

Section X

Undergraduate Program Summary and Curriculum Requirements

Background

The enrollment trends for undergraduates in Animal Sciences are depicted in Table 1. Enrollment declines in the College during the 1980's led to a college-wide curriculum revision called "Project Sunrise". As part of this revision process, several cross-disciplinary majors were created. Rather than departmentally-based, the new majors were based in the college. The Animal Science major was discontinued. Students interested in Animal Science generally went to one of three majors:

- **Science in Agriculture:** Emphases included: Animal Science, Climatology, Food Science, Nutrition, Plant Sciences, and Soil Science.
- **Animal and Plant Systems:** Emphases included: Animal Production, Crops and Soils/Horticultural Food Production, Integrated Pest Management, and Environment Horticulture.
- **Agricultural Industries and Marketing:** Emphases included: Animal Industries, Crops/Soils Industries, Horticultural Industries, and Food Industries.

Table 1. Enrollment trends in Animal Sciences.

Year	Major					Total AnSc	COAFES Enrollment
	AnSc	An & Plant Sys	Science in Ag-AnSc	Ag Industries & Mktng- AnSc	An Production Systems		
1978	431					431	1791
1979	388					388	1673
1980	325					325	1661
1981	353					353	1712
1982	289					289	1541
1983	265					265	1307
1984	242					242	1222
1985	190					190	1107
1986	170					170	1021
1987	135					135	774
1988	123					123	747
1989	121	3	11	5		140	698
1990	52	24	61	30		168	751
1991	32	41	86	51		210	858
1992	11	56	112	58		236	901
1993	4	60	131	54		249	866
1994	2	66	130	42		239	872
1995		65	194	32		290	917
1996	1	65	176	27		270	873
1997		66	184	27		276	823
1998	1	71	174	29		274	915
1999	2	61	163	30	1	258	914
2000	1	37	189	27	18	272	988
2001	1	6	203	45	43	298	1075
2002	1	1	221	33	50	306	1071
2003			204	39	54	298	1121
2004							

Assumed that 40% of Animal and Plant Systems majors had animal emphasis.

Assumed that 90% of Science in Agriculture majors had animal emphasis.

Assumed that 80% of Agricultural Industries and Marketing majors had animal emphasis.

The downward trend in enrollment reversed (1989-90) when the new majors were implemented. Whether this reversal was caused by demands for the new majors, increased resources dedicated to recruitment by the college, end of the “farm crisis” of the 1980’s or other factors is unknown. The percent of students selecting the Animal emphasis in the new majors was estimated: Science in Agriculture, 90% (almost all pre-vet); Animal and Plant Systems, 40%; and Agricultural Industries and Marketing, 80%.

The new majors initially received excellent faculty support, with orientation courses and keystone courses team taught or responsibilities shared by faculty from different departments. However, enthusiasm waned. Faculty attendance decreased at major curriculum meetings, it was difficult to recruit faculty to be major coordinators, orientation courses disappeared, and team-taught keystone courses lost their team.

In 1999, the Animal Plant Systems major was split into three majors: Animal Production Systems, Environmental Horticulture, and Crops and Soils Resource Management. The Horticulture Department, the main supporter of this split, felt their recruitment efforts for new students would be enhanced by having their own identity.

In 2002, the college administration became aware of problems in the Science in Agriculture major. It was difficult to find a faculty member willing to serve as the major coordinator or teach the orientation course. In addition, less than 15% of the freshman students coming into the Science in Agriculture major were graduating within 4 years from the college. The success rate of students was probably closer to 20% considering students who went into vet school after 3-4 years of undergraduate work and chose not to complete requirements for a B.S. degree. Also, freshman students who were undecided as to major or temporarily in COAFES waiting to get into another college, were often assigned to this major. Still, students were not succeeding at a rate the college felt was satisfactory. It was found that many students had completed all course requirements but had disappeared prior to completing their Senior Thesis. Among the colleges majors, the Senior Thesis was only required in the Science in Agriculture major.

In 2003, a new Animal Science major with emphases in Industry, Production, and Science/Pre-Vet/Biotechnology was approved. This replaced the Animal Production Systems major, the Animal Science emphasis in the Science in Agriculture major, and the Animal Industries emphasis in the Agricultural Industries and Marketing major. (Science in Agriculture major was subsequently replaced with the Applied Plant Sciences major.)

A main goal of creating the Animal Science major was to increase the retention and graduation rate of our students. The following changes should help in that regard:

1. The undergraduate thesis is now optional. Students may do the thesis, internship, or both.
2. There are more courses in common across the 3 emphases. Pre-vet students, not doing well in the science courses, can more easily change emphasis to industry or production without losing time.
3. We have added courses in:
 - **Companion/Small Animals**
 - AnSc 1403 Companion Animal Nutrition and Care
 - SACS 4600 Small Animal and Equine Behavior
 - SACS 4606 Small Animal Management
 - **Equine**
 - AnSc 1007 Horse in Your Backyard
 - AnSc 3007 Equine Nutrition
 - AnSc 3052 Equine Anatomy and Exercise Physiology
 - AnSc XXXX Equine Health
 - VPM XXXX Equine Reproduction

The majority of our Pre-vet students are urban with little interest in traditional livestock species. The addition of the above courses will encourage them to complete their degree in our major.

4. A 70% time recruiter/student adviser was added to the Department in fall 2003. Students still had the option of meeting with their faculty advisers but observations were that beginning students were more apt to meet with the person in this new position (she had just received her B.S. from the college the year before). We are currently refilling this position with an individual who will serve DAS 100% time. Sharon Thielen has been selected and will start September 27, 2004.
5. In fall 1005, Animal Science Pre-vet freshmen will be encouraged to live in the newly established freshmen Pre-vet house in Bailey Hall, St Paul Campus. In addition to giving these students a better sense of community, additional advising and tutors will be available to them. For fall 2004, 38% of the AnSc freshmen live in Bailey Hall, 38% live on the Minneapolis campus and 24% are in off campus housing (many commuting from home).

Student Composition

The majority of our students are Pre-vet students interested in companion animals or equine and do not have a farm background. Our next largest block of students are from dairy farms and are interested in careers in the dairy industry. Table 2 shows the results of a survey given to AnSc 1101 Introductory to Animal Science students (2002-2004). The three species the students were most interested in were dairy cattle, horses and dogs.

Table 2. Introductory Animal Science class survey: Animal species most interested in.

Species	2002	2003	2004	Total	Total Percentage (%)
Dairy	18	21	24	63	23
Horse	24	19	19	62	23
Beef	5	7	7	19	7
Swine	6	8	5	19	7
Chickens	3	3	3	9	3
Ducks	0	0	1	1	---
Sheep	3	2	5	10	4
Rabbits	0	0	4	4	1
Dogs	22	12	21	55	21
Cats	11	5	8	24	9
Birds	0	1	1	2	1
Exotic	0	1	2	3	1
Llama	1	1	0	2	1
Aquaculture	2	0	0	2	1
Totals	95	80	100	275	

Table 3 shows the majors of students taking the Introductory to Animal Science course in spring 2002, 2003 and 2004. Over two-thirds of the students were our AnSc majors; 18.5% were AgEd majors, 8 were crops majors (represents most of the crops students during this time) and there were very few students coming in from other majors.

Table 3. Majors of students in Introductory Animal Science – 2002, 2003 and 2004.

Majors	Students
Animal Production Systems	29
Science in Agriculture	98
Ag Industries and Marketing	10
AnSc (spring 2004)	51
Ag Education	51
Crops	8
Ag Business/Economics	6
Biology	4
Other	18
Total	275

One undesirable trend over the last ten years is that we get fewer students from outside our major into our AnSc courses. Reasons for this include:

1. In 1994, the number of credits required to graduate from the U of MN was reduced from 192 to 180 quarter credits. This policy was enacted to increase the 4 year graduation rate.
2. In 1999, the University converted from a quarter to a semester system. In the process, students lost many of their elective credits. Quarter credits needed to be reduced by two-thirds to equate to semester credits. University liberal education requirements were not reduced by two-thirds. Five credit courses became 4 credit classes. Four credit courses became 3 credits, or in some cases, remained at 4 credits – content of the course was just expanded.
3. Recently, the University started distributing departmental teaching dollars based on student credit hours delivered. This encouraged departments to create new courses and keep their students in their departmental courses rather than taking courses elsewhere.

Department of Animal Science. Summary of Student Credit Hours

1999-00 2,630*	2001-02 2,529*	2003-04 3,478* [†]
2000-01 2,766*	2002-03 3,225* [†]	

*Includes graduate level courses

[†]Includes ScAg 1001, 1501, 4009W

Revision of Animal Science Courses

At the time of semester conversion in 1999, we reviewed all courses in the department. Some were dropped, some were combined, and new courses were added. The new courses developed are listed below. Currently, we plan on reviewing all courses on a 3-year rotation beginning in fall 2004.

AnSc 1011	Domestic Animals and Society
AnSc 1403	Companion Animal Nutrition and Care
AnSc 4609	Livestock Production Systems
AnSc 4611	Advanced Pork Production Systems Management
AnSc 4613	Advanced Beef Production Systems Management
AnSc 4614	Advanced Dairy Production Systems Management

Extracurricular Activities

There are five undergraduate clubs in the Department advised by faculty members. The clubs are: Dairy Club, Block and Bridle, Equestrian Club, Poultry Club and Pre-Vet Club. Total undergraduate membership in the clubs is around 200 students.

The Dairy Judging, Livestock Judging and Dairy Challenge teams routinely place in the top five of their competitions. Four teams participated locally last year in the Animal Science Academic Quadrathlon. Our students have assumed many of the leadership roles in college clubs and the fraternities and sororities. U of M Dairy students have received more national recognition in the last 5 years than students at any other university in the Dairy Shrine student recognition program, national scholarships, ADSA student affiliates and National Holstein.

Goals and Vision for the Animal Science Undergraduate Program

Table 4 shows enrollment goals for the Department by fall 2008. We would like to increase enrollment from the current 300 to 500 students. The following are a few of the challenges/uncertainties we face:

1. The Equine Program is in development and has tremendous potential for growth. In 2004-05, six equine courses will be available to our students. We have not advertised, nor promoted our program and we do not have a stable or riding arena. We have limited access to horses kept by CVM for instructional purposes. Plans are for CVM to build (with donated funds) a horse facility and arena on-campus; probably within the next few years. Our undergraduate program will have access to this facility. We have not yet fully discussed a vision for our equine program among the whole DAS faculty.
2. The dairy faculty have done an excellent job recruiting dairy students to the college. This was possible largely because we have more dairy faculty than we have faculty in the other species. We are losing many of our general livestock students to neighboring institutions. A plan is needed to get more of the general livestock students to our campus.

Table 4. Animal Science Enrollment Goals

<u>Fall 2008</u>	<u>Total</u>	<u>Freshmen</u>	<u>Soph</u>	<u>Junior</u>	<u>Senior</u>
Industry	80	15	15	25	25
Pre-vet/Science	240	80	70	50	40
Biotechnology	20	5	5	5	5
Production	<u>160</u>	<u>25</u>	<u>35</u>	<u>45</u>	<u>50</u>
	500	125	125	125	125
<u>Distribution in Production Emphasis (160)</u>					
Equine	50		Poultry	10	
Companion Animal	40		Swine	8	
Dairy	32		Individualized	4	
Beef	16		Sheep	0	

Challenges

Table 5 shows the enrollment in Animal Science courses over the last five years. There is room to increase enrollment in all of our courses, especially the 4000 level courses. As we transition into the new Animal Science major, enrollment trends will need to be evaluated to determine which courses may have to be modified, eliminated, or offered in alternate years.

Table 5. AnSc course enrollment trends

Course	Fall 1999	Spr 2000	Fall 2000	Spr 2001	Fall 2001	Spr 2002	Fall 2002	Spr 2003	Fall 2003	Spr 2004
1001-Orientation to Animal Science*										
1007-Horse in Your Backyard							25		27	
1011-Domestic Animals & Society	93		145		107		123		102	
1021-Avian Sampler		14		16		22		18		25
1101-Introductory Animal Science		89		87		98		82		98
1403-Companion Animals		79		61		75		63		71
1511-Food Animal Products	20		19		20		24		23	
2011-Dairy Cattle Judging	10		9		7		13		18	
2012-Livestock & Carcass Evaluation		19		28		27		32		17
2013-Beginning Livestock Judging					8				4	
2102-Horse Production			30		11		19		8	
2211-Biometrics for Livestock		36		20		23		41		48
2301-Systemic Physiology	41		59		44		56		57	
2401-Animal Nutrition	56		43		59		75		64	
3141-Advanced Dairy Judging		8		8		3		8		9
3142-Advanced Livestock Judging	11						6			
3203W-Environ, Global Food Production & the Citizen		24		30		30		31		32
3221-Animal Breeding	48		33		30		49		59	
3305-Repro Biology in Health & Disease		23		14			13		19	
3307-AI Techniques		14		10		14		11		13
3501- Prin of Farm Animal Environment		13		8		8		4		6
3509-Animal Biotechnology										8
3511-Animal Growth & Development		21		26		37		35		43
4011-Dairy Breeding		13		13		9		10		11
4092-Special Prob in Animal Science	6	18	4	3	3	5	2	2		5
4093-Tutorial in Animal Science	2		3		3					
4096-Professional Experience: Internship	6	5	12	5	11	3	7	2	15	5
4099-Special Workshop in Animal Science		1								
4102-Equine Management				10		7		7		9
4401-Swine Nutrition	14		14		7	2	8		5	
4403-Ruminant Nutrition		39	13	19		14		13		28
4601-Swine Production Systems Mgmt				7		6		1		1
4602-Sheep Production Systems Mgmt									6	
4603-Beef Production Systems Mgmt		8		3		4		3		5
4604-Dairy Production Systems Mgmt		17		14		13		10		19
4605-Poultry Production Systems Mgmt									3	
4609-Animal Production Systems		9	27		14				24	
4611-Adv Swine Production Systems Mgmt		3		3		2		3		1
4613-Adv Beef Production Systems Mgmt		4		3		1		3		
4614-Adv Dairy Production Systems Mgmt		2		6		9		6		6

* 2004 is the first year that AnSc 1001 has been offered.

Overview (from COAFES Catalog)

The Animal Science major prepares students for animal-related careers, such as marketing, sales, production management, veterinary medicine or graduate study. Students may work for private industry, government agencies, or agribusinesses that specialize in animal health, nutrition, or management strategies.

Students select one of three emphasis areas: industry, production, or science/pre-veterinary medicine, or VetFAST that focuses on veterinary medicine for farm animals. In addition, students may specialize in a particular species: beef, dairy, companion animal, equine, swine, sheep or poultry program. Students also have the option, in consultation with their advisor, to develop an individualized area of emphasis.

Degree Requirements

Students must complete at least 120 credits to graduate. Besides completing the University's liberal education requirements, students must complete a core of foundational requirements (math, science, and writing and speaking performance) and professional requirements, including animal nutrition, physiology, and breeding principles. Students also take courses in their selected emphasis area: industry, production, or science/pre-veterinary medicine. All required courses must be taken A-F, and a grade of at least C- is required in all professional courses and area of emphasis courses.

Foundation Requirements (All Students)

ApEc	1101	Principles of Microeconomics (3 credits)
Biol	1009	General Biology (4 credits)
Rhet	1101	Writing to Inform, Convince, and Persuade (4 credits)
Rhet	1223	Oral Presentations in Professional Settings (3 credits)
Rhet	3562	Technical and Professional Writing (4 credits)
Math	1031	College Algebra (3 credits)
<i>Or</i>	Math 1142	Short Calculus (4 credits)
<i>Or</i>	Math 1271	Calculus I &/or Math 1272 (4 credits)
<i>Or</i>	Math 1281	Calculus II &/or Math 1282 (4 credits)

(1 semester of Calculus is required for the Biotechnology Option)

Science Required for Industry and Production emphasis:

Chem	1011	General Principles of Chemistry (4 credits)
BioC	2011	Biochemistry for Ag and Health Sciences (3 credits)

Science Required for Science/Pre-vet emphasis:

Chem	1021	Chemistry Principles I (4 credits)
Chem	1022	Chemistry Principles II (4 credits)
Chem	2301	Organic Chemistry I (3 credits)
Chem	2311	Organic Chemistry Lab (4 credits)
BioC	3021	Biochemistry (3 credits)
GCD	3022	Genetics (3 credits)
<i>Or</i>	Biol 4003	Genetics (3 credits) (for Biotechnology option)
VPB	2032	Microbiology w/Lab (4 credits)
Phys	1101	Introductory College Physics I (4 credits)
Phys	1102	Introductory College Physics II (4 credits)
<i>Or</i>	Phys 1201	Intro Physics for Pre-Med and Biology I (5 credits)
Phys	1202	Intro Physics for Pre-Med and Biology II (5 credits)

Professional Requirements (All Students)

AFEE	1002	Principles of Career Planning in Agriculture (1 credit)
<i>Or</i>	AnSc 1001	Orientation for Animal Science Pre-Vet (1 credit)
AnSc	1101	Introductory Animal Science (4 credits)
AnSc	2211	Biometrics for Livestock (3 credits)
AnSc	2301	Systemic Physiology (4 credits)
AnSc	2401	Animal Nutrition (3 credits)
AnSc	3221	Animal Breeding (4 credits)
AnSc	4096	Professional Experience Program: Internship (3 credits)
<i>Or</i>	ScAg 5009	Undergraduate Research Thesis (6 credits)

Emphasis Requirements

Students must select one of the following three emphasis areas:

Industry Emphasis

Rhet	1152	Writing on Issues in Science and Technology (4 credits)
<i>Or</i>	Rhet 3257	Scientific and Tech Presentations (3 credits)
Rhet	3266	Group Process, Team Building, and Leadership (3 credits)
ApEc	1102	Principles of Macroeconomics (3 credits)
ApEc	1251	Principles of Accounting (3 credits)

Choose 3:

ApEc	3001	Applied Microeconomics: Consumers, etc (4 credits)
ApEc	3002	Applied Microeconomics: Managerial Economics (4 credits)
ApEc	3411	Commodity Marketing (3 credits)
ApEc	3811	Principles of Farm Management (3 credits)
ApEc	3821	Retail Center Management (3 credits)
ApEc	4451	Food Marketing Economics (3 credits)
ApEc	4821	Agribusiness Management (5 credits)

Choose 1:

ApEc	3451	Food and Agricultural Sales (3 credits)
ApEc	3501	Agribusiness Finance (3 credits)
BIE	3061	Professional Sales Management (3 credits)

Choose 12 credits:

Agro	1103	Crops, Environment, and Society (4 credits)
AgEt	3213	Engineering Principles and Applications (3 credits)
FScN	1102	Food: Safety, Risks, and Technology (3 credits)
FScN	1112	Principles of Nutrition (3 credits)
Soil	1125	Basic Soil Science (4 credits)
AnSc	1011	Domestic Animals and Society (3 credits)
AnSc	1501	Biotechnology, People, and the Environment (3 credits)
AnSc	1511	Food Animal Products for Consumers (3 credits)
AnSc	2012	Livestock and Carcass Evaluation (3 credits)
AnSc	3203	Environment, Global Food Production and the Citizen (3 credits)
AnSc	3305	Reproductive Biology in Health and Disease (4 credits)
AnSc	3501	Principles of Farm Animal Environment (3 credits)
AnSc	3509	Animal Biotechnology (3 credits)
AnSc	3511	Animal Growth and Development (3 credits)
AnSc	4401	Swine Nutrition (3 credits)

AnSc	4403	Ruminant Nutrition (4 credits)
AnSc	4609	Animal Production Systems (2 credits)
Ent	4281	Veterinary Entomology (3 credits)
CAPS	3502	Animal Health and Disease (3 credits)

Choose 1:

AnSc	4102	Equine Management (3 credits)
AnSc	4601	Pork Production Systems Management (4 credits)
AnSc	4602	Sheep Production Systems Management (4 credits)
AnSc	4603	Beef Production Systems Management (4 credits)
AnSc	4604	Dairy Production Systems Management (4 credits)
AnSc	4605	Poultry Production Systems Management (4 credits)
AnSc	4606	Small Animal Management (3 credits)

Production Emphasis

AnSc	1511	Food Animal Products for Consumers (3 credits)
AnSc	4609	Livestock Systems Analysis (2 credits)

Choose 22 credits:

Agro	1103	Crops, Environment and Society (4 credits)
AFEE	2051	Current Technical Competencies (3 credits)
AnSc	1007	Horse in Your Backyard (2 credits)
AnSc	1011	Domestic Animals and Society (3 credits)
AnSc	1501	Biotechnology, People and the Environment (3 credits)
AnSc	3203	Environment, Global Food Production and the Citizen (3 credits)
AgEt	3213	Engineering Principles and Applications (3 credits)
AnSc	3305	Reproductive Biology in Health and Disease (4 credits)
AnSc	3511	Animal Growth and Development (3 credits)
AnSc	3501	Principles of Farm Animal Environment (3 credits)
AnSc	3509	Animal Biotechnology (3 credits)
ApEc	1251	Principles of Accounting (3 credits)
Soil	2125	Basic Soil Science (4 credits)
ApEc	3411	Commodity Marketing (3 credits)
ApEc	3451	Food and Agricultural Sales (3 credits)
ApEc	3811	Principles of Farm Management (3 credits)
Ent	4281	Veterinary Entomology (3 credits)
CAPS	3502	Animal Health and Disease (3 credits)
VPB	2032	General Microbiology (4 credits)

Livestock management course (outside of chosen option)

Choose 1 of the following options:

Dairy	AnSc	4403	Ruminant Nutrition (4 credits)
	AnSc	4011	Dairy Cattle Breeding (3 credits)
	AnSc	4604	Dairy Production Systems Management (4 credits)
	AnSc	4614	Advanced Dairy Production Systems Management (2 credits)
Beef	AnSc	2012	Livestock and Carcass Evaluation (3 credits)
	AnSc	4403	Ruminant Nutrition (4 credits)
	AnSc	4603	Beef Production Systems Management (4 credits)
	AnSc	4613	Advanced Beef Production Systems Management (2 credits)
Sheep	AnSc	2012	Livestock and Carcass Evaluation (3 credits)
	AnSc	4403	Ruminant Nutrition (4 credits)
	AnSc	4602	Sheep Production Systems Mgmt (4 credits)

Swine	AnSc	2012	Livestock and Carcass Evaluation (3 credits)
	AnSc	4401	Swine Nutrition (3 credits)
	AnSc	4601	Pork Production Systems Management (4 credits)
	AnSc	4611	Advanced Pork Production Systems Mgmt (2 credits)
Equine	AnSc	2102	Horse Production (ITV from Crookston) (3 credits)
	AnSc	3051	Equine Nutrition (3 credits)
	AnSc	3052	Equine Anatomy and Physiology (3 credits)
	AnSc	4102	Equine Mgmt (ITV from Crookston) (3 credits)
Companion Animal			
	AnSc	1403	Companion Animal Nutrition and Care (3 credits)
	AnSc	3211	Animal Behavior (3 credits)
	AnSc	4606	Small Animal Management (3 credits)
Poultry	AnSc	4605	Poultry Production Systems (4 credits)
	At least 3 Poultry courses from the Midwest Poultry Consortium Summer Program at Madison, WI. Courses cannot double count for requirements in this section and professional requirements.		

Individualized Option (12 credits minimum)

Courses may be selected according to the students' interests in consultation with the students' advisor and with approval of the Animal Science committee.

Science/Pre-Vet Emphasis

Students in the Science/Pre-Vet emphasis must select either the basic science or the biotechnology option. They also might be interested in the VetFAST program that focuses on veterinary medicine for farm animals

Basic Science Option:

Choose 12 credits: (at least 6 credits must be 3000 level or above):

AnSc	1011	Domestic Animals and Society (3 credits)
AnSc	1403	Companion Animal Nutrition and Care (3 credits)
AnSc	2221	Animal Biotechnology (3 credits)
AnSc	3203	Environment, Global Food Production and the Citizen (3 credits)
AnSc	3305	Reproductive Biology in Health and Disease (4 credits)
AnSc	3511	Animal Growth and Development (3 credits)
AnSc	4011	Dairy Cattle Breeding (3 credits)
AnSc	4401	Swine Nutrition (3 credits)
AnSc	4403	Ruminant Nutrition (4 credits)
AnSc	1501	Biotechnology, People and the Environment (3 credits)
CAPS	3502	Animal Health and Disease (3 credits)
Ent	4281	Veterinary Entomology (3 credits)

Any AnSc course not used to fulfill other requirements.

Choose 1:

AnSc	4102	Equine Management (3 credits)
AnSc	4601	Pork Production Systems Management (4 credits)
AnSc	4602	Sheep Production Systems Management (4 credits)
AnSc	4603	Beef Production Systems Management (4 credits)
AnSc	4604	Dairy Production Systems Management (4 credits)
AnSc	4605	Poultry Production Systems Management (4 credits)
AnSc	4606	Small Animal Management (3 credits)

Biotechnology Option:

AnSc 1501 Biotechnology, People and the Environment (3 credits)

AnSc 3509 Animal Biotechnology (3 credits)

Choose 11 credits (at least 2 with a laboratory):

AnSc 3511 Animal Growth and Development (3 credits)

AnSc 3305 Reproductive Biology in Health and Disease (4 credits)

Biol 4004 Cell Biology (3 credits)

BioC 4025 Laboratory in Biochemistry (2 credits)

BioC 4125 Laboratory in Molecular Biology and Biotechnology (3 credits)

BioC 5001 Biochemistry, Molecular and Cellular Biology (5 credits)

GCD 4015 Genetics Laboratory (2 credits)

GCD 4025 Cell Biology Laboratory (2 credits)

GCD 4034 Molecular Genetics (3 credits)

GCD 4143 Human Genetics (3 credits)

GCD 4151 Molecular Biology of Cancer (3 credits)

GCD 4161 Developmental Biology (3 credits)

GCD 5036 Molecular Cell Biology (3 credits)

MicB 3301 Biology of Microorganisms (5 credits)

MicB 4131 Immunology (3 credits)

MicB 4141 Biology, Genetics and Pathogenesis of Viruses (3 credits)

MicB 4151 Molecular and Genetic Bases for Microbial Diseases (3 credits)

MicB 4235 Advanced Lab: Virology, Immunology and Microbial Genetics (3 credits)