

# College of Agriculture

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Patricia A. Jensen, Dean

Agriculture provided the foundation upon which this institution was established in 1890. Its primary mission, to serve the people, has not changed over the years and the achievements by the faculty in teaching, research, extension, and service provide testimony to its success as a land-grant institution.

The demand for graduates with expertise in agricultural disciplines continues to grow. Career opportunities for men and women with urban and rural backgrounds are rapidly expanding in the agricultural industry. The availability of human resources has become a critical issue. Tomorrow's graduates in agriculture will be the benefactors of today's increasing shortages in human capital.

Faculty in the college are deeply involved in basic and applied research and, as a result, provide students with a unique educational experience utilizing state-of-the-art equipment and relevant laboratory exercises in many programs.

## Degree Programs

At the undergraduate level the College of Agriculture, offers a Bachelor of Science degree and a preprofessional program for veterinary school.

The pre-veterinary medicine program does not offer a B.S. degree and students are urged to select an additional major area of study. By following this recommendation, students will complete the requirements to veterinary medical school and earn a Bachelor of Science degree in a related field, such as animal and range sciences, biotechnology, food science, or microbiology. A graduate program is available in agriculture with curricula leading to Master of Science and Doctor of Philosophy degrees. Graduate program information is available in the Graduate Bulletin.

All students enrolled in the College of Agriculture are expected to meet or exceed the following basic requirements before graduating with the Bachelor of Science degree in agriculture.

	Credits
Program Core Requirements	24
First-Year Experience	1
Orientation Course (Agri 150 or VetS 150)	1
Written and Oral Communications*	12
This includes 9 general education credits from the communication category and 3 credits involving active student participation in writing/speaking.	
Basic and Applied Sciences*	20
This includes 10 general education credits from the science and technology category and 3 credits from the quantitative reasoning category.	
Humanities and Fine Arts*	6



Social and Behavioral Sciences*	6
(A three-discipline minimum is recommended across 12 credits in the two preceding categories.)	
Wellness*	2
Electives	41
Curriculum Total	128

\*Refer to Courses Approved for General Education Requirements listed in the Appendix.

Candidates for the Bachelor of Science degree must complete a minimum of 128 credits in one of the curricula of the college. They must also meet the requirements of the University. Program core requirements include courses in the major and supporting disciplines and are determined by the major.

## Graduation Status

A graduation status review is available to students each semester through their adviser. A graduation audit should be requested from the Registration and Records Office after students complete 75 credits.

## Honor System

The College of Agriculture recognizes the ability of its students to govern themselves as mature men and women. The Honor System has been functioning in the college since 1955 and provides students with a method of self-government during examinations. All students who are enrolled in agriculture courses are required to uphold the Honor System.

## Scholarships

Students who have declared a major in one of the agriculture disciplines are eligible for scholarships through their major department and the dean's office. Scholarships are awarded to students who have demonstrated excellence in their work, high interest in pursuing a career in agriculture, and involvement in University and community activities.

Several departments offer scholarships having specific requirements and students are encouraged to consult individual departments for details.

## Special Opportunities

Special opportunities available as a supplement or an enhancement to college majors include the following.

### Agribusiness Minor

The 19 credit Agribusiness minor supplements a student's technical training in agricultural sciences with an understanding of fundamental business concepts and applies business strategies to agribusiness decision making. The Agribusiness minor is restricted to students whose major is in the College of Agriculture, but excluding agricultural economics.

### Field Experience or Cooperative Education

Students majoring in one of the agricultural disciplines may gain practical experience by enrolling in the field experience courses in their major (195, 495) or through Cooperative Education (Univ 395). Students must enroll for field experience and follow the requirements of the individual department to receive credit. Cooperative Education credits are considered an enrichment experience and may not substitute for academic credits required for graduation.

### ROTC Programs

Up to 18 elective credits may be earned by participation in the Army or Air Force ROTC programs. Men or women may take these programs for elective credit and in addition may complete either program and receive a commission upon graduation. For details of the ROTC programs and scholarships available see Reserve Officers Training Corps programs under the Special Programs section.

## Agribusiness and Applied Economics

Programs in agribusiness and agricultural economics apply economic principles to the use of private and public resources to provide a safe and affordable food supply, to maintain a sustainable agricultural and natural resource base, and to manage natural and environmental resources for current and future generations. Students in applied economics develop a systematic and logical framework in economic science for analyzing how a society solves such problems as what goods and services to produce, how to organize production, and for whom goods and services are to be produced.

As the global population grows and the world's economies become more interdependent, economic principles become increasingly important for problems facing the agribusiness industry. Students interested in careers in agribusiness have several options. Beginning in their sophomore year, students take courses in management, marketing, and finance, all concentrating on the unique aspects of food system economics. Specialization in upper division courses permits students to concentrate in areas of particular interest: agribusiness, agrifinance, commodity marketing, or logistics and transportation.

The B.S. degree with a major in agricultural economics offers the same options as the Agribusiness major in finance, marketing, or management. This major requires a broader background in the agricultural sciences, with courses from other departments in the College of Agriculture providing students the scientific basis for applying economic concepts to problems in food systems. The Agricultural Economics major is ideally suited for students with career objectives in production agriculture.

Besides being important for understanding contemporary social issues, students majoring in economics will find the degree useful in developing career skills for business, law, teaching, public administration, and research. Choice of a custom option in the agricultural economics major or involvement in the natural resources management program broadens the options available to students interested in other areas of applied economics. These options allow students to select programs of study consistent with their personal career objectives.

The department offers minors in economics and in agribusiness. The description of the Agribusiness minor can be found under the Special Opportunities section for the College of Agriculture.

### Curriculum Options

The Department of Agribusiness and Applied Economics offers three majors: (1) Agribusiness, (2) Agricultural Economics, and (3) Economics.

### Agribusiness Major

Agribusiness students choose one of four areas of specialization:

**Agribusiness Management:** This option provides students with a broad background, preparing them for general career alternatives in agribusiness.

**Agrifinance:** This option prepares students for careers in agribusiness finance, agricultural lending, financial institution management, accounting, insurance, and investment.

**Agribusiness Marketing:** This option prepares students for careers in agricultural marketing, sales, or food product marketing.

**Transportation and Logistics:** Logistics is an increasingly important area for agribusinesses. Because of the internationalization of agricultural production, food processing, and trade in food products, students trained in getting the right product to the right place at the right time, the fundamental objective of logistics, are highly sought by employers seeking agribusiness graduates.

The agribusiness program has several main components:

1. Students are exposed to a range of concepts and methods useful in agribusiness decision making. Agribusiness graduates will master problem-solving skills to face challenges likely to be encountered in their professional careers.
2. Agribusiness students are required to participate in an internship during their studies. Employers continue to place high importance on work-related experience when they evaluate potential employees. Employers are assured that all NDSU agribusiness graduates have gained this valuable work experience through the required internship.
3. Collaboration with the College of Business Administration leads to the concurrent satisfaction of one of the minors offered by the College of Business Administration. Students may select business courses for the minor that complement their agribusiness interests.

### Recommended Curriculum Agribusiness

First Year	Credits
AgEc 150 or Math 146, Quant Econ or Calc	.2 (or 4)
AgEc 201, Prin of Microecon	.3
AgEc 202, Prin of Macroecon	.3
Engl 110, 120, College Composition I, II	.6
Comm 110, Fundamentals of Public Speaking	.3
Agri 189, Skills for Academic Success	.1
Agricultural Science Elective	.3
Natural Science Elective with Lab	.4
Wellness	.2
Elective	.3
Total	.30

Second Year	Credits
Acct 200, 201, Elements of Accounting I, II	.6
AgEc 242, Intro to Agricultural Management	.4
AgEc 244, Agricultural Marketing	.3
AgEc 246, Intro to Agricultural Finance I	.4
Stat 330, 331, Intro Statistics, Regression Analysis	.5
Agricultural Science Electives	.3
Communication or Foreign Language Elective	.6
Humanities and Fine Arts/Cultural Diversity Elective	.3
Total	.34

Third Year	Credits
AgEc 339, Quantitative Methods and Decision Making	.3
AgEc 344, Agriculture Price Analysis	.3
AgEc 346, Agricultural Finance II	.3
Econ 341, Intermediate Microeconomics	.3
Econ 343, Intermediate Macroeconomics	.3
Agricultural Science Electives	.3
Business Minor Electives	.9
Humanities and Fine Arts Elective	.3
Total	.30

Fourth Year	Credits
AgEc 445, Agribusiness Industrial Strategy	.3
AGEC 491/496, Internship	.3
Agribusiness Area Courses (incl. capstone)	.6
Business Minor Electives	.9
Electives	.13
Total	.34
Curriculum Total	.128

\* Course requirements vary depending upon the program option. Further information is available from the Department of Agribusiness and Applied Economics.

### Agricultural Economics Major

In addition to finance, marketing, and agribusiness management, students majoring in agricultural economics may select from two additional options:

**Production and Farm Management:** This option prepares students for both management and technical aspects of farming, ranching, and agribusiness, or for employment in Extension, consulting, or government agencies.

**Custom Option:** This option includes programs created to meet unique student interests in areas such as extension, community development, pre-law, public relations, journalism, broadcasting, or computer applications (contact department for details).

### Recommended Curriculum

Agricultural Economics	Credits
First Year	
AgEc 150 or Math 146, Quantitative Economics or Calculus	.2 (or 4)
AgEc 201, Principles of Microeconomics	.3
AgEc 202, Principles of Macroeconomics	.3
Agri 150, Agriculture Orientation	.1
Comm 110, Fundamentals of Public Speaking	.3
Engl 110, 120, College Composition I, II	.6
Agri 189, Skills for Academic Success	.1
Agricultural Science Elective	.3
Natural and Physical Science Elective with Lab	.4
Wellness	.2
Total	.28

Second Year	Credits
Acct 200, 201, Elements of Accounting I, II	.6
AgEc 242, Introduction to Agricultural Management	.4
AgEc 244, Agricultural Marketing	.3
AgEc 246, Introduction to Agricultural Finance I	.4
Econ 341, Intermediate Microeconomics	.3
Stat 330, 331, Introductory Statistics, Regression Analysis	.5
Communication Elective	.3
Humanities and Fine Arts/Cultural Diversity Elective	.3
Total	.31

Third Year	Credits
AgEc 339, Quantitative Methods and Decision Making	.3
AgEc 342, Farm and Agribusiness Management II	.3
AgEc 344, Agriculture Price Analysis	.3
AgEc 346, Agricultural Finance II	.3
AgEc 375, Applied Agricultural Law	.3
Econ 343, Intermediate Macroeconomics	.3
Agricultural Science Electives	.6
Business Elective	.3
Communication Elective	.3
Humanities and Fine Arts Elective	.3
Total	.33

Fourth Year	Credits
AgEc 484, Agricultural Policy	.3
Agricultural Economics Capstone	.3
Agricultural Economics Option*	.21
Electives	.9
Total	.36
Curriculum Total	.128

\* Course requirements vary depending upon the program option. Further information is available from the Department of Agribusiness and Applied Economics.

## Agricultural Systems Management

The Agricultural Systems Management (ASM) major prepares students for careers involving the delivery, management, and support of technical and business systems for food, agricultural, or closely related industries.

The ASM major blends the study of mechanized systems principles, computer-based technologies, business management, agricultural sciences, and communications. Students complete courses in machinery principles, off-road power systems, precision agriculture, commodity handling and processing, natural resources management, electrical and electronic systems, and information/decision support technology.

Taking courses in accounting, economics, marketing, management, business law, sales, and finance develops a strong business background. Personal career objectives may be pursued through specialization in areas such as agribusiness, production agriculture, or applied technology. Students are encouraged to also minor in agribusiness, business administration, or another discipline.

Agricultural systems management graduates are typically employed in positions that provide a link between the researcher, designer, engineer, manufacturer, and the consumer. Employers include: 1) companies and agencies that provide inputs, products, and services for agricultural production; 2) companies or agencies in the business of handling, storing, processing, and

distributing agricultural products/commodities and processed food or non-food products; and 3) companies and agencies that supply physical and business services to rural and urban communities. Graduates also are frequently self-employed as owners/operators of commercial farms and businesses, and as crop consultants or production specialists.

Students from other majors may minor in agricultural systems management by working with department faculty to select 16 credits in agricultural systems management.

Students interested in the innovation, design, test, manufacture, and development aspects of products, processes or systems for agricultural production, food and value-added processing of commodities, or sustainable management of environmental resources should consider the agricultural and biosystems engineering curriculum in the College of Engineering and Architecture.

## Recommended Curriculum Agricultural Systems Management

First Year	Credits
Agri 189, Skills for Academic Success	.1
ASM 115, Fundamentals of ASM	.3
ASM 125, Fabrication and Constr Tech	.3
CSci 114, Microcomputer Packages	.3
Engl 110,120, College Comp I, II	.3,3
Comm 110 Fundamentals of Public Speaking	.3
Math 103,105, College Algebra, Trigonometry	.3,3
Humanities and Fine Arts Elective	.3
Agri 150, Orientation	.1
ASM 496, Field Experience	.1

Second Year	Credits
ASM 225, Computer Applications in ASM	.3
ASM 264, Natural Resource Mgt Systems	.3
Acct 102, Fundamentals of Accounting	.3
AgEc 201,202, Micro, Macroeconomics	.3,3
Phys 211, 211L, College Physics I, Lab I	.3,1
Psyc 111, Intro to Psychology	.3
Agriculture/Biological Science Elective	.3
Elective (Free)	.3,3

Third Year	Credits
ASM 323, Post Harvest Technology	.3
ASM 373, Tractors and Power Units	.3
ASM 374, Power Units Lab	.1
ASM 378, Machinery Principles and Mgt	.3
Stat 330, Intro Statistics	.3
Chem 121,122, General Chemistry I,II	.3,3
Agriculture/Biological Science Elective	.3
Communication Elective	.3
Wellness	.2
Electives(Specialization/Minor)*	.3,4

Fourth Year	Credits
ASM 354, Electricity and Electronic Appl	.3
ASM 368, Structures and Environ Systems	.3
ASM 454, Site Specific Agriculture	.3
ASM 475, Mgt of Agricultural Systems	.2
ASM 491, Seminar	.1
Agriculture/Biological Science Elective	.6
Humanities and Fine Arts Elective	.3
Electives (Specialization/Minor)*	.6,3
Elective (Free)	.3

## \*Options/Minors (Choose One)

### Agribusiness or Business Administration (16)

Students select courses in agricultural economics, business, and related areas to achieve career goals in agribusiness and related business areas

A Dealer Management Specialization within the business option is available. This specialization is designed for students who want careers as equipment dealer managers or with equipment manufacturers. Technology, agribusiness, and communications are emphasized. Requirements include a minor in agribusiness, or business administration and two paid internships with equipment dealerships. Several industry scholarships are available to students enrolled in this specialization.

### Production Agriculture (16)

Students select courses in agricultural sciences and supporting areas to achieve career goals in the technical and management aspects of production agriculture systems.

### Applied Technology (16)

Students select courses to enhance curriculum diversity or interests in areas such as communications, international studies, industrial management, construction management, or food processing.

Curriculum Total .128

## Agricultural/Industrial Equipment Option

North Dakota State University and North Dakota State College of Science (NDSCS) collaboratively offer the Ag/Industrial Equipment option in the Agricultural Systems Management program. This collaboration gives students primary experience in physical science, engineering technology, and machinery systems with complementary hands-on training in mechanized systems laboratories at NDSCS. Students complete their education at NDSU in agricultural systems management and complement their program by selecting a business specialization or minor emphasizing courses in management, sales, marketing, finance, and personnel management. Completion of one or more cooperative education or internship placements in the equipment industry also is required.

Potential positions available for graduates in this option include: salesperson, service manager, parts and inventory control manager, sales manager, territory service manager, finance manager, general manager, regional marketing representative, manufacturer's representative, district sales manager, and warranty manager.

## Recommended Curriculum Agricultural/Industrial Equipment Option\*

First Year at NDSCS	Credits
Engl 110,120, College Comp I, II	6
Math 103,105, College Algebra, Trigonometry	5
Econ 201,202, Micro and Macro Economics	6
Comm 110, Fundamentals of Public Speaking	3
TECH 121, Engine Fundamentals	4
DTEC 122, Preventive Main./Power Trains	3
DTEC 101, Electrical Systems	2
DTEC 112, Intro. to Diesel Engines	3
CSCI 101, Computer Literacy	2
Total	34

\*The remaining curriculum is taken at NDSU in the ASM major

## Animal and Range Sciences

The Animal and Range Sciences major is designed to prepare students for careers in agriculture and related fields. Course work includes biological principles, scientific relationships, management practices, and business concepts applicable to animal products, livestock production systems, and range science. For other majors related to Animal and Range Sciences see Equine Studies, Natural Resources Management, and Veterinary Technology.

### Curriculum Options

Three options are available. Each is designed to strengthen career preparation.

**Production/Business:** This option is for students interested in careers associated with the production, marketing, and management of animals and the products they produce.

**Range Science:** This option is for students who are interested in careers that involve the conservation and improvement of range resources. This option enables the student to meet federal employment requirements for related careers in range science.

**Science:** This option is designed for students who are interested in specific careers that require advanced course work in the biological sciences. The option is designed to prepare students for graduate study or to provide a science-oriented degree while meeting the course requirements for veterinary schools.

**Minor:** Students may minor in animal and range sciences by completing 16 credits. Formal approval by the department is required.

**Transfer credits:** Transfer courses with grade C or better only will be accepted for courses in the major.

**Major:** The following requirements must be met by all animal and range sciences majors.

## Recommended Curriculum Animal and Range Sciences

First Year	Credits
AgEc 201, Prin of Microeconomics	3
Agri 150, Agriculture Orientation	1
Agri 189, Skills for Academic Success	1
ARSc 114, Introduction to Animal Sciences	3
ARSc 123, Feeds and Feeding	3
Chem 121, 121L, General Chemistry I, Lab	3,1
Engl 110, 120, College Composition I, II	3,3
Math 103, College Algebra	3
PISc 110, World Food Crops	3
Social/Behavioral Sciences Elective	3
Wellness	2
Total	32

Second, Third and Fourth Years	Options		
	Prod/ Bus.	Sci.	Range Sci.
ARSc 220, Livestock Production	3	3	3
ARSc 222, Meat Animal Evaluation	2	2	-
ARSc 225, Nat Res Agro Eco	-	-	3
ARSc 320, 330, 331, Judging	2	2	-
ARSc 323, Fund of Nutrition	3	3	-
ARSc 336, Intro to Range Mgt	3	3	3
ARSc 357, Animal Genetics	3	3	-
ARSc 450, 452, 456, 458, 460	-	-	15
ARSc 463, Physiology of Reprod	4	4	-
ARSc 470, Applied Nutrition	4	4	-
ARSc 480, 482, 484, 486, 488	4	2	-
ARSc 491, Seminar	2	2	2
Bot 152/153, 314, 380,	-	-	11
Comm 110, Fund of Public Spkg	3	3	3
Engl 320, Practical Writing	3	3	3
Biol 202, 202L, Intro Microbiol, Lab	3	3	-
PISc 315, Genetics	3	3	3
Soil 210, 444	-	-	8
VetS 135, 365	7	3	-
ARSc Electives	3	3	3
Biology Electives	3	4	4
Electives	21	21	22
Electives from AgEc, Busn	7	-	-
Electives from Humanities	6	6	6
Electives from Biol, Bot, Chem, Ent, Genetics, Geol, Math, Micro, Phys, Zoo	-	9	-
Organic Chemistry/Biochem	4	7	4
Statistics	3	3	3
Curriculum Totals	128	128	128

## Biotechnology

Biotechnology is an interdisciplinary field based on a combination of biology and technology. It includes the application of science and technology to the design of new plants, animals, and microorganisms that have improved characteristics. The methodologies include the use of recombinant DNA for gene cloning and gene transfers between organisms, culture of plant and animal cells and tissues, fusion of animal cells or plant protoplasts, and the regeneration of whole plants from single cells. Biotechnology also is concerned with the large-scale fermentation processes that utilize some of these novel organisms for the production of pharmaceuticals, diagnostic tests for diseases, feed additives, enzymes, and hormones.

Biotechnology offers seemingly unlimited opportunities to combine genes from related or unrelated species to produce useful organisms with desirable properties that were not previously found in nature. The development of crop plants that are resistant to herbicides or insects, the production of human growth hormone and insulin by genetically engineered bacteria, and the development of unique vaccines are all examples of successful biotechnology.

The biotechnology program is offered in either the College of Agriculture or the College of Science and Mathematics and leads to the Bachelor of Science degree. The curriculum is designed to provide students with knowledge and experience in both basic and applied sciences. Students have an opportunity to work with scientists in various areas including, animal science, biology, botany, chemistry, horticulture, microbiology, plant pathology, plant science, and zoology. Faculty in each of the cooperating life-science departments have been identified to serve as advisers for students who select the biotechnology major. Graduates of this program have excellent opportunities for employment in the biotechnology industry or for graduate education.

Students majoring in biotechnology are required to perform a research project in the laboratory of a faculty member/scientist, and to prepare a senior thesis describing their research project. A 2.50 cumulative grade-point average is required to remain in the program.

## Recommended Curriculum Biotechnology Major

First Year	Credits
Biol 150, 150L, General Biology I and Lab	3,1
Biol 151, 151L, General Biology II and Lab	3,1
Chem 121, 121L, General Chemistry I and Lab	3,1
Chem 122, 122L, General Chemistry II and Lab	3,1
Eng. 110, 120, College Composition I, II	6
Math 146, 147, Applied Calculus I, II	8
Univ 189 - Skills for Academic Success	1
Wellness	2
Total	33

### Second Year

Chem 341, 341L, Organic Chemistry I and Lab	3,1
Chem 432, Organic Chemistry II	3
Micr 350, 350L, General Microbiology and Lab	3,1
Phys 211, 211L, College Physics I and Lab	3,1
Phys 212, 212L, College Physics II and Lab	3,1
PISc 315, 315L, Genetics and Lab	3,1
Computer Science	3
Social and Behavioral Sciences, Humanities and Fine Arts Electives	6
Additional Writing or Speech Course	3
Total	35

Third Year	Credits
Bioc 460, 461, Foundations of Biochem and Molecular Biology I, II	.8
Comm 110, Fundamentals of Public Speaking	.3
Micr 470, Basic Immunology	.3
Micr 471, Immunology and Serology Lab	.2
Stat 330, Introductory Statistics	.3
*Biotechnology Elective	.2-3
Social and Behavioral Sciences, Humanities and Fine Arts Electives	.9
Biotechnology Seminar	.1
Total	.31-32

Fourth Year	Credits
Bioc 465, Prin. of Physical Chem. and Biophysics	.4
Bioc 474, Methods in Recombinant DNA Tech	.3
Bot 380, Plant Physiology or Zoo. 460 - Animal Physiology	.4
Micr 482, Bacterial Genetics and Phage	.3
Biotechnology Seminar	.1
*Biotechnology Elective	.2-3
Senior Research	.2-4
Senior Thesis	.1
Social and Behavioral Sciences, Humanities and Fine Arts Elective	.3
Elective	.6
Total	.29-32
Curriculum Total	.128-132

Students must meet the University's general education requirements as well as the curriculum requirements in effect at the time of entrance into a program.

*Biotechnology Electives (2 courses required):	Credits
Bioc 473, Methods of Biochem Research or PSci 409 - Isotope Tracer Tech	.3 each
Bioc 485, Industrial Biotechnology	.3
Micr 445, Animal Cell Culture Techniques	.2
PPth 453, Microscopy	.3
PISc 484, Plant Tissue Culture and Micropropagation	

## Minor

A minor in biotechnology requires satisfactory completion of 22 credits in the following courses:

Required:	Credits
Bioc 460, 461, Foundations of Biochem and Molecular Biology I, II	.8
PISc 315, 315L, Genetics and Lab	.3,1

Electives in Biotechnology Technique (2 courses required):	Credits
Bioc 473, Methods of Biochem Research	.3
Bioc 474, Methods in Recombinant DNA Tech	.3
Bioc 485, Industrial Biotechnology	.3
Micr 445, Animal Cell Culture Techniques	.2
PPth 453, Microscopy	.3
PISc 484, Plant Tissue Culture and Micropropagation	.2

Electives in Specialized Areas (6 credits):	Credits
Bot 380, Plant Physiology	.4
Micr 470, Basic Immunology	.3
Micr 471, Immunology and Serology Lab	.2
Micr 482, Bacterial Genetics and Phage	.3
PPth 324, Intro to Plant Pathology	.3
Zoo 370, Cell Biology	.3
Zoo 460, Animal Physiology	.4

## Crop and Weed Sciences

Instruction in crop and weed sciences includes field and forage crop production and management, weed science, general and plant genetics, plant breeding, experimental design, and biotechnology. The study of botany and other plant sciences, entomology, plant pathology, and soil science is basic or related to crop and weed sciences. Students may obtain either a major or minor. The Crop and Weed Sciences major or minor is intended for general use in sales, research, and technical services (crop consultant) of agribusinesses involved in seed, chemical, and other plant production and management aspects; in natural resources conservation service; by those interested in production agriculture; or as a prerequisite for graduate study.

## Minor

Students may minor in crop and weed sciences by selecting a total of 18 credits of study in crop and weed sciences or closely related fields, including Plant Sciences 110, 225, two courses from 315 and 315L, 320, or 323, plus a minimum of 5 credits approved by the department. A minimum of 8 credits must be taken at NDSU, and at least 6 credits must be at the 300-400 level.

## Major

All of the following requirements including courses in supporting disciplines must be met by majors.

## Recommended Curriculum Crop and Weed Sciences

First Year	Credits
AgEc 201, Prin of Microeconomics*	.3
Agri 150, Ag Orientation	.1
Agri 189, Skills for Academic Success	.1
Biol 150, 150L, Gen Biology, Lab	.3,1
Biol 151, 151L, General Biology II, Lab, or Bot 372, Structure/Div/Plants/Fungi	.3,1
Chem 121, 121L, General Chem I, Lab	.3,1
Engl 110, 120, College Composition I, II	.3,3
Math 103, College Algebra	.3
PISc 110, World Food Crops	.3
Wellness	.2

## Second, Third, and Fourth Years

Written and Oral Communications:	
Comm 110, Fund of Public Speaking	.3
Engl 320, Practical Writing	.3
Social and Behavioral Sciences*	.3
Humanities and Fine Arts*	.6
Basic and Applied Sciences:	
Bot 380 or ARSc 323	.4-3
Chem 122, 122L, Gen Chem II, Lab	.3,1
Chem 240, or Chem 260	.3-4
CSci 114, Microcomputer Pkgs.	.3
Stat 330, Intro Statistics	.3
Crop and Weed Sciences:	
PISc 215, Weed Identification	.1
PISc 225, Principles/Crop Production	.3
PISc 315, 315L, Genetics, Lab	.3,1
PISc 320, Forage Crops	.3
PISc 323, Weed Science	.3
PISc 455, Cropping Systems	.3
PISc 491, Sophomore, Senior Seminars	.1,1
PISc 300-400, Electives	.4
Complementary Agricultural Sciences:	
Biol 202, 202L, Intro Microbiol, Lab	.2,1
Ent 350, General Entomology	.5

	Credits
PPth 324, Intro Plant Path	.3
Soil 210, Intro Soil Science	.4
Electives	.27-29
Curriculum Total	.128

\*Required: 6 credits of humanities and fine arts and 6 credits of social and behavioral sciences including AgEc 201. One 3-credit course must fulfill the cultural diversity requirement for general education.

## Curriculum Options

Students may select one of the following options within crop and weed sciences. Students interested in a business career in crop and weed sciences should consider the Agribusiness minor through the College of Agriculture. Students interested in integrated pest management should follow the Weed Science option or pursue a second major in plant protection.

Students interested in biotechnology may major through crop and weed sciences or complete the Biotechnology option.

**Biotechnology:** This option is intended for students who wish to work in the biotechnology industry or pursue graduate study in the crop biotechnology area. Students must complete Bioc 460, Bot 380, Micr 350, 350L (instead of Biol 202, 202L), plus Math 105 or 146, PISc 346, and PISc 431 or 453, and PISc 484 or Bot 480.

**Production:** This option is for students most interested in production agriculture. This is the most popular option with students and provides the most flexibility of course selection. This option is fulfilled by completing the basic Crop and Weed Sciences curriculum.

**Science:** This option is intended for students who are interested in graduate studies and want more basic science courses as a foundation for graduate studies. Bot 380, Chem 341, 341L, and Math 146 must be taken under the general Basic and Applied Sciences requirements, plus 12 credits of science electives from outside the agriculture field. Suggested electives are Bioc 350, 460, 461, Bot 314, 460, Chem 342, Math 147, Phys 211, 212, or Stat 331.

**Weed Science:** This option is intended for students interested in crop consulting or weed science areas. AgEc 375 or Busn 431, Bot 380, PISc 453, and PPth 454, are required. ASM 378, Bot 314, PISc 210, 211, and Soil 322 are suggested electives. Students pursuing this option should consider a double major in plant protection.

## Economics Major

Economics is the social science that deals with problems of scarcity. It does so through a systematic and logical framework for analyzing how a society solves such problems as what goods and services to produce, how to organize their production, and for whom goods and services are to be produced. Knowledge of economics is necessary for understanding and

dealing intelligently with such current topics as inflation, unemployment, international trade and monetary systems, economic growth, government finance, and various forms of market regulation. Besides being important for understanding contemporary social issues, economics is useful in developing career skills for business, law, teaching, public administration, and research. Both verbal and mathematical training are involved in learning the discipline of economics.

## Degree Programs

Undergraduate students majoring in economics may choose either the Bachelor of Arts degree or the Bachelor of Science degree. During the freshman year, both programs require courses such as English, mathematics, and science. The introduction to economics includes (a) macroeconomics, which is the study of such topics as the general level of prices, employment, and output; (b) microeconomics, which is the study of relative prices and the consequences of different market forms; and (c) international trade and international monetary systems.

Both programs allow for selecting electives and developing areas of specialization in economics. Areas of specialization may emphasize such fields as money and banking, international economics, labor, industrial organization, environmental and resource economics, or public finance.

Requirements for the Bachelor of Arts degree include two years of one foreign language. For the Bachelor of Science degree, students are required to select a minor of study from another discipline.

## Career Choices

Economics majors are employed in virtually every area of the economy. In banks and financial institutions they forecast market activity, exchange rates, and interest rate movements. In industrial firms they forecast sales, evaluate changes in cost conditions, analyze changes in international economic conditions, and provide data needed for critical decisions.

Governments are among the largest employers of economists because they rely on the skills of these professionals to evaluate proposed projects and review tax policies. Virtually no other academic major offers the diversity in employment opportunities and flexibility among careers as does the study of economics.

A background in economics provides students with a set of versatile skills that will not become outdated with introduction of new technology.

## Economics Minor

The minor in economics complements many other majors by helping the student develop an analytical approach to understanding human events from the perspective of this discipline. The minor in economics consists of Principles

of Economics (Econ 201 and 202), Intermediate Economic Theory (Econ 341 and 343), plus two elective economics courses (one elective course must be at the 400 level).

## Recommended Curriculum

### Economics

First Year	Credits
Comm 110, Fundamentals of Public Speaking	.3
Engl 110, 120, College Composition I, II	.6
Math 146, Applied Calculus I	.4
Univ 189, Skills for Academic Success	.1
Science and Technology Electives	.8
Social and Behavioral Sciences Electives	.6
Elective	.3
Total	.31

### Second Year

Econ 201, Principles of Microeconomics	.3
Econ 202, Principles of Macroeconomics	.3
Stat 330, 331, Intro Stats, Regression Analysis	.5
Humanities and Fine Arts/Cultural Diversity Electives	.6
Minor Electives	.6
Social and Behavioral Sciences Elective	.3
Wellness	.2
Elective	.3
Total	.31

### Third Year

Econ 341, Intermediate Microeconomics	.3
Econ 343, Intermediate Macroeconomics	.3
Economics Elective	.3
English Elective	.3
Humanities and Fine Arts Electives	.6
Minor Electives	.6
Electives	.12
Total	.36

### Fourth Year

Economics Electives	.12
Minor Electives	.6
Electives	.12
Total	.30
Curriculum Total	.128

## Equine Studies

(Also see Animal and Range Sciences.)

The Equine Studies major is designed to prepare students for careers in the equine industry and related fields. Course work includes practical husbandry and equitation skills, scientific principles related to management of the equine, and study of the modern equine industry and business practices.

## Recommended Curriculum

### Equine Studies Major

All equine studies majors must meet the following requirements.

First Year	Credits
Agri 150, Agriculture Orientation	.1
Agri 189, Skills for Academic Success	.1
Math 103, College Algebra	.3
ARSc 114, Introduction to Animal Sciences	.3
VetS 135, Anatomy & Physiology of Domestic Animals	.3
Engl 110, 120 College Composition I & II	.6
Humanities/Social Science Electives	.3

### Credits

ARSc 123, Feed and Feeding	.3
Chem 121, 121L, General Chemistry I, Lab	.4
Biol 126, Human Biology	.3
AgEc 201, Principles of Microeconomics	.3
Total	.33

### Second Year

Comm 110, Fundamentals of Public Speaking	.3
AgEc 242, Intro to Agricultural Management	.4
ARSc 260, Intro to Equine Studies	.2
ARSc 260L, Equine Care & Mgmt Practicum	.1
Humanities/Social Science Electives	.6
ARSc 261, Basic Equitation and Horsemanship	.1
Wellness	.2
ARSc Elective	.2
Chem 260, Elements of Biochemistry	.4
AgEc 244, Agricultural Marketing	.3
ARSc 361, Intermediate Horsemanship	.1
ARSc Elective	.3
PISc 110, World Food Crops	.3
Total	.35

### Third Year

PISc 315, Genetics	.3
ARSc 323, Fundamentals of Nutrition	.3
Cultural Diversity Elective	.3
Stat 330, Introductory Statistics	.3
Biol 202, 202L, Introductory Microbiology, Lab	.3
ARSc 365, Equine Evaluation	.2
ARSc 357, Animal Genetics	.3
ARSc 463, Physiology of Reproduction	.4
ARSc Elective	.4
ARSc 594, Internship	.2
Total	.30

### Fourth Year

ARSc 363, Equine Nutrition and Physiology	.3
ARSc 491, Seminar	.2
Engl 320, Practical Writing	.3
ARSc 336, Intro to Range Management	.3
ARSc Elective	.4
Humanities/Social Science Electives	.3
ARSc 480, Equine Production and Industry	.3
Vets 365, Fundamentals of Animal Disease	.4
Unrestricted Electives	.5
Total	.30
Curriculum Total	.128

## Equine Studies Minor

A minor in equine studies requires satisfactory completion of the following courses.

### Second Year

Credits	
ARSc 123, Feeds and Feeding	.3
ARSc 260, Introduction to Equine Studies	.2
ARSc 260L, Equine Care & Mgmt Practicum	.1
Total	.6

### Third Year

ARSc 261, Basic Equitation & Horsemanship	.1
ARSc 361, Intermediate Horsemanship	.1
ARSc 365, Equine Evaluation	.2
ARSc 463, Physiology of Reproduction	.4
Total	.8

### Fourth Year

ARSc 363, Equine Nutrition & Physiology	.3
ARSc 480, Equine Production & Industry	.3
Total	.6
Total for Minor	.20

## Certificate

A certificate in equine studies is awarded upon the successful completion of the following courses during a single academic year.

### First Semester

Credits	
ARSc 123, Feeds and Feeding	.3
ARSc 260, Introduction to Equine Studies	.2
ARSc 260L, Equine Care & Mgt Practicum	.1

**Credits**

ARSC 261, Basic Equitation & Horsemanship . . . . .	1
ARSC 363, Equine Nutrition & Physiology . . . . .	3
Total . . . . .	10

**Second Semester**

ARSC 361, Intermediate Horsemanship . . . . .	1
ARSC 365, Equine Evaluation . . . . .	2
ARSC 480, Equine Production and Industry . . . . .	3
Total . . . . .	6
Total for Certificate . . . . .	16

**Food Safety (Safe)**

Our multidisciplinary team of faculty with expertise in food safety from various departments within NDSU's Colleges of: Agriculture; Arts, Humanities and Social Sciences; and Human Development and Education has formed the Great Plains Institute of Food Safety and developed a unique educational experience for NDSU students. The comprehensive food safety curriculum leads to B.S., M.S., and Ph.D. degrees in food safety, an undergraduate minor in food safety and a Graduate Certificate in food protection. All these programs are unified around the single issue of food safety, an area of concern for many Americans, the current target of tremendous interest, effort, and spending worldwide, and an area in which shortages of expertise are manifest. Students in food safety have successfully found employment in the food safety area.

The curriculum is based on contemporary educational theory and employs experiential learning techniques to foster development of students' critical-thinking abilities, collaborative and problem-solving skills, and awareness of employment opportunities. The core undergraduate and graduate courses are team-taught and use a "hands on" approach to learning. Courses are fully integrated so that students have the opportunity to troubleshoot food-safety issues from "farm-to-fork." The program promises to meet NDSU students' present and future educational needs.

**Food Science**

The Food Science major is offered through the Department of Cereal and Food Sciences in the College of Agriculture. It is designed to prepare students for a career in the food industry, the "world's largest industry," which is responsible for feeding the world.

The program is structured to develop an understanding of the nature, properties, and characteristics of foods through foundation courses in biochemistry, chemistry, microbiology, physics, and other sciences. Food science courses are built on this foundation. Applications include the study of food safety, processing, preservation, sanitation, storage, and marketing of foods. The analysis and microbiological and biochemical characterization of food products are also studied. Additional elective courses in economics and business administration are available to students intending to enter a management career.

**Note:** Transfer credits in food science from other institutions must have grades of C or better to be accepted for the food science program at NDSU.

The curriculum in the food science program is approved by the Institute of Food Technologists (IFT). Students majoring in food science, therefore, are eligible to compete for the prestigious IFT scholarships.

The program also provides the opportunity to gain industrial experience during undergraduate study by means of industry internships.

Upon completion of the program, graduates will be able to recognize, critically analyze, and solve problems realistically in both industrial and academic environments.

**Recommended Curriculum****Food Science**

First Year	Credits
Agri 150, Ag Orientation . . . . .	1
Agri 189, Skills for Academic Success . . . . .	1
Chem 121, 121L, General Chemistry I, Lab . . . . .	3,1
Chem 122, 122L, General Chemistry II, Lab . . . . .	3,1
CSci 114, Microcomputer Packages . . . . .	3
CFS 210, Intro to Food Sci and Tech . . . . .	2
Engl 110, 120, College Composition I, II . . . . .	3,3
HNES 250, Nutrition Science . . . . .	3
Math 146, 147, Applied Calculus I,II or Math 165, 166, Calculus I,II . . . . .	4,4
Total . . . . .	32

**Second Year**

AgEc 201, Prin of Microeconomics . . . . .	3
ARSc 340, Meat Science and Technology . . . . .	3
Biol 150, General Biology . . . . .	3
Chem 341, 341L, Organic Chemistry I, Lab . . . . .	3,1
Comm 110, Fund of Public Speaking . . . . .	3
Phys 211, 211L, College Physics I, Lab . . . . .	3,1
*Electives . . . . .	12
Total . . . . .	32

**Third Year**

Bioc 460, Biochemistry . . . . .	4
CFS 430, 431, Food Unit Operations, Lab . . . . .	2,1
Engl 320, Practical Writing . . . . .	3
Micr 350, 350L, General Microbiol, Lab . . . . .	3,1
Stat 330, Introductory Statistics . . . . .	3
*Electives . . . . .	15
Total . . . . .	32

**Fourth Year**

CFS 450, Cereal Technology . . . . .	3
CFS 460, 461, Food Chemistry, Lab . . . . .	3,1
CFS 470, 471, Food Processing, Lab . . . . .	3,1
CFS 464, Food Analysis . . . . .	3
Micr 453, Food and Dairy Microbiology . . . . .	3
*Electives . . . . .	15
Total . . . . .	31
Curriculum Total . . . . .	128

\*Electives may be chosen from approved courses to fulfill the general education requirements, and to emphasize one of the following areas: sciences, engineering, business, nutrition, or processing.

**General Agriculture Degree Program**

The degree program in general agriculture is designed to serve students who wish to pursue a college education in a broad area of agriculture or who want to tailor a program to meet their specific career objectives. Traditionally, students interested in careers focusing on agricultural production follow this program of study.

Students electing to graduate with a General Agriculture major must file a "plan of study" with the General Agriculture Coordinating Committee by the third week of the second semester of the junior year. This plan of study must include a "statement of goals" or why a tailored degree is desired and an outline of courses to be taken to meet their stated career goals. Identification of the capstone course and any internship that the student plans to take is also to be included in the plan of study.

**Curriculum Requirements  
General Agriculture Major**

Major	Credits
Major . . . . .	48
Required: a minimum of 12 credits in four Ag disciplines. Basic and Applied Sciences . . . . .	20-21
Required: Chem 121, CSci 114 or 116, Math 103 or 104, PISc 315, and Stat 330	
Written and Oral Communications . . . . .	12
Required: Comm 110, Engl 110, 120, and 220 or 320	
Social/Behavioral Sciences and Humanities . . . . .	12
Required: Six credits in Humanities	
Agricultural Science Electives . . . . .	12
Electives . . . . .	20
Other	
Agri 150, Ag Orientation . . . . .	1
Agri 189, Skills for Academic Success . . . . .	1
Wellness . . . . .	2
Curriculum Total . . . . .	128-129

**Minor**

A minor in general agriculture may be obtained by satisfactorily completing 24 credits with at least six credits in each of any four disciplines offered by the College of Agriculture. The minor is intended for students who are majoring in a college other than agriculture.

**General Agriculture  
Exploratory Program  
(Non-Degree Program)**

The exploratory program in general agriculture is intended for students who know they are interested in agriculture but are undecided on a major. This program is designed to expose students to various agricultural disciplines and, thereby, various career options. New students are encouraged to enroll in at least three introductory courses in different agricultural majors in their freshman year in addition to completing general education requirements in English, math, chemistry, social and behavioral sciences, and humanities. By following the exploratory program, students may easily be phased into a specific discipline by the end of their sophomore year. About 85% of entering students selecting general agriculture initially will transfer to a specific discipline.

## Exploratory General Agriculture (Non-Degree Program)

First Year	Credits
*Agricultural Sciences	8-12
**Basic Sciences	7
English	6
Mathematics	3
Orientation/Skills for Success	2
Social and Behavioral Sciences	6

Second Year	Credits
*Agricultural Sciences	10-12
**Basic Sciences	10
Computer Science	3
Social and Behavioral Sciences/Humanities	3-6
Speech Communication	3
Wellness	2
Electives	3

\*Agricultural science courses recommended include AgEc 201, 242 or 244; AgEd 232; ASM 115 or 125; ARSc 114 or 123; Biol 202 and 202L; CS 210; Ent 210 or 350; PISc 110, 111, 210 and 211 or 225; PPth 324; or Soil 210. Students are encouraged to select at least one course within each discipline.

\*\*Basic science courses in biology, botany, chemistry, entomology, microbiology, or zoology are recommended.

Advisers for students in the exploratory program are selected from the various disciplines in agriculture. These faculty members work with students to develop an appropriate plan of study and assist them in exploring various career opportunities. Once the student identifies the discipline of choice, an adviser in that discipline should be selected by the student.

## Horticulture

Instruction and study in horticulture is focused on fruits, vegetables, turfgrass, and woody and herbaceous landscape plants, including propagation, production, culture, marketing, processing, and utilization. Horticulture encompasses the design and planting for landscapes, parks, highways, and public facilities, including interiorscapes, in rural, suburban, and urban areas. It includes skills for management of nursery, garden center, greenhouse, seed, fruit, vegetable, turfgrass, biotechnology, and specialty crop enterprises, as well as floral design and flower shops.

The Horticulture major is a four-year curriculum leading to the B.S. degree. Students also may

minor in horticulture. Prospective students should consult with department advisers regarding horticulture programs and options so their educational needs may best be fulfilled. Master of Science and Ph.D. degree programs are also available. Refer to the Graduate Bulletin for details.

## Curriculum Options

Horticulture majors may select one or more options of study. All of the requirements for the major and the supporting disciplines must be met to complete any horticulture option. Students may select from the following five options.

**Horticulture Biotechnology:** This option is for students who plan to engage in laboratory research or further their education in the biotechnology of horticultural crops.

**Horticulture Science:** This option is for students who plan to continue formal graduate school education leading to careers in research, teaching, and extension.

## Recommended Curriculum Horticulture Major

First Year	Credits
AgEc 201 or 202, Prin of Micro or Macro	.3
Agri 150, Ag Orientation	.1
Agri 189, Skills for Academic Success	.1
Biol 150, 150L, Gen Biology, Lab (Biol 150L not required for Landscape or Urban For-Prk Options)	.3,1
Biol 151, Gen Biol II or Bot 372, Struc/Div/Plants & Fungi	.3/4
Chem 121, 122, 122L, Gen Chem I, II, Lab I	.3,3,1
Engl 110, 120, College Composition I, II	.3,3
Math 103, College Algebra (not required for Biotech Option)	.3
PISc 210, 211, Horticulture Science, Lab	.3,1
Total	.32-33

## Horticulture Options

	Hort Biotech	Horti Sci	Lndscp	Prod Busn	Urban For-Prk
<b>Major:</b>					
PISc 177, Floral Design	-	-	2	-	-
PISc 219, Prairie & Comm For	-	-	-	-	2
PISc 341, Land Bidding & Contr	-	-	1	-	-
PISc 355, Woody Land Plants	3	3	-	-	1
PISc 360, Hort Food Crops	4	4	-	4	-
PISc 365, Herb Land Plants	-	-	2	-	2
PISc 368, Plant Propagation	3	3	-	3	-
PISc 375, Turf Management	-	-	3	-	3
PISc 412, Nursery Prod & Mgmt	-	-	-	3	-
PISc 422, Grnhse Prod & Mgmt	-	-	-	3	-
PISc 465, Advan Land Plants	-	-	2	-	2
PISc 484, Plt Tiss Cult & Micro	2	2	-	-	-
PISc 485, Arboriculture Science	-	-	3	-	3
PISc 486, Eco-Physiol of Hort Crp	2	2	2	2	2
PISc 491, Hort Seminar	1	1	1	1	1
PISc Electives	7	7	6	3	4
<b>Agriculture:</b>					
Ent 350, General Entomology	5	5	5	5	5
PISc 315, Genetics	3	3	3	3	3
PISc 315L, Genetics Lab	1	1	-	1	1
PISc 323, Prin of Weed Science	-	3	3	3	3
PPth 324, Intro Plant Pathology	3	3	3	3	3
PPth 455, Plant Disease Mgt OR	-	-	-	3	-
PPth 456, Tree Path	-	-	3	3	3
Soil 210, Intro to Soil Science	-	4	4	4	4
NRM 150, Nat Res Mgmt Orient	-	-	-	-	1

	Hort Biotech	Horti Sci	Lndscp	Prod Busn	Urban For-Prk
<b>Major:</b>					
<b>Basic and Applied Sciences:</b>					
Biol 202, Intro Micro	2	-	-	-	-
Biol 202L, Intro Micro Lab	1	-	-	-	-
Bot 380, Plant Physiology	4	4	-	-	-
Bot 460, Plant Ecology	-	-	3	-	3
Chem 240, Survey of Organic Chem OR	-	-	-	3	3
Chem 260, Elements of Biochem-	-	4	-	4	4
Chem 341, Organic Chemistry I	3	3	-	-	-
Chem 341L, Organic Chem Lab	1	1	-	-	-
Chem 342, Organic Chem II	3	-	-	-	-
CSci 116, Bus/Computers OR	4	4	4	4	4
CSci 114, Microcomp Pkgs	3	3	3	3	3
Math 146, Calculus	4	4	-	-	-
Phys 120, Fund of Physics	-	3	-	-	-
Stat 330, Intro Statistics	3	3	3	3	3
<b>Humanities and Fine Arts/Social and Behavioral Sciences:</b>					
	9	9	9	9	9
<b>Written and Oral Communications:</b>					
Comm 110, Fund Public Speaking	3	3	3	3	3
Engl 320, Practical Wtg OR	3	3	3	3	3
Engl 322, Creative Wtg	or 3	or 3	-	-	-
<b>Related:</b>					
Acct 102, Fundamentals of Acct	-	-	-	3	-
AgEc 380, Pub Pol Choices	-	-	-	-	1
AgEc 382, Econ State & Loc Govt	-	-	-	-	2
Busn 350, Prin of Mgt	-	-	-	3	3
Busn 431, Busn Law I	-	-	3	-	-
Busn 450, Human Resource Mgt	-	-	-	3	-
HNES 426, Parks & Rec Adm	-	-	-	-	3
LA 331, Intro to Planting Design	-	-	-	-	3
PoS 360, Prin of Pub Admin	-	-	-	-	3
Wellness	2	2	2	2	2
<b>Minor in Biotechnology:</b>					
(See Hort Biotech Opt)	13	-	-	-	-
<b>Minor in Landscape Arch:</b>					
(See Landscape Hort Opt)	-	-	16	-	-
<b>General Electives</b>					
	9-11	11-13	7-9	14-17	5-8
Curriculum Totals	128	128	128	128	128

**Landscape:** This option is for students interested in planning, designing, and installing landscape plantings for functional and aesthetic purposes (a 16-credit minor in landscape architecture is required).

**Production Business:** This option is for students who wish to grow, market, and process horticultural crops; for example, nursery and/or greenhouse flower, fruit, and vegetable crops.

**Urban Forestry Parks:** This option is for students who desire a career in the management of urban forests and the horticultural aspects of park-like areas, including arboreta and botanic gardens.

### Special Opportunities

**Pre-Forestry:** the student who desires to major in forestry may select a two-year pre-forestry curriculum. However, the forestry student must transfer to another institution to complete degree requirements.

**Interdisciplinary Program:** A four-year interdisciplinary program (Plant Protection major) is available with a horticultural specialization (see Plant Protection).

**Horticulture and Forestry Club:** This club meets monthly. Members take field trips to botanical gardens, arboreta, trade shows, parks and other horticultural sites. They also are actively involved in growing and marketing flowers and foliage plants, regional and national judging contests, and horticulture science and education programs.

### Horticulture Minor

**Required Horticulture Courses** Credits  
 PISc 210, 211, Hort Science, Lab . . . . . 3,1

**At least three of the following four courses:**  
 PISc 355, Woody Landscape Plants . . . . . 3  
 PISc 360, Horticultural Food Crops . . . . . 4  
 PISc 365, Herbaceous Landscape Plants . . . . . 2  
 PISc 368, Plant Propagation . . . . . 3

**Electives from the following to total 18 credits minimum:**  
 Any 300-400 level PISc course, Ent 350, PPth 324, or Soil 210.

### Two-Year Pre-Forestry

**First Year**  
 AgEc 201, Prin Microeconomics . . . . . 3  
 Agri 150, Ag Orientation . . . . . 1  
 Agri 189 Skills for Academic Success . . . . . 1  
 Biol 150, General Biology . . . . . 3  
 Biol 151, General Biology II or  
 Bot 372, Struc & Div of Plants & Fungi . . . . . 3/4  
 Chem 121, 122, 121L, Chem I, II, Lab I . . . . . 3,3,1  
 Engl 110, 120, College Composition I,II . . . . . 3,3  
 Math 103, 105, or above, College Alg, Trig. . . . . 3,3  
 Wellness . . . . . 2  
 Total . . . . . 32-33

**Second Year**  
 Comm 110, Fund of Public Speaking . . . . . 3  
 CSci 116, Bus/Computers or  
 CSci 114, Micro/Pkgs . . . . . 4/3  
 Ent 350, General Entomology . . . . . 5  
 Phys 120, Fund Physics . . . . . 3  
 PISc 219, 355, Pr and Com For, Wdy Land Pla . . 2,3

	Credits
PISc 315, 315L, Genetics, Lab. . . . .	3,1
Soil 210, Intro Soil Science. . . . .	4
Soc Sci, Hum and Fine Arts Electives . . . . .	6
Total . . . . .	33-34

## Microbiology

(See Veterinary and Microbiological Sciences)

Microbiology is a fundamental biological science that offers a variety of challenges and opportunities. Some of the most important scientific discoveries in this century have been made by microbiologists. Since 1910, about one-third of the Nobel Prizes in medicine and physiology have been awarded to microbiologists. The discipline covers a wide spectrum of specialized interest areas that show how microbes affect human and animal health, our environment, food safety, food technology, and the biotechnology industry. In recent years, the field of microbiology has had a major impact upon virtually all other scientific disciplines. For this reason, even students who choose to major in other fields may find it advantageous to minor in microbiology.

Students majoring in microbiology are well prepared to enter graduate school, veterinary school, medical school and careers in food or pharmaceutical industries, hospitals, public health agencies, universities and research laboratories. A 2.50 cumulative grade point average and minimum grade of "C" in major courses are required to remain in the microbiology major.

Students may minor in microbiology by selecting a total of 16 credits including Microbiology 350-350L. Additional credits are to be earned in other 300- or 400-level microbiology courses, Plant Pathology 460, or Safe 464 or 484.

## Recommended Curriculum Microbiology

	Credits		Credits
<b>Fall, Year 1</b>		<b>Spring, Year 1</b>	
Agri 189 . . . . .	1	Wellness . . . . .	2
Biol 150, 150 L . . . . .	4	Biol 151, 151 L . . . . .	4
Engl 110 . . . . .	3	Engl 120 . . . . .	3
Math 105 or 146 . . . . .	3	Comm 110 . . . . .	3
Chem 121, 121L . . . . .	4	Chem 122, 122 L . . . . .	4
Total . . . . .	15	Total . . . . .	16

<b>Fall, Year 2</b>		<b>Spring, Year 2</b>	
Micr 350, 350 L . . . . .	4	Micr 352, 352 L . . . . .	4
Chem 341, 341 L . . . . .	4	Chem 342 . . . . .	3
Stat 330 . . . . .	3	Biol 315, 315 L . . . . .	4
General elective . . . . .	3	General elective . . . . .	3
General elective . . . . .	3	General elective . . . . .	3
Total . . . . .	17	Total . . . . .	17

<b>Fall, Year 3</b>		<b>Spring, Year 3</b>	
Phys 211, 211 L . . . . .	4	Phys 212, 212 L . . . . .	4
Bich 460 . . . . .	4	Bich 461 . . . . .	4
Micro elective . . . . .	3	Micr 475 . . . . .	3
General elective . . . . .	3	Micr 460 . . . . .	3
General elective . . . . .	3	Micr 460 L . . . . .	2
Total . . . . .	17	Total . . . . .	16

	Credits		Credits
<b>Fall, Year 4</b>		<b>Spring, Year 4</b>	
Micr 470 . . . . .	3	Micr 445 . . . . .	2
Micr 471 . . . . .	2	Micr 486 . . . . .	3
Micr 482 . . . . .	3	Micr elective . . . . .	2-3
Micr elective . . . . .	1-3	Micr elective . . . . .	1-3
General elective . . . . .	3	Other elective . . . . .	3
Other elective . . . . .	3	Other elective . . . . .	3
Total . . . . .	15-17	Total . . . . .	14-17

## Natural Resources Management

(Also see Animal and Range Sciences.)

The Natural Resources Management major prepares students to fill positions requiring a broad background in natural resources as well as depth in one or two specific areas. The program addresses the biological, engineering, and social and economic aspects of managing natural resources as an integrated system.

The Natural Resources Management major, leading to a B.S. degree, is offered through the Colleges of Agriculture, Engineering and Architecture, and Sciences and Mathematics.

### Emphasis Areas

Natural resources management majors may choose from courses in one of the four emphasis areas.

**Biotic Resources Science:** This emphasis area deals with basic scientific principles that govern the interrelationship between biotic (e.g., plants, animals, insects, microorganisms) and abiotic factors (e.g., climate, soils) in major ecosystems and the use of these principles for environmentally sound management of natural resources and agroecosystems. Topics of study include grassland ecosystems, wetland ecosystems, land reclamation, agroforestry, wildlife, sustainable agriculture, soil biology, and others.

### Physical/Earth Resources Sciences:

This emphasis area provides an understanding of the physical and chemical aspects of ecosystems. Topics of study include hydrology, water management and quality, waste management, soil properties, data acquisition, energy resources, and land-use management.

**Pollution Science:** This emphasis area focuses on the principles and practices of managing natural resources for pollution control. Topics include the technical aspects of pollution as they relate to water, air/solids, and the impact of environmental pollution on biotic factors.

**Social Sciences:** This emphasis area prepares students for management, administrative, regulatory, and policy positions that require a broad understanding of the social, biological, and physical aspects of natural resources management and allocation. This area concentrates on human factors (social, political, economic) in environmental management, while recognizing constraints and opportunities presented by physical and biological factors.



interacting field of agricultural meteorology.

Students also gain an appreciation for environmental concerns such as erosion, land-use decisions, and water quality.

The following requirements must be met by all majors in soil science:

### Recommended Curriculum Soil Science

	Credits
	F
<b>First Year</b>	<b>S</b>
Agri 150, Ag Orientation . . . . .	1
Agri 189, Skills for Academic Success . . . . .	1
Chem 121, 121L, Gen Chemistry I, Lab . . . . .	3,1
Chem 122, 122L, Gen Chemistry II, Lab . . . . .	3,1
Engl 110, 120, College Composition I,II . . . . .	3
Math 103, 105, College Algebra, Trig . . . . .	3
PISc 110, World Food Crops . . . . .	3
Wellness . . . . .	2
Electives . . . . .	5
Totals . . . . .	17
<b>Second Year</b>	
ASM 264, Natural Resource Mgt Sys . . . . .	3
CSci 114, Microcomp Pkgs, 122, BASIC, or 126, FORTRAN . . . . .	3
Math 146 or 165, Calculus . . . . .	4
Phys 211, 211L, General Physics, Lab . . . . .	3,1
Soil 210, Intro to Soil Science . . . . .	4
Soil 217, Intro to Meteorol and Climat . . . . .	3
Soil 322, Fertility and Fertilizer . . . . .	3
Soil 325, Fertility and Fertilizer . . . . .	3
Electives . . . . .	4
Totals . . . . .	16
<b>Third Year</b>	
Biol 150, General Biology . . . . .	3
Biol 202, 202L, Intro Microbiol, Lab . . . . .	2,1
Chem 240 or 341, Organic Chemistry . . . . .	3
Comm 110, Fund of Public Speaking . . . . .	3
Soil 321, Mgt and Conservation . . . . .	3
Soil 333, 339, Managing Soil Phys Prop, Lab . . . . .	2,1
Stat 330, Intro Statistics . . . . .	3
Electives . . . . .	4
Totals . . . . .	15
<b>Fourth Year</b>	
Engl 215, Wtg/Work or 320, Pract Wtg . . . . .	3
Soil 444, Soil Genesis and Survey . . . . .	4
Soil 455, Soil Chemistry . . . . .	3
Soil 499, Soil Microbiology . . . . .	2
Soil 491, Capstone Seminar I, II . . . . .	1
Electives . . . . .	8
Totals . . . . .	16
Curriculum Total . . . . .	128

### Soil Science Minor

A minor in soil science requires a minimum of 16 semester credits.

	Credits
Introduction to Soil Science . . . . .	4
Soil Genesis/Survey . . . . .	4

#### Choose three of the following

Soil Conservation Management . . . . .	3
Soil Fertility and Fertilizers . . . . .	3
Soil Chemistry . . . . .	3
Soil and Plant Analysis . . . . .	3
Soil and the Environment . . . . .	2
Soil Physical Properties . . . . .	2/1
Intro to Meteorology/Climatology . . . . .	3
Microclimatology . . . . .	3

Soil and Waste Disposal . . . . . 2

## Veterinary and Microbiological Sciences

(Also see Microbiology.)

This department offers instruction in veterinary science and microbiology (listed earlier), including the epidemiology and prevention of diseases; courses in virology, bacteriology and immunology; animal disease; parasitology; food safety. The veterinary technology major is offered through the Department of Animal and Range Sciences.

### Recommended Curriculum

#### Pre-Veterinary Medicine

All veterinary schools stress the importance of high scholastic standing and judge applicants on academic preparation, character, personality, general fitness, and adaptability for veterinary medicine.

For entrance, most veterinary medical schools require at least two to three years of general college study.

Because the number of students admitted to veterinary schools is limited, prospective students should check the specific requirements of the college of their choice well in advance to make certain that preparatory work is properly channeled. Consult the pre-veterinary adviser.

Pre-Veterinary students should enroll in the College of Agriculture.

### Veterinary Technology

(Also see Animal and Range Sciences.)

Veterinary technology is an exciting and challenging major that offers a multitude of career opportunities in animal health care and related areas. The Veterinary Technology major leads to the B.S. degree. This major offers a well-rounded program of general and clinical studies. Graduates are prepared not only for traditional veterinary practice careers, but also for pursuit of emerging non-traditional careers through the choice of electives and minor areas of study.

The first year of the veterinary technology program is open to all interested students and offers an opportunity to explore the veterinary technology field. Advancement into the second year of the program is limited to a maximum of 24 students who are selected on a competitive basis.

The veterinary technology program is accredited by the American Veterinary Medical Association.

General Courses	Credits
Acct 102, Fundamentals of Acct . . . . .	3
Agri 189, Skills for Academic Success . . . . .	1
ARSc 114, Intro to Animal Sciences . . . . .	3
Biol 150, 150L, General Biology I, Lab or . . . . .	3,1

Biol 151, 151L, General Biology II, Lab . . . . . 3,1  
 Biol 202, 202L, Intro Microbiology, Lab . . . . . 2,1

#### Credits

Chem 117, 117L, Chem Concepts, Lab or Chem 121, 121L, Gen Chem I, Lab . . . . .	3,1
Comm 110, Fund of Public Speaking . . . . .	3
CSci 116, Busn Use or 114, Micro Packages . . . . .	4-3
Engl 110, 120, College Composition I, II . . . . .	3,3
Engl 320, Practical Writing . . . . .	3
Math 104, Finite Math . . . . .	3
Micr 460, Pathogenic Microbiology . . . . .	3
PISc 315, 315L, Genetics, Lab . . . . .	3,1
VetS 194, Breeds of Animals . . . . .	1
VetS 365, Fund of Animal Disease . . . . .	4
General Electives . . . . .	16
Humanities and Fine Arts . . . . .	6
Social and Behavioral Sciences . . . . .	6
Wellness . . . . .	2

#### Pre-Professional Veterinary Technology Courses

VetS 115, Medical Terminology . . . . .	1
VetS 125, Animal Restraint . . . . .	2
VetS 135, Anat and Phys of Domestic Ani . . . . .	3
VetS 136, Anatomy and Phys Lab . . . . .	1
VetS 150, Intro to the Vet Profession . . . . .	1

#### Professional Veterinary Technology Courses

(limited enrollment)	
VetS 196, Ward/Clinic Care 2 @ 1 credit . . . . .	2
VetS 255, Fund of Vet Radiography . . . . .	3
VetS 256, Vet Clinical Tech. and Instruments . . . . .	3
VetS 259, Small Animal Diseases . . . . .	2
VetS 357, Vet Pharmacology . . . . .	3
VetS 358, Vet Surg Nurs Tech . . . . .	4
VetS 359, Vet Hosp Info and Proc . . . . .	2
VetS 385, Vet Clin Path I . . . . .	3
VetS 386, Vet Clin Path II . . . . .	3
VetS 387, Vet Clin Path III . . . . .	3
VetS 485, Externship . . . . .	12
VetS 496, Ward/Clinic Care 2 @ 1 credit . . . . .	2
Curriculum Total . . . . .	128