detailed visual evaluation of conformation and performance of the equine athlete. Decision-making skills are practiced in the context of making selection choices. Development of written and oral communication skills as students defend their judgments. Industry trends will be addressed.

**AN S 313: Exercise Physiology of Animals**

(2-0) Cr. 2. F.S.

*Prereq: AN S 214, BIOL 211, one course in chemistry*

Physiological adaptations to athletic training in canine and equine athletes. Topics of emphasis include exercise-related adaptations in metabolism, locomotion, the cardiovascular system, musculoskeletal system, and endocrine system. The roles of nutrition and conditioning programs are assessed.

**AN S 317: Fundamentals of Equine Behavior and Training**

(0-6) Cr. 1-3.

Modifying the behavior of the horse using systematic approaches to horse training emphasizing the psychology of training horses. Equipment and its use and preparation of horses for competition. A maximum of 4 credits of An S 317 may be applied toward graduation.

**AN S 317A: Fundamentals of Equine Behavior and Training: Young Horses at Halter**

(0-6) Cr. 1. F.

Modifying the behavior of the horse using systematic approaches to horse training emphasizing the psychology of training horses. Equipment and its use and preparation of horses for competition. A maximum of 4 credits of An S 317 may be applied toward graduation.

**AN S 317B: Fundamentals of Equine Behavior and Training: Yearlings**

(0-6) Cr. 3.

*Prereq: Permission of instructor*

Modifying the behavior of the horse using systematic approaches to horse training emphasizing the psychology of training horses. Equipment and its use and preparation of horses for competition. A maximum of 4 credits of An S 317 may be applied toward graduation.

**AN S 317C: Fundamentals of Equine Behavior and Training: Two-year olds and older**

(0-6) Cr. 3.

Modifying the behavior of the horse using systematic approaches to horse training emphasizing the psychology of training horses. Equipment and its use and preparation of horses for competition. A maximum of 4 credits of An S 317 may be applied toward graduation.

**AN S 319: Animal Nutrition**

(3-0) Cr. 3. F.S.

*Prereq: AN S 214, course in organic chemistry or biochemistry*

Structure and function of organic and inorganic nutrients. Digestion, absorption, metabolism and utilization of nutrients for maintenance and productive functions. Essential nutritive requirements of domestic livestock, poultry, and companion animals. Sources of nutrients, application of energy systems and concepts, and regulation of feed intake in animals.

**AN S 320: Animal Feeds and Feeding**

(2-2) Cr. 3. F.S.

*Prereq: AN S 319*

Composition, physical properties, and storage and processing of feedstuffs. Nutrient requirements of and diet formulation, and preparation systems for food and companion animal species at varying stages of age, activity or production. Manual and computer methodologies for diet formulation.

**AN S 324: Food Processing for Companion Animals**

(3-0) Cr. 3. F.

*Prereq: AN S 319, Junior Classification*

Food processing and nutrition for carnivorous companion animals. Topics covered include meat processing and meat preservation for companion animal diets, regulatory standards, cutting edge technologies for processing meat for companion animals, dietary needs of carnivorous companion animals, effect of different processing methods on safety and nutrient bioavailability.

**AN S 331: Domestic Animal Reproduction**

(3-0) Cr. 3. F.S.

*Prereq: AN S 214 or BIOL 255 256 or BIOL 335 or B M S 329*

Comparative anatomy, physiology, and endocrinology of domestic mammalian animal reproduction. Techniques for the control and manipulation of reproductive processes.

**AN S 332: Laboratory Methods in Animal Reproduction**

(0-2) Cr. 1. F.S.

*Prereq: Credit or enrollment in AN S 331*

Reproductive anatomy with emphasis on the physiology of normal reproductive function; ways to control and improve reproduction; principles of semen collection and artificial insemination; pregnancy testing.

**AN S 332A: Laboratory Methods in Animal Reproduction: Livestock, Companion, and Laboratory Animals**

(0-2) Cr. 1. F.S.

*Prereq: Credit or enrollment in AN S 331.*

Comparative reproductive anatomy with emphasis on the physiology of normal reproductive function; ways to control and improve reproduction; principles of semen collection and artificial insemination; pregnancy testing.

**AN S 332E: Laboratory Methods in Animal Reproduction: Equine**

(0-2) Cr. 1. S.

*Prereq: Credit or enrollment in AN S 331.*

Reproductive anatomy with emphasis on the physiology of normal reproductive function; breeding season management; ways to control and improve reproduction; semen collection, evaluation, and processing; artificial insemination; pregnancy testing; parturition in the mare, foal care.

**AN S 333: Embryo Transfer and Related Technologies**

(3-0) Cr. 3. F.

*Prereq: AN S 331 or AN S 332*

Application of embryo transfer and related technologies to genetic improvement of mammalian livestock. Techniques for control of female reproduction, embryo collection and transfer, embryo cryopreservation, and embryo manipulation. Gender selection. Economic and genetic aspects of embryo transfer.

**AN S 334: Embryo Transfer Laboratory**

(0-3) Cr. 1. F.

*Prereq: Credit or concurrent enrollment in AN S 333; or AN S 332; permission of instructor*

Selected laboratory exercises related to embryo transfer such as synchronization of estrus, superovulation, detection of estrus, artificial insemination, embryo collection, embryo evaluation, microscopy, embryo cryopreservation, in vitro fertilization, embryo sexing, rectal palpation, and ultrasonography will be demonstrated and/or performed.

**AN S 335: Dairy Cattle Evaluation**

(0-6) Cr. 3. S.

*Prereq: Sophomore classification*

Evaluation of breeding dairy replacement animals and lactating for dairy cows. Emphasis placed on familiarity with anatomical terms/structures, the use of comparative terminology, decision-making skills, and presentation of oral reasons. Trips to dairy cattle farms. Livestock handling. (Introduction and skills development course for AN S 475B.).

**AN S 336: Domestic Animal Behavior and Well-Being**

(2-2) Cr. 3. F.

*Prereq: One course in physiology*

Understand how managed animals cope and perceive the environment. Principles of behavior and well-being relative to animal care, management and housing. Methods to objectively assess animal well-being. Awareness of animal protection through education/assessments, audits and law.

**AN S 337: Lactation**

(3-0) Cr. 3. S.

*Prereq: AN S 214*

The structure, development and evolution of the mammary gland. Mammary metabolism, milk synthesis; neural and endocrine regulation of mammary function. Immune function and health of the mammary gland. Current events related to lactation.

**AN S 345: Growth and Development of Domestic Animals**

(3-0) Cr. 3. S.

*Prereq: AN S 214; Course(s) in nutrition, genetics, meat science and/or biochemistry recommended*

Basic principles of animal growth and development covered at the tissue, cellular and molecular level. Emphasis placed on skeletal muscle, adipose, bone, and immune system growth and development. The effects of genetics, nutrition, and pharmaceuticals on growth.

**AN S 352: Genetic Improvement of Domestic Animals**

(2-2) Cr. 3. F.S.

*Prereq: One course in statistics, BIOL 211, course in genetics*

Principles of qualitative and quantitative genetics applied to improve domestic animal populations. Impact of selection and mating schemes in achieving breeding program goals. Applications and impacts of biotechnological advancements in genetics and genomics.

**AN S 360: Fresh Meat Science and Applied Muscle Biology**

(3-0) Cr. 3. F.

*Prereq: AN S 270; a course in organic or biochemistry*

Impact of muscle structure, composition, rigor mortis, inspection, fabrication, handling, packaging and cooking on the palatability, nutritional value, yields, market value, and safety of fresh meat.

**AN S 380A: Swine Breeding and Gestation Management**

Cr. 1. S.

*Prereq: AN S 225, or AN S 280 and AN S 280L*

Concepts related to: reproductive physiology and endocrinology of boars and sows; genetic selection programs; development programs for future replacement gilts and boars; semen collection, evaluation, and preparation; detection of estrus and artificial insemination; pregnancy diagnosis; feeding and housing programs for gestating sows; environmental management; records; diseases, and development of quality assurance programs for identifying and solving reproductive problems.

**AN S 380B: Contemporary Issues in the Swine Industry**

Cr. 1. S.

*Prereq: AN S 225, or AN S 280 and AN S 280L*

Evaluation of issues facing today's swine industry including: welfare, nutrient management, and food safety and security. Development of skills needed for effective community relations such as media interviews and message points.

**AN S 380C: Employee Management for the Swine Industry**

Cr. 1. F.

*Prereq: AN S 225, or AN S 280 and AN S 280L*

Effective employee management in swine production units. Principles, policies, and practices related to procurement, development, maintenance, and utilization of employees.

**AN S 380D: Farrowing Management**

Cr. 1. S.SS.

*Prereq: AN S 225, or AN S 280 and AN S 280L*

Advanced integration and application of reproductive management concepts during farrowing and lactation. Identification of production trends; formulation of strategies to improve productivity, and parturition and neonatal management.

**AN S 380E: Swine Feed Mill Management**

Cr. 1. F.

*Prereq: AN S 225, or AN S 280 and AN S 280L*

Principles of feed manufacturing, equipment operation, feed and ingredient quality assurance and regulatory compliance in a modern feed milling operation. Overview of feed mill regulations and safety.

**AN S 380F: Marketing and Risk Management in the Swine Industry**

Cr. 1. S.

*Prereq: AN S 225, or AN S 280 and AN S 280L*

A comprehensive view of industry structure and trends and marketing options available in the swine industry. Management of risk between markets and/or contracts.

**AN S 380G: Swine Nursery and Finishing Management**

Cr. 1. SS.

*Prereq: AN S 225, or AN S 280 and AN S 280L*

Overview of the critical management, housing, and financial considerations relevant to the successful operation of a swine nursery, grow-finish, or wean to finish enterprise, including nutrient requirements; building and facility management; and marketing.

**AN S 380I: Pork Export Markets**

Cr. 1. SS.

*Prereq: AN S 225, or AN S 280 and AN S 280L*

Introduction to global markets; cultural preferences and customs associated with the global swine industry. International trade regulations potential impact of foreign animal diseases and bioterrorism affecting the U.S. swine industry.

**AN S 380J: Pork Product Quality and Safety**

Cr. 1. S.

*Prereq: AN S 225, or AN S 280 and AN S 280L*

Pre- and post-harvest affecting pork product quality and safety. Overview of pork harvesting process and traits and characteristics of quality pork products.

**AN S 380K: Swine Nutrition**

Cr. 1. F.

*Prereq: AN S 225, or AN S 280 and AN S 280L; AN S 319*

Principles of developing and implementing a swine feeding program. Fundamentals of feeding pigs including nutrients; factors affecting nutrient recommendations; feeding systems and management; feed ingredients, and formulation of swine diets.

**AN S 382: Swine Environment Management**

(1-0) Cr. 1.

*Prereq: AN S 225 or 280 and 280L. Recommended TSM 210.*

Response of swine to thermal environment, ventilation system design and analysis, heating and cooling systems, and examples of various designs for all phases of production. Troubleshooting ventilation systems and energy analysis of production units.

**AN S 383: Swine Manure and Nutrient Management**

(1-0) Cr. 1.

*Prereq: AN S 225 or AN S 280 and AN S 280L.*

Function, application, and advantages and disadvantages of nutrient management systems. Manure production rates, manure handling systems, storage and manure management planning for land application and odor mitigation strategies.

**AN S 384: Swine Health and Biosecurity**

(1-0) Cr. 1.

*Prereq: AN S 225 or AN S 280 and AN S 280L. Recommended a course in microbiology.*

Overview of standard biosecurity protocols and identification of behavior and clinical signs of illness in pigs. Treatment administration and prevention methods. Introduction to immune system function and basic swine disease transmission.

**AN S 399: Animal Science Internship**

Cr. arr. Repeatable. F.S.SS.

**AN S 399A: Animal Science Internship: Graded Internship Experience**

Cr. 2-6. Repeatable. F.S.SS.

*Prereq: Permission of the instructor*

Learning experience focused on professional development for a career related to animal science. Journal, presentation, and scientific component.

**AN S 399B: Animal Science Internship: Supervised Internship Experience**

Cr. R. Repeatable. F.S.SS.

*Prereq: Permission of the instructor*

Learning experience focused on professional development for a career related to animal science. Journal, presentation, and scientific component. This course is designed for those students who are completing a semester long internship located off campus.

**AN S 411: Addressing Issues in Animal Science**

(0-2) Cr. 1. F.S.

*Prereq: Senior classification in An S*

Life skill development emphasized in the context of exploring one's perspective of the most pressing moral and scientific issues facing animal agriculture. Clarification and communication of personal conclusions in small and large group settings expected.

**AN S 415: Equine Systems Management**

(2-2) Cr. 3. F.S.

*Prereq: AN S 216, AN S 319, AN S 320, AN S 331*

Identification and development of financial and production goals in a horse business. Scientific approach to make decisions in management of enterprises in the horse industry.

**AN S 419: Advanced Animal Nutrition**

(2-0) Cr. 2. F.

*Prereq: AN S 319*

Detailed consideration of digestion, metabolism, and assimilation of nutrients. Recent advances and developments in basic nutrition.

**AN S 424: Companion Animal Systems Management**

(2-2) Cr. 3. S.

*Prereq: AN S 224, AN S 319, AN S 320, AN S 331, AN S 352*

Decisions facing the administrator of a companion animal enterprise. Financial and business goal identification, problem clarification, and resource allocation to manage the companion animal system.

**AN S 425: Swine Systems Management**

(2-2) Cr. 3. F.

*Prereq: AN S 225, AN S 270, AN S 270L, AN S 319, AN S 320, AN S 331, AN S 352; ECON 230 or equivalent recommended*

Decisions facing the administrator of a swine enterprise. Financial and production goal identification, problem clarification, and resource allocation to manage the swine enterprise.

**AN S 426: Beef Cattle Systems Management**

(2-2) Cr. 3. F.S.

*Prereq: AN S 226, AN S 270, AN S 270L, AN S 320; ECON 230 or equivalent*

Decisions facing the administrator of a beef cow-calf or feedlot enterprise. Financial and production goal identification, problem clarification, and resource allocation to manage the beef enterprise. Computer aided study.

**AN S 429: Sheep Systems Management**

(2-2) Cr. 3. S.

*Prereq: AN S 229, AN S 319, AN S 320, AN S 331, AN S 352; AGRON 334 recommended; ECON 230 or equivalent recommended*

Decisions facing the administrator of a sheep enterprise. Financial and production goal identification, problem clarification, and resource allocation to manage the sheep enterprise.

**AN S 434: Dairy Systems Management**

(3-0) Cr. 3. F.

*Prereq: AN S 235, AN S 331, AN S 320, AN S 337, AN S 352*

The scientific foundation of dairy cattle management. The impact of dairy farm management practices on the biological processes of the cow. Integrates concepts from the disciplines of lactation, reproduction, nutrition, genetics, and animal health.

**AN S 435: Applied Dairy Farm Evaluation**

(2-2) Cr. 3. S.

*Prereq: AN S 434; ECON 230 or equivalent recommended*

Evaluate nutrition, reproduction, milk quality, breeding, and related management practices of commercial dairy herds in a case study format. Students will apply knowledge gained in the classroom to commercial dairy farm situations and develop skills in information gathering, decision making, problem solving, and interpersonal communications.

**AN S 441: International Animal Agriculture**

(Cross-listed with GLOBE). (3-0) Cr. 3. S.

*Prereq: One course from AN S 223, AN S 225, AN S 226, AN S 229, AN S 235*

An overview of animal agriculture with emphasis in developing countries. Historical, economic, environmental, and political considerations will be assessed and evaluated. Issues related to gender, resilience and sustainability for different production systems including alternative livestock species, will be investigated. The role of animal source foods in attainment of global food security will be discussed. Meets International Perspectives Requirement.

**AN S 460: Science and Technology of Value Added Meat Products**

(Dual-listed with AN S 560). (2-2) Cr. 3. S.

*Prereq: AN S 270*

Physical, chemical and biological properties of meat important to achieving value-added meat product characteristics. Ingredients, technology and equipment used for processing, preservation and safety of cured meats, loaf products and fresh, cooked, dry and semi-dry sausage products.

**AN S 475: Intercollegiate Judging Training and Competition**

(0-4) Cr. 1-2. Repeatable. F.S.

*Prereq: permission of instructor*

Specialized training in evaluation and grading of livestock, livestock products, and livestock production management plans. Maximum of 6 credits may be applied toward graduation.

**AN S 475A: Intercollegiate Judging Training and Competition: Meat Animals**

(0-4) Cr. 1-2. Repeatable. F.S.

*Prereq: permission of instructor*

Specialized training in evaluation and grading of livestock. Maximum of 6 credits may be applied toward graduation.

**AN S 475B: Intercollegiate Judging Training and Competition: Dairy Cattle**

(0-4) Cr. 1-2. Repeatable. F.S.

*Prereq: permission of instructor*

Specialized training in evaluation and grading of dairy cattle, in particular heifers and lactating dairy cows. Development and advancement of decision-making skills, comparative techniques, and presentation of oral reasons. Maximum of 6 credits may be applied toward graduation.

**AN S 475C: Intercollegiate Judging Training and Competition: Meats**

(0-4) Cr. 1-2. Repeatable. F.S.

*Prereq: permission of instructor*

Specialized training in evaluation and grading of livestock/meat products. Maximum of 6 credits may be applied toward graduation.

**AN S 475D: Intercollegiate Judging Training and Competition: Meat Animal Evaluation**

(0-4) Cr. 1-2. Repeatable. F.S.

*Prereq: permission of instructor*

Specialized training in evaluation and grading of livestock, livestock products, and livestock production management plans. Maximum of 6 credits may be applied toward graduation.

**AN S 475E: Intercollegiate Judging Training and Competition: Horses**

(0-4) Cr. 1-2. Repeatable. F.S.

*Prereq: permission of instructor*

Specialized training in evaluation of horses. Emphasis placed on familiarity with anatomical terms/structures, the use of comparative terminology, and decision making skills. Maximum of 6 credits may be applied toward graduation.

**AN S 475F: Intercollegiate Judging Training and Competition: Management Systems**

(0-4) Cr. 1-2. Repeatable. F.S.

*Prereq: permission of instructor*

Specialized training in evaluation of livestock/domesticated animal production management plans. Maximum of 6 credits may be applied toward graduation.

**AN S 480: Animal Industry Leadership Fellows**

Cr. 1. Repeatable. F.S.

*Prereq: A. AN S 226; permission of instructor C. AN S 225; permission of instructor*

Students broaden their perspective of the livestock industry through site visits, case-study (Fellows) projects, and cooperative learning experiences that capitalize on interaction skills in the context of studying the structure of the U.S. livestock industry. This for-credit offering represents the central academic focus of the Iowa State University Animal Industry Leadership Fellows Program. Study is species specific, and enrollment is limited. Offered on a satisfactory-fail basis only.

**AN S 480A: Animal Industry Leadership Fellows: Beef**

Cr. 1. Repeatable. F.S.

*Prereq: AN S 226; permission of instructor*

Students broaden their perspective of the livestock industry through site visits, case-study (Fellows) projects, and cooperative learning experiences that capitalize on interaction skills in the context of studying the structure of the U.S. livestock industry. This for-credit offering represents the central academic focus of the Iowa State University Animal Industry Leadership Fellows Program. Study is species specific, and enrollment is limited. Offered on a satisfactory-fail basis only.

**AN S 480C: Animal Industry Leadership Fellows: Pork**

Cr. 1. Repeatable. F.S.

*Prereq: AN S 225; permission of instructor*

Students broaden their perspective of the livestock industry through site visits, case-study (Fellows) projects, and cooperative learning experiences that capitalize on interaction skills in the context of studying the structure of the U.S. livestock industry. This for-credit offering represents the central academic focus of the Iowa State University Animal Industry Leadership Fellows Program. Study is species specific, and enrollment is limited. Offered on a satisfactory-fail basis only.

**AN S 480G: Animal Industry Leadership Fellows: Poultry**

Cr. 1. Repeatable. F.S.

*Prereq: AN S 223; permission of instructor*

Students broaden their perspective of the livestock industry through site visits, case-study (Fellows) projects, and cooperative learning experiences that capitalize on interaction skills in the context of studying the structure of the U.S. livestock industry. Central academic focus of the Iowa State University Animal Industry Leadership Fellows Program. Study is species specific, and enrollment is limited. Offered on a satisfactory-fail basis only.

**AN S 489: Issues in Food Safety**

(Cross-listed with FS HN, HSP M, VDPAM). (1-0) Cr. 1. S.

*Prereq: Credit or enrollment in FS HN 101 or FS HN 272 or HSP M 233; FS HN 419 or FS HN 420; FS HN 403*

Capstone seminar for the food safety minor. Case discussions and independent projects about safety issues in the food system from a multidisciplinary perspective.

**AN S 490: Independent Study**

Cr. 1-3. Repeatable, maximum of 6 credits. F.S.SS.

*Prereq: Permission of the instructor*

Open to juniors and seniors in animal science and dairy science showing satisfactory preparation for problems chosen. Individual topic conference and preparation of report. A maximum of 6 credits of An S 490 may be applied toward the total credits required for graduation.

**AN S 490A: Independent Study: Animal Science**

Cr. 1-3. Repeatable, maximum of 6 credits. F.S.SS.

*Prereq: Permission of the instructor*

Open to juniors and seniors in animal science and dairy science showing satisfactory preparation for problems chosen. Individual topic conference and preparation of report. A maximum of 6 credits of An S 490 may be applied toward the total credits required for graduation.

**AN S 490B: Independent Study: Dairy Science**

Cr. 1-3. Repeatable, maximum of 6 credits. F.S.SS.

*Prereq: Permission of the instructor*

Open to juniors and seniors in animal science and dairy science showing satisfactory preparation for problems chosen. Individual topic conference and preparation of report. A maximum of 6 credits of An S 490 may be applied toward the total credits required for graduation.

**AN S 490C: Independent Study: Meat Science**

Cr. 1-3. Repeatable, maximum of 6 credits. F.S.SS.

*Prereq: Permission of the instructor*

Open to juniors and seniors in animal science and dairy science showing satisfactory preparation for problems chosen. Individual topic conference and preparation of report. A maximum of 6 credits of An S 490 may be applied toward the total credits required for graduation.

**AN S 490D: Independent Study: Companion Animal Science**

Cr. 1-3. Repeatable, maximum of 6 credits. F.S.SS.

*Prereq: Permission of the instructor*

Open to juniors and seniors in animal science and dairy science showing satisfactory preparation for problems chosen. Individual topic conference and preparation of report. A maximum of 6 credits of An S 490 may be applied toward the total credits required for graduation.

**AN S 490E: Independent Study: Equine Science**

Cr. 1-3. Repeatable, maximum of 6 credits. F.S.SS.

*Prereq: Permission of the instructor*

Open to juniors and seniors in animal science and dairy science showing satisfactory preparation for problems chosen. Individual topic conference and preparation of report. A maximum of 6 credits of An S 490 may be applied toward the total credits required for graduation.

**AN S 490G: Independent Study: Poultry Science**

Cr. 1-3. Repeatable, maximum of 6 credits. F.S.SS.

*Prereq: Permission of the instructor*

Open to juniors and seniors in animal science and dairy science showing satisfactory preparation for problems chosen. Individual topic conference and preparation of report. A maximum of 6 credits of An S 490 may be applied toward the total credits required for graduation.

**AN S 490H: Independent Study: Honors**

Cr. 1-3. Repeatable, maximum of 6 credits. F.S.SS.

*Prereq: Permission of the instructor*

Open to juniors and seniors in animal science and dairy science showing satisfactory preparation for problems chosen. Individual topic conference and preparation of report. A maximum of 6 credits of An S 490 may be applied toward the total credits required for graduation.

**AN S 490I: Independent Study: Entrepreneurship**

Cr. 1-3. Repeatable, maximum of 6 credits. F.S.SS.

*Prereq: Permission of the instructor*

Open to juniors and seniors in animal science and dairy science showing satisfactory preparation for problems chosen. Individual topic conference and preparation of report. A maximum of 6 credits of An S 490 may be applied toward the total credits required for graduation.

**AN S 493: Workshop in Animal Science**

Cr. 1-3. Repeatable.

*Prereq: Permission of instructor*

Workshop in livestock production. Includes current concepts in breeding, nutrition, reproduction, meats, and technologies that impact the animal industry.

**AN S 495: Agricultural Travel Course Preparation**

Cr. R. Repeatable. F.S.

*Prereq: Permission of instructor*

Limited enrollment. Students enrolled in this course will also register for Agron 495 and intend to register in Agron 496 and An S 496 the following term. Topics will include the agricultural industries, climate, crops, culture, history, livestock, marketing, soils, and preparation for travel to locations to be visited. Information normally available 9 months before departure.

**AN S 496: Agricultural Travel Course**

Cr. arr. Repeatable.

*Prereq: Permission of instructor, 30 college credits*

Limited enrollment. Students enroll in both An S 496 and Agron 496. Tour and study of production methods in major crop and livestock regions of the world. Influence of climate, economics, geography, soils, landscapes, markets, and other factors on livestock and crop production. Locations and duration of tours will vary. Summer tour will usually visit a northern location and winter tour will usually visit a southern location. Information usually available 9 months before departure. Tour expenses paid by students.

**AN S 496A: Agricultural Travel Course: International Tour**

Cr. arr. Repeatable.

*Prereq: Permission of instructor, 30 college credits*

Limited enrollment. Students enroll in both An S 496 and Agron 496. Tour and study of production methods in major crop and livestock regions of the world. Influence of climate, economics, geography, soils, landscapes, markets, and other factors on livestock and crop production. Locations and duration of tours will vary. Summer tour will usually visit a northern location and winter tour will usually visit a southern location. Information usually available 9 months before departure. Tour expenses paid by students.

Meets International Perspectives Requirement.

**AN S 496B: Agricultural Travel Course: Domestic tour**

Cr. arr. Repeatable.

*Prereq: Permission of instructor, 30 college credits*

Limited enrollment. Students enroll in both An S 496 and Agron 496. Tour and study of production methods in major crop and livestock regions of the world. Influence of climate, economics, geography, soils, landscapes, markets, and other factors on livestock and crop production. Locations and duration of tours will vary. Summer tour will usually visit a northern location and winter tour will usually visit a southern location. Information usually available 9 months before departure. Tour expenses paid by students.

**AN S 497: Undergraduate Teaching Experiences in Animal Science**

Cr. 1-2. Repeatable, maximum of 4 credits. F.S.SS.

*Prereq: Permission of instructor*

Development of oral and written communication skills of technical concepts in animal science. Emphasis on organizational skills, conducting activities and interpersonal communication skills. Responsibilities in a class under direct supervision of a faculty member. A maximum of 4 credits of An S 497 may be applied toward graduation.

**Courses primarily for graduate students, open to qualified undergraduates:**

**AN S 500: Computer Techniques for Biological Research**

(2-0) Cr. 1. F.

Introduction to UNIX and SAS for solving research problems, including organization of data files, transfer of files between workstations, developing models, and techniques for analysis of designed experiments. Introduction to matrix algebra for solving animal breeding problems using MATLAB and computer simulation.

**AN S 500A: Computer Techniques for Biological Research: UNIX and SAS**

(2-0) Cr. 1. F.

First half semester course. Introduction to UNIX and SAS for solving research problems, including organization of data files, transfer of files between workstations, developing models, and techniques for analysis of designed experiments. Introduction to matrix algebra for solving animal breeding problems using MATLAB and computer simulation.

**AN S 500B: Computer Techniques for Biological Research: Problem solving using matrix algebra**

(2-0) Cr. 1. F.

Second half semester course. Introduction to UNIX and SAS for solving research problems, including organization of data files, transfer of files between workstations, developing models, and techniques for analysis of designed experiments. Introduction to matrix algebra for solving animal breeding problems using MATLAB and computer simulation.

**AN S 501: Survey of Animal Disciplines**

(1-0) Cr. 1. F.

Required for Animal Science graduate students. Orientation to departmental and graduate school policies and procedures. Discussion of programs of research and outreach in Animal Science. Issues impacting the animal industry. Offered on a satisfactory-fail basis only.

**AN S 515: Integrated Crop and Livestock Production Systems**

(Cross-listed with A B E, AGRON, SUSAG). (3-0) Cr. 3. Alt. F., offered odd-numbered years.

*Prereq:* SUSAG 509

Methods to maintain productivity and minimize the negative ecological effects of agricultural systems by understanding nutrient cycles, managing manure and crop residue, and utilizing multispecies interactions. Crop and livestock production within landscapes and watersheds is also considered. Course includes a significant field component, with student teams analyzing Iowa farms.

**AN S 517: Gut Microbiome: Implications for Health and Diseases**

(Cross-listed with FS HN, MICRO, V MPM). Cr. 3.

*Prereq:* 2-3 credits in microbiology and/or immunology.

Explore current research on gut microbiome including modern tools used to study the gut microbiome. Examine the linkages between gut microbiome and health status, diseases, and manipulation of gut microbiome to improve health.

**AN S 518: Digestive Physiology and Metabolism of Non Ruminants**

(Cross-listed with NUTRS). (3-0) Cr. 3. Alt. S., offered odd-numbered years.

*Prereq:* AN S 419 or NUTRS 501

Digestion and metabolism of nutrients. Nutritional requirements and current research and feeding programs for poultry and swine.

**AN S 520: Digestive Physiology and Metabolism of Ruminants**

(Cross-listed with NUTRS). (2-2) Cr. 3. Alt. S., offered even-numbered years.

*Prereq:* AN S 419 or NUTRS 501

Digestive physiology and nutrient metabolism in ruminant and preruminant animals.

**AN S 533: Physiology and Endocrinology of Animal Reproduction**

(2-0) Cr. 2. Alt. S., offered even-numbered years.

*Prereq:* General physiology course

Development of structure and function of the reproductive system. Physiologic and endocrine aspects including puberty, gametogenesis, estrous cycle, pregnancy, maternal recognition, fertilization and early embryonic development.

**AN S 536: Perinatology**

(2-0) Cr. 2. S.

*Prereq:* One course in physiology; one course in biochemistry

Regulation of metabolism and development in the mammalian fetus and neonate is explored in a comparative manner. Emphasis will be on the dynamic changes in these relationships occurring at birth.

**AN S 537: Topics in Animal Behavior, Welfare**

(3-0) Cr. 3.

*Prereq:* permission of instructor; M.S. or Ph.D. student

Each semester, the students' focus is on different topics related to animal behavior, animal welfare and contemporary issues related to animal behavior and welfare. Each topic is separate and distinct, and students may enroll in multiple topics. This is an on-line course only. Each topic may be taken only one time for credit.

**AN S 537A: Topics in Animal Behavior, Welfare: Animal Behavior**

(3-0) Cr. 3. Alt. S., offered odd-numbered years.

*Prereq:* permission of instructor; M.S. or Ph.D. student

Each semester, the students' focus is on different topics related to animal behavior, animal welfare and contemporary issues related to animal behavior and welfare. Each topic is separate and distinct, and students may enroll in multiple topics. This is an on-line course only. Each topic may be taken only one time for credit.

**AN S 537B: Topics in Animal Behavior, Welfare: Contemporary Issues.**

(3-0) Cr. 3. Alt. S., offered odd-numbered years.

*Prereq:* permission of instructor; M.S. or Ph.D. student

Each semester, the students' focus is on different topics related to animal behavior, animal welfare and contemporary issues related to animal behavior and welfare. Each topic is separate and distinct, and students may enroll in multiple topics. This is an on-line course only. Each topic may be taken only one time for credit.

**AN S 537C: Topics in Animal Behavior, Welfare: Animal Welfare**

(3-0) Cr. 3. Alt. S., offered odd-numbered years.

*Prereq:* permission of instructor; M.S. or Ph.D. student

Each semester, the students' focus is on different topics related to animal behavior, animal welfare and contemporary issues related to animal behavior and welfare. Each topic is separate and distinct, and students may enroll in multiple topics. This is an on-line course only. Each topic may be taken only one time for credit.

**AN S 537D: Topics in Animal Behavior, Welfare: Immune and Stress**

(3-0) Cr. 3. Alt. S., offered odd-numbered years.

*Prereq:* permission of instructor; M.S. or Ph.D. student

Each semester, the students' focus is on different topics related to animal behavior, animal welfare and contemporary issues related to animal behavior and welfare. Each topic is separate and distinct, and students may enroll in multiple topics. This is an on-line course only. Each topic may be taken only one time for credit.

**AN S 540: Livestock Immunogenetics**

(Cross-listed with MICRO, V MPM). (2-0) Cr. 2. Alt. S., offered odd-numbered years.

*Prereq: AN S 561 or MICRO 575 or V MPM 520*

Basic concepts and contemporary topics in genetic regulation of livestock immune response and disease resistance.

**AN S 549: Advanced Vertebrate Physiology I**

(Cross-listed with KIN, NUTRS). (4-0) Cr. 4. F.

*Prereq: recommended: an undergraduate physiology course and a biochemistry course*

Overview of mammalian physiology. Cell biology, endocrinology, cardiovascular, respiratory, immune, digestive, skeletal muscle and reproductive systems.

**AN S 552: Advanced Vertebrate Physiology II**

(Cross-listed with KIN, NUTRS). (3-0) Cr. 3. S.

*Prereq: BIOL 335; credit or enrollment in BBMB 404 or BBMB 420*

Cardiovascular, renal, respiratory, and digestive physiology.

**AN S 556: Current Topics in Genome Analysis**

(3-0) Cr. 3. Alt. S., offered even-numbered years.

*Prereq: BBMB 405 or GDCB 510*

Introduction to principles and methodology of molecular genetics useful in analyzing and modifying large genomes.

**AN S 560: Science and Technology of Value Added Meat Products**

(Dual-listed with AN S 460). (2-2) Cr. 3. S.

*Prereq: AN S 270*

Physical, chemical and biological properties of meat important to achieving value-added meat product characteristics. Ingredients, technology and equipment used for processing, preservation and safety of cured meats, loaf products and fresh, cooked, dry and semi-dry sausage products.

**AN S 561: Population and Quantitative Genetics for Breeding**

(Cross-listed with AGRON). (4-0) Cr. 4. F.

*Prereq: STAT 401*

Population and quantitative genetics for plant and animal genetics. Study of the genetic basis and analysis of variation in quantitative traits in domestic or experimental populations using phenotypic and molecular marker data, including estimation of heritability and other genetic parameters, linkage analysis and mapping of quantitative trait loci, and the impact of inbreeding, heterosis, and genotype-by-environment interaction.

**AN S 562: Methodologies for Population/Quantitative Genetics**

(2-0) Cr. 2. S.

*Prereq: AN S 561, STAT 402*

Basic theory for genetic analysis of animal breeding data. Course A (1st half semester) covers linear models, selection index methods, and basic theory for best linear unbiased prediction. Course B (2nd half semester) best linear unbiased prediction, including genetic groups, environmental adjustment, repeated records, multiple trait models, maternal effects models, and theory for maximum likelihood estimation of genetic parameters.

**AN S 562A: Methodologies for Population/Quantitative Genetics: Linear Models and Genetic Prediction**

(2-0) Cr. 2. S.

*Prereq: AN S 561, STAT 402*

Basic theory for genetic analysis of animal breeding data. Course A (1st half semester) covers linear models, selection index methods, and basic theory for best linear unbiased prediction. Course B (2nd half semester) best linear unbiased prediction, including genetic groups, environmental adjustment, repeated records, multiple trait models, maternal effects models, and theory for maximum likelihood estimation of genetic parameters.

**AN S 562B: Methodologies for Population/Quantitative Genetics: Advanced Genetic Prediction&Parameter Estimation**

(2-0) Cr. 2. S.

*Prereq: AN S 561, STAT 402*

Basic theory for genetic analysis of animal breeding data. Course A (1st half semester) covers linear models, selection index methods, and basic theory for best linear unbiased prediction. Course B (2nd half semester) best linear unbiased prediction, including genetic groups, environmental adjustment, repeated records, multiple trait models, maternal effects models, and theory for maximum likelihood estimation of genetic parameters.

**AN S 563: Advanced Processed Meats Technology**

Cr. 3. S.

*Prereq: AN S 270 or equivalent, or at least two undergraduate courses in biology, food science, microbiology or culinology*

Physical, chemical and biological properties of meat important to processed meat product characteristics. Ingredients, technology and equipment used for fresh and cured meat products. Packaging, preservation and food safety issues critical to processed meat products are emphasized.

**AN S 570: Advanced Meat Science and Applied Muscle Biology**

(2-2) Cr. 3. Alt. S., offered even-numbered years.

*Prereq: AN S 460*

Ante and postmortem factors impacting composition, structure, and chemistry of red meat and poultry muscle/meat, the conversion of muscle to meat, and the sensory and nutritional attributes of fresh meats. Oral research reports and a research proposal.

**AN S 571: Advanced Meat Processing Principles and Technology**

(2-2) Cr. 3. Alt. F., offered even-numbered years.

*Prereq: AN S 460 or AN S 570*

Physical/chemical relationships during processing. Effects of modern technology, non-meat additives and preservation techniques on quality and safety of processed meat. Laboratory demonstration of principles and technology.

**AN S 573: Fresh Meat Science and Technology**

Cr. 3. F.

*Prereq: AN S 270 or equivalent, or minimum two undergraduate courses in biology, food science, microbiology or culinology.*

Quality, and sensory attributes of fresh meats and how they develop and how they are evaluated. The study of ante and postmortem factors impacting quantity, composition, structure, and chemistry of red meat and poultry muscle/meat. Students cannot receive credit for both AN S 570 and AN S 573

**AN S 590: Special Topics**

Cr. 1-3. Repeatable. F.S.SS.

*Prereq: Permission of instructor*

Special topics in the animal sciences, offered on demand and may be conducted by guest professors.

**AN S 590A: Special Topics: Animal Breeding**

Cr. 1-3. Repeatable. F.S.SS.

*Prereq: Permission of instructor*

Special topics in the animal sciences, offered on demand and may be conducted by guest professors.

**AN S 590B: Special Topics: Animal Nutrition**

Cr. 1-3. Repeatable. F.S.SS.

*Prereq: Permission of instructor*

Special topics in the animal sciences, offered on demand and may be conducted by guest professors.

**AN S 590C: Special Topics: Meat Animal Production**

Cr. 1-3. Repeatable. F.S.SS.

*Prereq: Permission of instructor*

Special topics in the animal sciences, offered on demand and may be conducted by guest professors.

**AN S 590D: Special Topics: Dairy Production**

Cr. 1-3. Repeatable. F.S.SS.

*Prereq: Permission of instructor*

Special topics in the animal sciences, offered on demand and may be conducted by guest professors.

**AN S 590E: Special Topics: Meat Science**

Cr. 1-3. Repeatable. F.S.SS.

*Prereq: Permission of instructor*

Special topics in the animal sciences, offered on demand and may be conducted by guest professors.

**AN S 590F: Special Topics: Physiology of Reproduction**

Cr. 1-3. Repeatable. F.S.SS.

*Prereq: Permission of instructor*

Special topics in the animal sciences, offered on demand and may be conducted by guest professors.

**AN S 590G: Special Topics: Muscle Biology**

Cr. 1-3. Repeatable. F.S.SS.

*Prereq: Permission of instructor*

Special topics in the animal sciences, offered on demand and may be conducted by guest professors.

**AN S 590H: Special Topics: Poultry Nutrition**

Cr. 1-3. Repeatable. F.S.SS.

*Prereq: Permission of instructor*

Special topics in the animal sciences, offered on demand and may be conducted by guest professors.

**AN S 590I: Special Topics: Poultry Products**

Cr. 1-3. Repeatable. F.S.SS.

*Prereq: Permission of instructor*

Special topics in the animal sciences, offered on demand and may be conducted by guest professors.

**AN S 590J: Special Topics: Experimental Surgery**

Cr. 1-3. Repeatable. F.S.SS.

*Prereq: Permission of instructor*

Special topics in the animal sciences, offered on demand and may be conducted by guest professors.

**AN S 590K: Special Topics: Professional Topics**

Cr. 1-3. Repeatable. F.S.SS.

*Prereq: Permission of instructor*

Special topics in the animal sciences, offered on demand and may be conducted by guest professors.

**AN S 590L: Special Topics: Teaching**

Cr. 1-3. Repeatable. F.S.SS.

*Prereq: Permission of instructor*

Special topics in the animal sciences, offered on demand and may be conducted by guest professors.

**AN S 590M: Special Topics: Molecular Biology**

Cr. 1-3. Repeatable. F.S.SS.

*Prereq: Permission of instructor*

Special topics in the animal sciences, offered on demand and may be conducted by guest professors.

**AN S 590N: Special Topics: Ethology**

Cr. 1-3. Repeatable. F.S.SS.

*Prereq: Permission of instructor*

Special topics in the animal sciences, offered on demand and may be conducted by guest professors.

**AN S 599: Creative Component**

Cr. 1-8. F.S.SS.

*Prereq: Nonthesis M.S*

A written report based on research, library readings, or topics related to the student's area of specialization and approved by the student's advisory committee.

**AN S 599A: Creative Component: Animal Breeding and Genetics**

Cr. 1-8. F.S.SS.

*Prereq: Nonthesis M.S*

A written report based on research, library readings, or topics related to the student's area of specialization and approved by the student's advisory committee.

**AN S 599B: Creative Component: Animal Nutrition**

Cr. 1-8. F.S.SS.

*Prereq: Nonthesis M.S*

A written report based on research, library readings, or topics related to the student's area of specialization and approved by the student's advisory committee.

**AN S 599C: Creative Component: Animal Physiology**

Cr. 1-8. F.S.SS.

*Prereq: Nonthesis M.S*

A written report based on research, library readings, or topics related to the student's area of specialization and approved by the student's advisory committee.

**AN S 599D: Creative Component: Animal Science**

Cr. 1-8. F.S.SS.

*Prereq: Nonthesis M.S*

A written report based on research, library readings, or topics related to the student's area of specialization and approved by the student's advisory committee.

**AN S 599E: Creative Component: Meat Science**

Cr. 1-8. F.S.SS.

*Prereq: Nonthesis M.S*

A written report based on research, library readings, or topics related to the student's area of specialization and approved by the student's advisory committee.

**Courses for graduate students:****AN S 603: Seminar in Animal Nutrition**

(1-0) Cr. 1. Repeatable. F.S.

*Prereq: Permission of instructor*

Discussion of current literature; preparation and submission of abstracts.

**AN S 618: Vitamins and Minerals**

(Cross-listed with NUTRS). Cr. 2. Alt. S., offered even-numbered years.

*Prereq: Biochemistry, physiology, basic nutrition*

Understanding molecular aspects of vitamin and mineral metabolism and homeostasis in humans and animals. An in-depth examination of the chemistry of vitamins and minerals, including genetic mutations, proteins involved in absorption and excretion, and their necessity in biological processes.

**AN S 619: Advanced Nutrition and Metabolism - Protein**

(Cross-listed with NUTRS). (2-0) Cr. 2. F.

*Prereq: BBMB 405*

Digestion, absorption, and intermediary metabolism of amino acids and protein. Regulation of protein synthesis and degradation. Integration of cellular biochemistry and physiology of mammalian protein metabolism.

**AN S 620: Advanced Nutrition and Metabolism - Energy**

(Cross-listed with NUTRS). (2-0) Cr. 2. Alt. S., offered odd-numbered years.

*Prereq: BBMB 405*

Energy constituents of feedstuffs and energy needs of animals as related to cellular biochemistry and physiology. Interpretations of classical and current research.

**AN S 633: Seminar in Animal Reproduction**

(1-0) Cr. 1. Repeatable. F.

*Prereq: Permission of instructor*

Discussion of current literature and preparation of reports and seminars on selected topics concerning animal physiology.

**AN S 652: Animal Breeding Strategies**

(2-0) Cr. 2.

*Prereq: AN S 561*

Basic concepts and methods for design and evaluation of genetic improvement programs for livestock. Topic A. (1st half semester) Prediction of response to selection, selection index theory, multiple trait selection, inbreeding, crossbreeding, and marker-assisted selection. Topic B. (2nd half semester) Advanced concepts in design and evaluation of animal breeding programs, including modeling and optimization, derivation of economic values, gene-flow, and predicting rates of inbreeding. Each topic may be taken only one time for academic credit.

**AN S 652A: Animal Breeding Strategies: Breeding Goals and Response to Selection**

(2-0) Cr. 2.

*Prereq: AN S 561*

Basic concepts and methods for design and evaluation of genetic improvement programs for livestock. Topic A. (1st half semester) Prediction of response to selection, selection index theory, multiple trait selection, inbreeding, crossbreeding, and marker-assisted selection. Topic B. (2nd half semester) Advanced concepts in design and evaluation of animal breeding programs, including modeling and optimization, derivation of economic values, gene-flow, and predicting rates of inbreeding. Each topic may be taken only one time for academic credit.

**AN S 652B: Animal Breeding Strategies: Design and Evaluation of Animal Breeding Programs**

(2-0) Cr. 2.

*Prereq: AN S 561*

Basic concepts and methods for design and evaluation of genetic improvement programs for livestock. Topic A. (1st half semester) Prediction of response to selection, selection index theory, multiple trait selection, inbreeding, crossbreeding, and marker-assisted selection. Topic B. (2nd half semester) Advanced concepts in design and evaluation of animal breeding programs, including modeling and optimization, derivation of economic values, gene-flow, and predicting rates of inbreeding. Each topic may be taken only one time for academic credit.

**AN S 653: Applied Animal Breeding Strategies**

(3-0) Cr. 3. F.

*Prereq: AN S 561 recommended*

Industrial applications of breeding systems, selection methods, and new genetic technologies. One or more field trips to an industry breeding company.

**AN S 655: Advanced Computational Methods in Animal Breeding and Genetics**

(3-1) Cr. 2. Alt. F., offered odd-numbered years.

*Prereq: AN S 500, AN S 562, Com S 207*

Computational methods and strategies for analysis of large data sets with animal breeding data for use in research and industry applications. Course A (1st half semester) Strategies for handling large sets and for prediction using best linear unbiased prediction using a formal language and utility programs. Course B (2nd half semester) Strategies for estimation of genetic parameters and for use of non-linear models for genetic analysis of categorical and survival type data.

**AN S 655A: Computational Strategies for Predicting Breeding Values**

(3-1) Cr. 2. Alt. F., offered odd-numbered years.

*Prereq: AN S 500, AN S 562, COM S 207*

Computational methods and strategies for analysis of large data sets with animal breeding data for use in research and industry applications. Strategies for handling large sets and for prediction using best linear unbiased prediction using a formal language and utility programs.

**AN S 655B: Computational Strategies for Genetic Parameter Estimation**

(3-1) Cr. 2. Alt. F., offered odd-numbered years.

*Prereq: AN S 500, AN S 562, COM S 207*

Computational methods and strategies for analysis of large data sets with animal breeding data for use in research and industry applications. Strategies for estimation of genetic parameters and for use of non-linear models for genetic analysis of categorical and survival type data.

**AN S 656: Statistical Methods for Mapping Quantitative Trait Loci**

(2-0) Cr. 2. Alt. S., offered even-numbered years.

*Prereq: AN S 562, STAT 447*

Statistical methods for mapping quantitative trait loci in out-bred populations. Methods based on modeling covariances between relatives. Likelihood based methods using half-sib and full-sib families and extended pedigrees. Bayesian methods applied.

**AN S 658: Seminar in Animal Breeding and Genetics**

(1-0) Cr. 1. Repeatable. F.S.

Presentation of current research related to animal breeding and genetics.

**AN S 670: Molecular Biology of Muscle**

(Cross-listed with KIN). (3-0) Cr. 3. Alt. S., offered odd-numbered years.

*Prereq: BBMB 405, BBMB 420*

Ultrastructure of muscle; chemistry, structure, function, and molecular biology of muscle proteins. Molecular aspects of muscle contraction, development and turnover. Cytoskeletal proteins and dynamics.

**AN S 684: Seminar in Meat Science**

(1-0) Cr. 1. Repeatable. S.

*Prereq: Permission of instructor*

Discussion and evaluation of current topics in research publications in meat science.

**AN S 685: Seminar in Muscle Biology**

(1-0) Cr. 1. Repeatable. S.

*Prereq: Permission of instructor*

Reports and discussion of recent literature and current investigations.

**AN S 695: Seminar in Animal Science**

(1-0) Cr. 1. Repeatable. S.

Reports and discussion of current issues and research in animal science.

One credit is required for all M.S. degree candidates with graduate majors in the Department of Animal Science, and two credits are required for all Ph.D. candidates with graduate majors in the Department of Animal Science. Offered on a satisfactory-fail basis only.

**AN S 699: Research**

Cr. arr. Repeatable.

**AN S 699A: Research: Animal Breeding**

Cr. arr. Repeatable.

**AN S 699B: Research: Animal Nutrition**

Cr. arr. Repeatable.

**AN S 699C: Research: Meat Animal Production**

Cr. arr. Repeatable.

**AN S 699D: Research: Dairy Production**

Cr. arr. Repeatable.

**AN S 699E: Research: Meat Science**

Cr. arr. Repeatable.

**AN S 699F: Research: Physiology of Reproduction**

Cr. arr. Repeatable.

**AN S 699G: Research: Muscle Biology**

Cr. arr. Repeatable.

**AN S 699H: Research: Poultry Nutrition**

Cr. arr. Repeatable.

**AN S 699I: Research: Poultry Products**

Cr. arr. Repeatable.

**AN S 699J: Research: Animal Ethology**

Cr. arr. Repeatable.