

# College of Science and Mathematics

Stevens Hall 201 (701) 231-7411

Alan R. White, Dean

Opportunities in the college reflect the belief that an understanding of the methods and findings of science is best achieved through first-hand experience in the process of conducting, analyzing, and reporting research. Students are encouraged to participate in this process by working closely with faculty and other students in laboratory and field research, thus gaining direct knowledge of the power, limits, and problems in scientific inquiry. These opportunities for direct experience with the tools of the scientist are liberally available to the interested and motivated student.

Departments of the College of Science and Mathematics include the following:

Biochemistry and Molecular Biology	Mathematics Physics
Biological Sciences	Polymers & Coatings
Chemistry	Psychology
Computer Science	Statistics
Geosciences	Zoology

## Degree Programs

The College of Science and Mathematics provides undergraduate programs leading to a Bachelor of Science or Bachelor of Arts degree. Graduate programs at the masters and doctorate levels are also offered. More information about advanced degrees is available in the Graduate Bulletin.

## Degree Requirements

All majors are required to complete departmental and general education requirements. Departmental requirements for graduation are those in existence at the beginning of the junior year. Junior standing, in this case, applies only to majors who have satisfied the freshman and sophomore curriculum of a departmental program. Available majors include the following:

Behavioral Statistics  
Biological Sciences  
Biotechnology  
Botany  
Chemistry  
Clinical Laboratory Science  
Computer Science  
Geology  
Mathematics  
Natural Resources Management  
Physics  
Psychology  
Radiologic Sciences  
Respiratory Care  
Statistics  
Zoology

Minors are available in most departments.

The Department of Biochemistry and Molecular Biology and the Department of Polymers and Coatings provide areas of specialization for chemistry majors but do not offer a separate major at the undergraduate level.

Academic credits may be earned within majors due to participation in the Cooperative Education program. Students may obtain one or two semesters of professional work experience related to their studies; however, no more than a total of three credits may be applied to the minimum of 122 credits required for the degree. Each department has specific requirements for earning these credits, which will be graded S or U. The student must have approval by the co-op coordinator and chair of the department prior to beginning the co-op program.

Courses to fulfill the major requirements in the college may not be taken pass/fail. Only elective courses outside the major may be taken pass/fail.

Course work transferring from another institution with a grade of "D" will count toward total number of credits, but not toward specific degree requirements.

Math 099 and 102 are developmental courses and will not count toward credits for graduation in any program.

General college requirements for the two undergraduate degrees extend beyond the minimum University general education

requirements. An adviser should be consulted for specific courses. Students are also encouraged to follow their own interests in choosing electives that go beyond the minimum requirements. Basic requirements for each degree include the following:

## Bachelor of Science Degree

	Credits
Comm 110, Fund of Public Speaking	.3
Engl 110, 120, College Composition I, II	.6
Univ 189, Skills for Academic Success	.1
Humanities and Fine Arts*	.6
Humanities and Social Sciences (additional college requirement)*	.6
Quantitative Reasoning*	.3
Science and Technology*	.10
Social and Behavioral Sciences*	.6
Wellness*	.2
Major and related supporting courses	

\*Refer to [www.ndsu.edu/ndsu/deott/registrar/geneds.stm](http://www.ndsu.edu/ndsu/deott/registrar/geneds.stm) for courses approved for General Education listed in the Appendix.

## Bachelor of Arts Degree

B.A. degree requirements are the same as the B.S. degree with an additional 6 credits of humanities and social and behavioral sciences and the addition of two years of a modern foreign language. This means completion of the second year of college-level language or the equivalent. For example, students with two years of a foreign language in high school should enter second year college-level language. Students with four or more years of a foreign language in high school will be considered to have completed this requirement.



All degree candidates must apply for graduation through the Office of Registration and Records according to University procedures and deadlines.

## Specializations

Specializations are provided for career preparation in a range of areas.

### Pre-Professional Programs

Pre-professional curricula are offered by a number of departments for students interested in preparing for careers in medicine, dentistry, mortuary science, chiropractic, optometry, osteopathy, and other health related fields. Some example curricula are included under individual department sections. Most pre-professional programs are flexible and can be developed around many different majors. Departments that have expressed a special interest in advising pre-professional majors include biological sciences, biochemistry, chemistry, physics, and psychology.

In addition to the preceding, a number of departments have developed other specializations to meet today's rapidly changing job markets. These may be found in the individual department sections as follows:

Biochemistry—biotechnology

Biological Sciences—environmental science, biotechnology, biological sciences education, comprehensive science education, wildlife and fisheries biology, cell biology/physiology

Chemistry—biochemistry, chemistry education, pre-professional chemistry, polymers and coatings

Geosciences—geochemistry

Psychology—natural science track, social sciences track, options in behavioral neuroscience, industrial-organizational, human services, and experimental

### Teacher Certification

Several of the majors available through the College of Science and Mathematics lead to careers in teaching.

Students may complete the requirements for a major in the college, then apply for admission to the School of Education in the College of Human Development and Education to undertake the additional requirements necessary to qualify for teacher certification. Alternatively, students may initially select a science and mathematics education curriculum through the School of Education.

Programs leading to teacher certification are available in the following areas: biological sciences, chemistry, comprehensive science, geology, mathematics, and physics.

### ROTC Opportunities

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. In addition they may complete either program and receive a commission upon graduation. Students receiving commissions will have the opportunity to serve as officers in the active service or in the Army reserve components. For more complete details of the ROTC programs, refer to the Special Programs section.

### Pre-Medicine and Pre-Dentistry

The suggested program will meet the requirements of most medical and dental schools. In general, these requirements include organic chemistry, physics, and the equivalent of a year of general biology. Some college-level mathematics, such as Math 146-147, is strongly recommended. The Bachelor of Arts degree program is recommended. Contact the Department of Biological Sciences for additional information (231-8421).

### Pre-Medical and Pre-Dental Requirements

	Credits
English and Speech Communication . . . . .	9
Foreign Language . . . . .	12
Humanities and Social Sciences . . . . .	28*
Major . . . . .	30*
Sciences and Mathematics . . . . .	32
Skills for Academic Success . . . . .	1
Wellness . . . . .	2
Electives . . . . .	10
Total . . . . .	124

\*Approximate number of credits in this subject area

## Biochemistry and Molecular Biology

Biochemistry is an interdisciplinary study of the chemical and physical properties of living matter and the chemical changes that occur during life processes. Careers in biochemistry require preparation in both chemistry and biology as well as biochemistry. A biochemistry option is offered in cooperation with the Department of Chemistry. The option includes biochemistry and electives in the life sciences. Students following this curriculum will have career opportunities in medical, pharmaceutical, food processing, and agricultural laboratories, especially in the areas of molecular biology, genetic engineering, and the newer biotechnologies. A major in chemistry with the biochemistry option is an excellent preparation for graduate school or schools of medicine, dentistry, and veterinary science.

Courses in biochemistry are also of interest to students in other fields such as agriculture, microbiology, botany, and the health sciences.

Electives for the major in chemistry with the biochemistry option leading to the baccalaureate degree include courses in cell biology, botany, zoology, microbiology, genetics, physiology, cereal technology, and entomology. At least 10 credits of these electives must be in upper-division courses. Selection of electives will be made by the student in consultation with an adviser from the biochemistry department faculty.

Graduate work in biochemistry is offered at both the M.S. and Ph.D. levels. Students beginning study in these programs should have a strong chemistry background. Prior training in the life sciences is desirable but not essential. Further details about graduate programs are in the Graduate Bulletin.

## Biological Sciences

The Department of Biological Sciences offers broad undergraduate preparation in the basic concepts and principles of the life sciences with major emphasis on both plants and animal forms. Various curricular options are available for specific career interests. It is important for students to consult frequently with their advisers regarding the proper options and courses related to their special interests. In addition, students should correspond early with professional or graduate schools to make sure they satisfy specific requirements.

### Biological Sciences Major

The biological sciences major is available for the student seeking broad biological training. Required courses for this curriculum include the following:

Biol 150, 150L, 151, 151L, 364, 459, 491  
Bot 315, 315L, 372  
Chem 121, 121L, 122, 122L, 240,  
and Bioc 260

OR Chem 341, 341L, 342 and Bioc 460  
Math 146  
Phys 211, 211L and 212, 212L  
Stat 330  
Zoo 370

One three-credit course in computer science  
Two courses in earth science  
Advanced biology electives (12 credits) with at least one course from each of the following areas: systematics, anatomy/morphology, and physiology (2 botany, 2 zoology).

A student is expected to take approximately an equal number of credits in botany and zoology with the distribution of course work in the two fields determined by the student in consultation with his/her adviser.

A list of courses that meet the required categories of systematics, anatomy/morphology, physiology, computer science, and earth sciences may be obtained from the departmental office. Curricula for secondary school comprehensive science education, environmental studies, traditional course sequences, and pre-professional programs are available in the department.

A minor in biological sciences consists of at least 18 credits, including Biology 150, 150L, 151, 151L, Botany 372, and elective credits selected from 300- and 400-level courses in biology, botany, or zoology. The chair of the Department of Biological Sciences must approve elective credits.

Students interested in majoring in a specific biological science (animal science, botany, entomology, horticulture, microbiology, plant pathology, zoology) should consult the appropriate discipline.

### Environmental Science Option

For students interested in careers that address solving environmental problems, there is the biological sciences major with an environmental option. This rigorous option incorporates balanced studies in the natural sciences (biology, chemistry, physics, and earth sciences) with social sciences (economics, political science, and sociology). It also involves technology, business, law, ethics, and human relations and behavior. Students interested in this option should visit with an adviser to obtain the specific requirements.

### Biological Sciences Education

Students who intend to teach biology in the secondary schools should make their intentions known to the School of Education and consult with a biology education adviser in the Department of Biological Sciences early in their programs to make certain that they have a well-designed program and take the professional education courses required for state teacher certification.

### Comprehensive Science Education

The comprehensive science education major is designed to prepare the secondary general science teacher. This major is an especially good preparation for the student who may find her/himself teaching several different science courses. Information about curriculum and other requirements is available from the School of Education and the education adviser in the Department of Biological Sciences.

### Recommended Curriculum Biological Sciences Major

	Credits	
	F	S
<b>First Year</b>		
Biol 150, 150L, General Biology I, Lab . . .	3,1	
Biol 151, 151L, General Biology II, Lab . . . .		3,1
Chem 121, 121L, 122, 122L, General Chem I, II, Labs . . . . .	3,1	3,1
Engl 110, 120, College Composition I, II . . .	3	3
Math 146, Applied Calculus I . . . . .	4	
Univ 189, Skills for Academic Success . . . .	1	
Computer Science . . . . .		3
Wellness . . . . .		2
Totals . . . . .	16	16

#### Second Year

Biol 364, General Ecology . . . . .	3	
Bot 315, 315L, Genetics, Lab . . . . .	3,1	
Chem 341, 341L, 342, Organic Chemistry I, II, Lab . . . . .	3,1	3
Comm 110, Fund of Public Speaking . . . . .	3	
Stat 330, Introductory Statistics . . . . .	3	
Bot 372, Struct & Diversity Plants & Fungi . .	4	
Social Science . . . . .	3	3
Totals . . . . .	15	16

#### Third Year

Bioc 460, Elements of Biochem . . . . .	4	
Phys 211, 211L, 212, 212L, College Physics I, II and Labs . . . . .	4	4
Zoo 370, Cell Biology . . . . .		3
Biological Science . . . . .	3	3
Earth Science . . . . .	3	3
Humanities and Fine Arts . . . . .	3	
Totals . . . . .	14	16

	Credits	
	F	S
<b>Fourth Year</b>		
Biol 459, Evolution . . . . .	3	
Biol 491, Senior Seminar . . . . .	1	
Biological Sciences . . . . .	6	6
Humanities and Fine Arts . . . . .		3
Humanities or Social Sciences Electives . .	3	3
Electives . . . . .	6	
Totals . . . . .	15	16
Curriculum Total . . . . .		122

### Recommended Curriculum Environmental Science Option

	Credits	
	F	S
<b>First Year</b>		
Biol 150, 150L, General Biology I, Lab . . .	3,1	
Biol 151, 151L, General Biology II, Lab . . .		3,1
Chem 121, 121L, 122, 122L, Gen Chem I, II, Labs . . . . .	3,1	3,1
Engl 110, 120, College Composition I, II . .	3	3
Math 146, 147, Applied Calculus I, II . . . .	4	4
Univ 189, Skills for Academic Success . . .	1	
Totals . . . . .	16	15

#### Second Year

Biol 315, 315L, Genetics, Lab . . . . .	3,1	
Bot 372, Struct & Diversity Plants & Fungi .	4	
Chem 341, 341L, 342, Organic Chem I, II, Lab . . . . .	3,1	3,1
Geol 105, 105L, Physical Geology, Lab . . .	3,1	
Geol 106, 106L, Earth Through Time, Lab .		3,1
Phys 211, 211L, 212, 212L, College Physics I, II, Labs . . . . .	3,1	3,1
Totals . . . . .	16	15

#### Third Year

Biol 364, General Ecology . . . . .	3	
Comm 110, Fund of Public Speaking . . . . .	3	
Geol 428, Geochemistry . . . . .	3	
Soil 217, Meteorology/Climatology . . . . .	3	
Stat 330, Introductory Statistics . . . . .	3	
Biological Sciences . . . . .	3	3
Computer Science . . . . .		3
General Education . . . . .	3-6	3
Totals . . . . .	15-18	15

#### Fourth Year

Bioc 460, Biochemistry . . . . .	4	
Biol 459, Evolution . . . . .	3	
Biol 491, Seminar . . . . .	2	
Soil 410, Soil and the Environment . . . . .	2	
Biological Sciences . . . . .	3	3
General Education . . . . .	3-3	3
Wellness . . . . .	2-3	
Totals . . . . .	15-16	13
Curriculum Total . . . . .		122

### Recommended Curriculum Biological Sciences Education

	Credits	
	F	S
<b>First Year</b>		
Biol 150, 150L, General Biology I, Lab . . .	3,1	
Biol 151, 151L, General Biology II, Lab . . .		3,1
Chem 121, 121L, 122, 122L, Gen Chem I, II, Labs . . . . .	3,1	3,1
Engl 110, 120, College Composition I, II . .	3	3
HD&E 120, Orientation to HD&E . . . . .	1	
HD&E 189, Skills for Academic Success . .	1	
Math 146, Applied Calculus I . . . . .	4	
Computer Science . . . . .		3
Wellness . . . . .		2
Totals . . . . .	17	16

#### Second Year

Biol 315, 315L, Genetics, Lab . . . . .	3,1	
Bot 372, Struct & Diversity Plants & Fungi .	4	
Chem 240, Survey of Organic Chem . . . .	3	
Chem 260, Elements of Biochemistry . . .	4	
Comm 110 Fund of Public Speaking . . . . .	3	
Educ 321, Intro to Teaching . . . . .	3	
Educ 322, Educational Psychology . . . . .	3	
Educ 381, Early Experience . . . . .	1	
Phys 211, 211L, 212, 212L,		

	Credits	
	F	S
College Physics I, II, Labs . . . . .	3,1	3,1
Humanities or Social/Behavioral Sci . . . .		3
Totals . . . . .	15	18

#### Third Year

Biol 364, General Ecology . . . . .	3	
Biol 459, Evolution . . . . .	3	
Educ 389, Native Am/Inst Pract . . . . .	3	
Educ 451, Inst Planning/Strategies . . . . .	3	
Geol 105, 105L, Physical Geol, Lab . . . .	3,1	
Geol 106, 106L, Earth Through Time, Lab .		3,1
Stat 330, Introductory Statistics . . . . .	3	
Biol 220, 220L, Anatomy/Physiology, Lab .	3,1	
Biol 221, 221L, Anatomy/Physiology Lab . .		3,1
Zoo 370, Cell Biology . . . . .		3
Social and Behavioral Sci . . . . .	3	
Totals . . . . .	17	20

#### Fourth Year

Biol 491, Seminar . . . . .	1	
Educ 481, Classroom Pract/Sci Methods . .	3	
Educ 485, Student Teaching Seminar . . . .		1
Educ 486, Classroom Mgt . . . . .		3
Educ 487, Student Teaching . . . . .		10
Biology Electives . . . . .	3,3	
Humanities and Fine Arts . . . . .	3	
Humanities or Social/Behavioral Sci . . . .	3	
Totals . . . . .	17	14
Curriculum Total . . . . .		132

### Recommended Curriculum Comprehensive Science Education

	Credits	
	F	S
<b>First Year</b>		
Biol 124, Environmental Science . . . . .		3
Chem 121, 121L, 122, 122L, Gen Chem I, II, Labs . . . . .	3,1	3,1
Engl 110, 120, College Composition I, II . .	3	3
Geol 105, 105L, Physical Geol, Lab . . . .	3,1	
Geol 106, 106L, Earth Through Time, Lab .		3,1
HD&E 120, Orientation to HD&E . . . . .	1	
HD&E 189, Skills for Academic Success . .	1	
Humanities and Fine Arts . . . . .	3	
Social and Behavioral Sci . . . . .		3
Wellness . . . . .	2	
Totals . . . . .	18	17

#### Second Year

Biol 150, 150L, General Biology I, Lab . . .	3,1	
Biol 151, 151L, General Biology II, Lab . . .		3,1
Chem 341, 341L, 342, 342L, Organic Chemistry I, II, Labs . . . . .	3,1	3,1
Educ 321 Intro to Teaching . . . . .		3
Educ 322, Educational Psychology . . . . .		4
Math 165, 166, Calculus I, II . . . . .	4	4
Educ 381, Early Experience . . . . .		1
Totals . . . . .	15	16

#### Third Year

Chem 260, Elements of Biochemistry . . . .	4	
Comm 110, Fund of Public Speaking . . . . .	3	
Educ 389, Native Am/Inst Pract . . . . .	3	
Educ 451, Inst Planning/Strategies . . . . .	3	
Phys 251, 251L, 252, 252L, Univ Phys I, II, Labs . . . . .	5,1	4,1
Bot 372, Struct & Diversity Plants & Fungi .	4	
Biol, Bot, or Zoo Elective (300+ level) . . .	3	
Computer Science . . . . .	3	
Totals . . . . .	19	15

#### Fourth Year

Educ 481, Classroom Pract/Sci Methods . .	3	
Educ 485, Student Teaching Seminar . . . .		1
Educ 486, Classroom Mgt . . . . .		3
Educ 487, Student Teaching . . . . .		10
Phys 110, Introductory Astronomy . . . . .	3	
Stat 330, Introductory Statistics . . . . .	3	
Biol, Bot, or Zoo Elective (300+ level) . .	3	
Humanities and Fine Arts . . . . .	3	
Social and Behavioral Sci . . . . .	3	
Totals . . . . .	18	14
Curriculum Total . . . . .		131

## 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 has 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, Gen Biology I and Lab . . . . .	3,1
Biol 151, 151L, General Biology II and Lab . . . . .	3,1
Chem 121, 121L, Gen Chem I, and Lab. . . . .	3,1
Chem 122, 122L, General Chemistry II and Lab. . . . .	3,1
Engl 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, Org Chem I, and Lab . . . . .	3,1
Chem 342, Organic Chemistry II. . . . .	3
Micr 350, 350L, Gen Microbiology and Lab . . . . .	3,1
Phys 211, 211L, College Phys I, and, Lab. . . . .	3,1

### Credits

Phys 212, 212L, College Physics II and Lab. . . . .	3,1
PISc 315, 315L, Genetics and Lab. . . . .	3,1
Computer Science . . . . .	3
Soc & Behavioral Sci, Humanities & Fine Arts . . . . .	6
Additional Writing or Speech Course. . . . .	3
Total . . . . .	35

### Third Year

Bioc 460, 461, Found of Biochem & Molecular Biology I, II. . . . .	8
Comm 110, Fund of Public Speaking . . . . .	3
Micr 470, Basic Immunology . . . . .	3
Micr 471, Immunology & Serology Lab . . . . .	2
Stat 330, Intro Statistics . . . . .	3
*Biotechnology Elective . . . . .	2-3
Soc & Behavioral Sci, Humanities & Fine Arts . . . . .	9
Biotechnology Seminar . . . . .	1
Total . . . . .	31-32

### Fourth Year

Bioc 465, Prin of Phys Chem & Biophysics . . . . .	4
Bioc 474, Methods in Recomb DNA Tech . . . . .	3
Bot 380, Plant Phys 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
Soc & Behavioral Sci, Humanities & Fine Arts . . . . .	3
General Electives. . . . .	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):

Bioc 473, Methods of Biochem Research or PSci 409, Isotope Tracer Techniques (3 cr. each)	
Bioc 485, Industrial Biotechnology (3 cr.)	
Micr 445, Animal Cell Culture Techniques (2 cr.)	
PPth 453, Microscopy (3 cr.)	
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 & Molecular Biology I, II. . . . .	8
PISc 315, 315L, Genetics & Lab . . . . .	3,1

**Electives in Biotechnology Technique (2 courses required):**

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 & Micropropagation. 2	

**Electives in Specialized Areas (6 credits):**

Bot 380, Plant Physiology . . . . .	4
Micr 470, Basic Immunology . . . . .	3
Micr 471, Immunology & Serology Lab . . . . .	2
Micr 482, Bacterial Genetics & Phage. . . . .	3
PPth 324, Intro to Plant Pathology . . . . .	3
Zoo 370, Cell Biology . . . . .	3
Zoo 460, Animal Physiology . . . . .	4

## Botany

Departmental instruction is offered in the major areas of botany for students in all colleges of the University, but botany courses and instructional procedures are specially

designed for undergraduate and graduate students in the College of Science and Mathematics and the College of Agriculture. Completion of an undergraduate major prepares the students for graduate work or for professional employment. Graduate work in botany is offered at both the M.S. and Ph.D. levels.

Majors in botany are required to take a minimum of 25 credits in botany, plus additional credits in related fields. Required courses include the following:

Biol 150/150L, 151/151L, 315/315L, 459	
Bot 314, 372, 380, 452, 460, 471 or 472, 491	
Chem 121/121L, 122/122L, 240 and 260	
OR Chem 341/341L, 342 and Bioc 460	
Math 146	
Micr 350/350L	
Phys 211/211L and 212/212L	
Stat 330	
Zoo 370	
One course in computer science	

## Recommended Curriculum Botany Major

First Year	Credits	
	F	S
Biol 150, 150L, General Biology I, Lab . . . . .	3,1	
Biol 151, 151L, General Biology II, Lab . . . . .		3,1
Chem 121, 121L General Chemistry I, Lab 3,1		
Chem 122, 122L General Chemistry II, Lab. . . . .		3,1
Engl 110, 120, College Composition I, II . . . . .	3	3
Math 146, Applied Calculus I. . . . .	4	
Univ 189, Skills for Academic Success . . . . .	1	
Computer Science. . . . .		2-3
Wellness . . . . .		2-3
Totals . . . . .	16	15-17

### Second Year

Bot 315, 315L, Genetics, Lab . . . . .	3,1
Bot 314, Systematic Botany. . . . .	3
Chem 341, 341L, 342, Organic Chem I, II, Lab . . . . .	3,1
Phys 211, 211L, College Physics I, Lab . . . . .	3,1
Phys 212, 212L, College Physics II, Lab . . . . .	3,1
Bot 372, Struct & Diversity Plants & Fungi . . . . .	4
Humanities and Fine Arts . . . . .	3
Social and Behav Sci. . . . .	3
Totals . . . . .	15

### Third Year

Bioc 460, Elements of Biochem . . . . .	4
Bot 380, Plant Physiology . . . . .	4
Bot 452, Plant Structure . . . . .	3
Comm 110, Fund of Public Speaking. . . . .	3
Stat 330, Introductory Statistics . . . . .	3
Botany Electives . . . . .	6
Humanities and Fine Arts . . . . .	3
Social and Behav Sci. . . . .	3
Totals . . . . .	14

### Fourth Year

Biol 459, Evolution. . . . .	3
Bot 460, Plant Ecology . . . . .	3
Bot 471 or 472, Phycology, Lichenology. . . . .	3
Bot 491, Seminar . . . . .	2
Micr 350, 350L, General Microbiology, Lab 3,1	
Zoo 370, Cell Biology . . . . .	3
Humanities and Fine Arts . . . . .	3
Social and Behav Sci. . . . .	3
Electives . . . . .	3
Totals . . . . .	16
Curriculum Total . . . . .	122

## Chemistry

Programs leading to the B.S. degree and the B.A. degree are available. For an outline of the general requirements for the B.A. degree, refer to the beginning of the College of Science and Mathematics section.

The principal curricula leading to the B.S. degree are designed to meet the standards set by the Committee on Professional Training of the American Chemical Society (ACS).

Requirements for a chemistry minor are Chem 121, 121L, 122, 122L, plus 11 credits in chemistry, biochemistry, or polymers and coatings at the 300-course level or higher, including at least one laboratory credit.

Graduate study in chemistry may lead to the Master of Science (M.S.) and to the doctorate (Ph.D.) in chemistry. Further information is available in the Graduate Bulletin.

## Recommended Curriculum Chemistry Major

The ACS certified chemistry major is the standard program designed for students seeking careers in the chemical industry or careers in law, government, journalism, business, and others, which would benefit from a strong background in the physical sciences and mathematics. Many B.S. graduates pursue M.S. or Ph.D. studies.

Students may apply for scholarships available from the Department of Chemistry and the Department of Polymers and Coatings.

Graduates of the standard chemistry program for the B.S. degree are certified by the American Chemical Society. The curriculum for the polymers and coatings option includes added specialized courses to the standard program. The curriculum for the biochemistry option includes biological sciences courses and substitutions of some upper-division chemistry courses for advanced biochemistry courses. These two options also lead to ACS certification of graduates.

	Credits	
	F	S
<b>First Year</b>		
Chem 150, 151, Prin of Chem I, II . . . . .	3	3
Chem 160, 161, Prin of Chem Lab . . . . .	1	1
Comm 110, Fund of Public Speaking . . . . .	3	3
Engl 110, 120, College Composition I, II . . . . .	3	3
Math 165, 166, Calculus I, II . . . . .	4	4
Univ 189, Skills for Academic Success . . . . .	1	1
General Education* . . . . .	3	3
Wellness . . . . .	—	2
Totals . . . . .	15	16

<b>Second Year</b>		
Chem 341, 342, Organic Chem . . . . .	3	3
Chem 353, 354, Majors' Org Chem Labs . . . . .	1	2
Math 228, Intro Linear Algebra . . . . .	1	1
Math 259, **University Calculus III . . . . .	3	3
Math 266, Intro Diff Equations . . . . .	3	3
Phys 251, 252, Univ Physics . . . . .	5	4
Phys 251L, 252L, Univ Physics Lab . . . . .	1	1
General Education* . . . . .	—	3
Totals . . . . .	14	16

<b>Third Year</b>		
Chem 431, 431L, Analytical Chem I, Lab . . . . .	3,2	3
Chem 364, 365, Physical Chem I, II . . . . .	4	4
Chem 380, Seminar in Chem . . . . .	1	1
Chem 471, Physical Chem Lab . . . . .	2	2
General Education* . . . . .	6	9
Totals . . . . .	15	16

	Credits	
	F	S
<b>Fourth Year</b>		
Bioc 460, Found/Biochem/Molec Biol . . . . .	4	4
Chem 425, 429, Inorganic Chem, Lab . . . . .	3,2	3
Chem 432, 432L, Analytical Chem II, Lab . . . . .	3,1	3
Chem 491, Seminar in Chem . . . . .	2	2
General Education* . . . . .	6	9
Totals . . . . .	15	15
Curriculum Total . . . . .	122	122

\*General education credits must be selected from approved courses and include 18 credits in humanities and social sciences; 6 of these must be in humanities and fine arts and 6 in social/behavioral sciences. Also, 3 credits must be from the global perspectives category and 3 from cultural diversity.

\*\*Math 265 may be substituted for Math 259.

## Recommended Curriculum Biochemistry Option

The curriculum for the biochemistry option is derived from the ACS certified chemistry major. The following arrangement of courses is presented as a model and may be restructured to meet individual needs.

	Credits	
	F	S
<b>First Year</b>		
Biol 150, 150L, Gen Biology I, Lab . . . . .	3,1	3
Biol 151, 151L, General Biology II, Lab . . . . .	3,1	3
Chem 150, 151, Principles of Chem I, II . . . . .	3	3
Chem 160, 161, Principles Lab I, II . . . . .	1	1
Comm 110, Fund of Public Speaking . . . . .	3	3
Engl 110, 120, College Composition I, II . . . . .	3	3
Math 165, 166, Calculus I, II . . . . .	4	4
Univ 189, Skills for Academic Success . . . . .	1	1
Totals . . . . .	16	18

<b>Second Year</b>		
Chem 341, 342, Org Chem I, II . . . . .	3	3
Chem 353, 354, Org Chem, Lab . . . . .	1	2
Math 228, Intro Linear Algebra . . . . .	1	1
Math 259, University Calculus III . . . . .	3	3
Math 266, Intro Diff Eqns . . . . .	3	3
Phys 251, 252, Univ Physics I, II . . . . .	5	4
Phys 251L, 251L, Univ Physics Lab I, II . . . . .	1	1
General Education* . . . . .	3	3
Wellness . . . . .	2	2
Totals . . . . .	16	16

<b>Third Year</b>		
Bioc 460, 461, Biochem/Mol Biol I, II . . . . .	4	4
Chem 431, 431L, Analytical Chem I, Lab . . . . .	3,2	3
Chem 380, Seminar . . . . .	1	1
Biological Sciences Electives . . . . .	3	3
General Education* . . . . .	3	9
Totals . . . . .	15	17

<b>Fourth Year</b>		
Bioc 473, Meth Biochem Res . . . . .	3	3
Bioc 474, Meth Recomb DNA Tech . . . . .	3	3
Chem 364, 365, Phys Chemistry I, II . . . . .	4	4
Chem 425, Inorganic Chem . . . . .	3	3
Chem 471, Phys Chem Lab . . . . .	2	2
Chem 491, Senior Seminar** OR Bioc 491, 494, Seminar, Res . . . . .	2	2
Micr 350, 350L, Gen Micro, Lab . . . . .	3,1	3
General Education* . . . . .	—	3
Totals . . . . .	14	14
Curriculum Total . . . . .	126	126

\*General education credits must be selected from approved courses and include 18 credits in humanities and social sciences; 6 of these must be in humanities and fine arts and 6 in social/behavioral sciences. Also, 3 credits must be from the global perspectives category and 3 from cultural diversity.

\*\*Biochemistry option students may substitute Bioc 491 plus Bioc 494 for Chem 491.

## Recommended Curriculum Polymers and Coatings Option

This program is for students who wish to prepare for a career as a chemist in polymers and coatings industries or for graduate school in polymer chemistry. This is the only program in the U.S. that combines an ACS-accredited program in chemistry with a polymers and coatings curriculum. Students have numerous opportunities to participate in the summer research programs and cooperative programs sponsored by industry. For students who elect the Polymers and Coatings option to the chemistry major, substantial scholarship support is available.

	Credits	
	F	S
<b>First Year</b>		
Chem 150, 151, Prin of Chem I, II . . . . .	3	3
Chem 160, 161, Prin of Chem I, II Labs . . . . .	1	1
Comm 110, Fund of Public Speaking . . . . .	3	3
Engl 110, 120, College Composition I, II . . . . .	3	3
Math 165, 166, Calculus I, II . . . . .	4	4
Univ 189, Skills for Academic Success . . . . .	1	1
General Education* . . . . .	3	3
Wellness . . . . .	—	2
Totals . . . . .	15	16

<b>Second Year</b>		
Chem 341, 342, Organic Chem I, II . . . . .	3	3
Chem 353, 354, Majors' Org Chem I, II Labs . . . . .	1	2
Math 228, Intro to Linear Algebra . . . . .	1	1
Math 259, University Calculus III . . . . .	3	3
Math 266, Intro/Diff Equations . . . . .	3	3
266, Cal III, Intro/Diff Equations . . . . .	4	3
Phys 251, 252, Univ Physics I, II . . . . .	5	4
Phys 251L, 252L, Univ Physics I, II Labs . . . . .	1	1
General Education* . . . . .	—	3
Totals . . . . .	14	16

<b>Third Year</b>		
Chem 364, 365, Physical Chem I, II . . . . .	4	4
Chem 380, Chemistry Junior Seminar . . . . .	1	1
Chem 431, 431L, Analytical Chem I, Lab . . . . .	4,1	4
Chem 471, Physical Chem Lab . . . . .	2	2
P&C 474, 475, Coatings I, II . . . . .	3	3
P&C 484, 485, Coatings I, II Labs . . . . .	2	2
General Education* . . . . .	3	3
Totals . . . . .	17	15

<b>Fourth Year</b>		
Bioc 460, Found/Biochem/Molec Biol . . . . .	4	4
Chem 425, 429, Inorg Chem, Lab . . . . .	4,1	4
Chem 432, 432L, Analytical Chem II, Lab . . . . .	3,1	3
Chem 491, Chemistry Senior Seminar . . . . .	2	2
P&C 473, Polymer Synthesis . . . . .	3	3
General Education* . . . . .	3	9
Totals . . . . .	15	15
Curriculum Total . . . . .	123	123

\*General education credits must be selected from approved courses and include 18 credits in humanities and social sciences; 6 of these must be in humanities and fine arts and 6 in social/behavioral sciences. Also, 3 credits must be from the global perspectives category and 3 from cultural diversity.

\*\*Offered alternate years. Students may enroll in junior or senior year.

## Recommended Curriculum Pre-Professional Chemistry Option

This option is designed for students interested in medical, dental, optometry, or veterinary professional school, but who wish an alternative career path to careers in industry, law, government, journalism, business, and others, which would benefit from a strong background in the physical sciences and mathematics. This

option also provides excellent preparation for graduate study in biochemistry, biotechnology, and molecular biology.

ACS certification may be earned by choosing Chem 425, 429, 471, and either Bioc 461 or Chem 432/432L as electives.

	Credits	
	F	S
<b>First Year</b>		
Biol 150, 150L, General Biology I, Lab . . . . .	3,1	
Biol 151, 151L, General Biology II, Lab . . . . .	3,1	
Chem 150, 151, Prin of Chem I, II . . . . .	3	3
Chem 160, 161, Prin of Chem I, II Labs . . . . .	1	1
Engl 110, 120, College Composition I, II . . . . .	1	1
Math 165, 166, Calculus I, II . . . . .	4	4
Univ 189, Skills for Academic Success . . . . .	1	—
Totals . . . . .	16	15

<b>Second Year</b>		
Chem 341, 342, Organic Chem I, II . . . . .	3	3
Chem 353, 354, Majors' Org Chem I, II Labs 1	2	
Math 228, Intro to Linear Algebra . . . . .	1	
Math 259, 266, Univ Calc III, Intro/Diff Eqns 3	3	3
Phys 251, 252, Univ Physics I, II . . . . .	5	4
Phys 251L, 252L, Univ Phys I, II Lab . . . . .	1	1
General Education* . . . . .	3	3
Wellness . . . . .	2	—
Totals . . . . .	16	16

<b>Third Year</b>		
Chem 364, 365, Physical Chem I, II . . . . .	4	4
Chem 380, Chemistry Junior Seminar . . . . .	1	
Chem 431, 431L, Analytical Chem I, Lab . 4,1	4,1	
Comm 110, Fund of Public Speaking . . . . .	3	3
Biological Science** . . . . .	3	3
General Education* . . . . .	6	3
Totals . . . . .	15	14

<b>Fourth Year</b>		
Bioc 460, Found/Biochem/Molec Biol I . . . . .	4	
Chem 491, Chemistry Senior Seminar . . . . .	2	
Biological Science** . . . . .	3	
General Education* . . . . .	3	3
Electives . . . . .	6	9
Totals . . . . .	16	14
Curriculum Total . . . . .		122

\*General education credits must be selected from approved courses and include 18 credits in humanities and social sciences; 6 of these must be in humanities and fine arts and 6 in social/behavioral sciences. Also, 3 credits must be from the global perspectives category and 3 from cultural diversity.

\*\*Must be 300-400-level biological sciences courses. Bioc 461 recommended for a fourth year elective.

## Recommended Curriculum Chemistry Education Option

This option is designed for the student interested in a disciplinary major in chemistry, but who is also considering becoming a chemistry and physics teacher. The curriculum includes physics course work beyond the usual chemistry major to enable the graduate to teach physics in most states. For teacher certification, students must apply to the School of Education to enroll in the additional requirements, which include Educ 389, 451, 481, 485, 486, and 487, taken post-baccalaureate.

ACS certification may be earned by taking Chem 471 and 432/432L as additional courses and choosing Bioc 460 instead of 260.

Scholarships starting in the sophomore year are available for students in the chemical education option.

	Credits	
	F	S
<b>First Year</b>		
Chem 150, 151, Prin of Chem I, II . . . . .	3	3
Chem 160, 161, Prin of Chem I, II Labs . . . . .	1	1
Comm 110, Fund of Public Speaking . . . . .	3	3
Engl 110, 120, College Composition I, II . . . . .	3	3
Math 165, 166, Calculus I, II . . . . .	4	4
Phys 110, Introductory Astronomy . . . . .	3	3
Univ 189, Skills for Academic Success . . . . .	1	—
Totals . . . . .	15	14

<b>Second Year</b>		
Chem 341, 342, Organic Chem I, II . . . . .	3	3
Chem 353, 354, Majors' Org Chem I, II Labs 1	2	2
Math 228, Intro to Linear Algebra . . . . .	1	
Math 259, 266, Univ Calc III, Intro/Diff Eqns 3	3	3
Phys 251, 252, Univ Physics I, II . . . . .	5	4
Phys 251L, 252L, Univ Physics I, II Labs . . . . .	1	1
General Education* . . . . .	3	3
Wellness . . . . .	2	—
Totals . . . . .	16	16

<b>Third Year</b>		
Chem 364, 365, Physical Chem I, II . . . . .	4	4
Chem 380, Chemistry Junior Seminar . . . . .	1	
Chem 431, 431L, Analytical Chem I, Lab . 4,1	4,1	
Educ 321, Intro to Teaching . . . . .	3	3
Educ 322, Educational Psychology . . . . .	3	
Educ 381, Early Experience . . . . .	1	
General Education* . . . . .	3	3
Physics Elective . . . . .	3	3
Totals . . . . .	15	15

<b>Fourth Year</b>		
Chem 260, Elements of Biochem** . . . . .	4	
Chem 425, 429, Inorganic Chem, Lab . . . . .	4,1	
Chem 491, Chemistry Senior Seminar . . . . .	2	
General Education* . . . . .	6	3
Physics Elective . . . . .	3	3
Electives*** . . . . .	5	3
Totals . . . . .	16	15
Curriculum Total . . . . .		122

\*General education credits must be selected from approved courses and include 18 credits in humanities and social sciences; 6 of these must be in humanities and fine arts and 6 in social/behavioral sciences. Also, 3 credits must be from the global perspectives category and 3 from cultural diversity.

\*\*Bioc 460, offered fall semesters, may be substituted for Bioc 260.

\*\*\*A course in earth sciences and in biology may be required for certification in some states. Geol 105/105L and Biol 150/150L are recommended electives.

## Clinical Laboratory Science

Clinical laboratory scientists use the latest biomedical instruments to perform laboratory tests to determine the presence of disease and aid in patient treatment, monitor quality, evaluate and communicate results, and research and develop new tests and methodologies.

The baccalaureate clinical laboratory science (CLS) program is located in the Department of Biological Sciences. To become a certified medical technologist or clinical laboratory scientist, a student must complete three years (92 semester credits) of university course work, a 12-month internship at an accredited school of clinical laboratory science, and pass a national certifying examination. The clinical laboratory science curriculum leading to the Bachelor of Science degree includes university general education requirements and the

entrance requirements for schools of clinical laboratory science (16 credits each of biological sciences and chemistry, including organic and biochemistry, microbiology, immunology, and a course in mathematics). Survey courses qualify as fulfillment of chemistry and biological science prerequisites only under exceptional circumstances and subject to the prior approval of the program director. Courses in management, research methods, and virology are also recommended.

North Dakota State University has affiliation agreements with various schools of clinical laboratory science that provide the professional education or internship. Criteria for admission to the year of internship are established by each school and generally include academic performance, references, prior work experience, and an interview. Admission to the internship is selective. Information about these affiliates and internship application procedures are available from the CLS adviser.

During the internship, students register for 30 credits. Descriptions of professional courses and registration procedures for the year of internship are available from the CLS academic director. Grades submitted by the clinical institution for each of the courses taken during the professional training are attached to the student's official university transcript, but are not included in calculation of grade-point average.

## Recommended Curriculum Clinical Laboratory Science

	Credits	
	F	S
<b>First Year</b>		
Biol 150, 150L, Gen Biology, Lab . . . . .	3,1	
Chem 121, 122, Gen Chemistry I, II . . . . .	3	3
Chem 121L, 122L, Gen Chem Lab I, II . . . . .	1	1
CLS 111, Intro to Clinical Lab Sci . . . . .	1	
Comm 110, Fund of Public Speaking . . . . .	3	3
CSci 114, Microcomp Pkgs . . . . .	3	3
Engl 110, 120, College Composition I, II . . . . .	3	3
Math 103, College Algebra . . . . .	3	
Univ 189, Skills for Academic Success . . . . .	1	
Wellness . . . . .	2	—
Totals . . . . .	16	15

<b>Second Year</b>		
Biol 220, Anatomy & Physiology I . . . . .	3	
Biol 220L, Anatomy & physiology I Lab . . . . .	1	
Biol 221, Anatomy & Physiology II . . . . .	3	
Biol 221L Anatomy & Physiology II Lab . . . . .	1	
Biol 435, Hematology . . . . .	2	
Chem 240, Survey/Organic Chem & Electives 3	4	
OR		
Chem 341, Organic Chemistry I . . . . .	3	
Chem 341L, Organic Chemistry I Lab . . . . .	1	
Chem 342, Organic Chemistry II . . . . .	2	
Chem 342, Organic Chemistry II Lab . . . . .	1	
Micr 350, General Microbiology . . . . .	3	
Micr 350L, General Microbiology Lab . . . . .	1	
Micr 363, Clinical Parasitology . . . . .	2	
Micr 460, Pathogenic Microbiology . . . . .	3	
Micr 460L, Pathogenic Microbiology Lab . . . . .	2	
Electives/Gen Educ Requirements . . . . .	6	6
Totals . . . . .	17-18	16-17

<b>Third Year</b>		
Bioc 460, Found of Biochemistry . . . . .	4	
Micr 470, 471, Immunology, Lab . . . . .	3,2	
Stat 330, Introductory Statistics . . . . .	3	
Zoo 315, 315L, Genetics, Lab . . . . .	3,1	
General Education . . . . .	6	6
Totals . . . . .	15	13

Fourth Year	Credits	
	F	S
Credits earned at an accredited school of medical technology . . . . .	15	15
Curriculum Total . . . . .	122	

## Computer Science

The Department of Computer Science and Operations Research at North Dakota State University provides course work leading to the following degrees: Bachelor of Arts or Bachelor of Science with a major in computer science or management information systems, Master of Science and Ph.D. in computer science. The B.S. program is accredited by the Computing Accreditation Commission of ABET, 111 Market Place, Suite 1050, Baltimore, MD 21202-4012, phone: 410-347-7700. Minors in computer science and computer science education are also offered. Advisers will provide students with personal attention in forming programs tailored to their interests and abilities. For students with no computer experience, introductory courses are offered in the standard curriculum for majors. It is possible for advanced undergraduate students to take graduate courses while completing their undergraduate programs.

Graduates in computer science might choose a job in business, agriculture, industry, teaching, research, or government. Their work might be in any of these areas: systems analysis, networking, management information processing, data base management, software systems, computer operating systems, systems for process control, special automation systems, simulation models, technical support, design and development of new computer systems, or management.

Graduates of the computer science program have recently accepted employment in major national businesses and industries. Many have chosen positions in North Dakota and adjoining states. With the wide use of computers and the Internet there is a growing need for computer specialists within North Dakota. In recent years, graduates have been offered attractive starting salaries. Every graduate who has actively sought a job has been offered full-time employment in computer science.

To be prepared to enter the computer science program, a student should have the usual college preparatory courses including at least three years of mathematics. Courses that develop the ability to think logically, to organize, and to analyze are especially important and require a background in mathematics (e.g., algebra, geometry, trigonometry). Experience with a computer is not necessary.

If a student has a background of college-level work or computer experience, the department will evaluate his/her work or experience and arrange for advanced placement.

The computer science programs, based on recommendations of the Association for Computing Machinery, consist of a core of courses required for majors and a large selection

of service courses and advanced courses. All courses in the B.S. program are taught by regular faculty. In the core, students are offered an opportunity to study concepts, applications, and implementation techniques that provide a broad and practical base both for further study and for a career in computing. Through a variety of service courses, every student in the University is provided an opportunity to develop computer literacy or competency. Through advanced undergraduate and graduate courses, students are offered an opportunity for in-depth study of such topics as artificial intelligence, programming languages, system simulation, computer communications networks, office automation, software development, combinatorial optimization, systems programming, and data base management systems. Students are encouraged to choose elective courses from related areas including business, economics, engineering, mathematics, operations research, and statistics.

After completing part of their studies, students will find many opportunities to work part-time as a research assistant to a scientist on campus, or as an intern with a local business, applying what they have learned in the classroom.

## Recommended Curriculum Computer Science

First Year	Credits	
	F	S
CSci 160, 161, Computer Science I, II . . . . .	4	4
Engl 110, 120, College Composition I, II . . . . .	3	3
Math 165, 166, Calculus I, II . . . . .	4	4
Univ 189, Skills for Academic Success . . . . .	1	
Humanities/Social Science Electives . . . . .	6	6
Totals . . . . .	18	17
<b>Second Year</b>		
Comm 110, Fund of Public Speaking . . . . .		3
CSci 222, Discrete Math . . . . .	3	
CSci 235, 236, Theory Comp Sci I, II . . . . .	3	3
CSci 373, 374, Assembl Prog, Comp Org . . . . .	3	3
Stat 367, 368, Probability Stats . . . . .	3	3
Lab Science . . . . .	3,1	3,1
Wellness . . . . .	2	
Totals . . . . .	18	16
<b>Third Year</b>		
CSci 366, 372, File/Data Sys, Comp Lang . . . . .	3	3
CSci 467, Algorith Analysis . . . . .		3
Computer Science Elective . . . . .	3	
Humanities/Social Science Elective . . . . .	3	
Science Electives . . . . .	3	3
Free Electives . . . . .	3	6
Totals . . . . .	15	15
<b>Fourth Year</b>		
CSci 474, Operating Systems . . . . .	3	
CSci 475, Operating Systems II OR CSci 468, Database Management . . . . .		3
CSci 489, Social Implications of Computers . . . . .	3	
Computer Science Electives . . . . .	3	3
Free Electives . . . . .	9	6
Totals . . . . .	15	15
Curriculum Total . . . . .	129	

Choose electives that satisfy the general requirements for the B.S. or B.A. degree, including the general education requirements (q.v.). There must be a total of 18 credits in computer science courses numbered 300 or higher approved for the major by your adviser. See the document "Requirements for a Bachelor's

degree in Computer Science at NDSU" for distribution requirements that must be satisfied in choosing electives. This document is available from the department office, 258 IACC, or on the Web ([www.cs.ndsu.nodak.edu](http://www.cs.ndsu.nodak.edu)).

## Geosciences

Geology and geography are the sciences of the Earth, its environments, peoples, and cultures.

### Geography Minor

Geography is the study of places, spaces, and spatial relationships on the Earth. There are two major thrusts in the geography program: (a) gaining an understanding of the geographic perspective, and (b) acquiring skills in the use of spatial analysis tools (such as geographic information systems, computer mapping, and other computer applications). Using the four broad themes in geography (earth-science, culture-environment, locational analysis, and area analysis), courses fit into a wide variety of programs and aid in preparation for both academic and non-academic professional careers.

The geography program does not offer a major. However, a minor is offered, and may be taken in conjunction with a variety of majors such as social science and secondary education. The minor consists of 18 credits in geography selected in consultation with the geography adviser. Students preparing for teaching geography in the secondary schools should follow the School of Education curriculum.

### Geology Major

The geology major is an interdisciplinary curriculum in which knowledge from chemistry, physics, mathematics, soil science, and engineering is applied to obtain a better understanding of the Earth's environment. This is an excellent major to follow for a career in the environmental sciences. Completion of an undergraduate geology major leads to a variety of career opportunities in industry, government, teaching, or to continuing studies in graduate research. Typical professional careers are involved with the development, management, or regulation of the Earth's resources. Curriculum requirements include a departmental core of 46 credits, including year-long sequences in calculus, chemistry, and physics, as well as skills courses in technical writing and computer science.

A typical first year for all geology majors includes physical geology, the Earth through time, and year-long sequences in English, mathematics, and chemistry.

A minor in geology consists of at least 18 credits of geology, geography, and soil science courses selected in consultation with a minor adviser.

## Optional Curricula

**Pre-Professional Option:** Curriculum emphasis is on preparation for graduate study leading to a profession in geology or related earth sciences.

**Geochemistry Option:** Curriculum emphasis is on the chemistry of earth materials.

**Environmental Option:** Curriculum emphasis is on a career in the environmental sciences.

**Teaching Option:** Curriculum emphasis is on the teaching of earth science. Students preparing for teaching earth science in the secondary schools must follow the School of Education curriculum.

## Geology Core Requirements<sup>1</sup>

### Geosciences and Soil Science Courses<sup>2</sup>

	Credits
Geog 161, World Regional Geography . . . . .	3
Geol 105, 105L, Phys Geology, Lab . . . . .	4
Geol 106, 106L, Earth Through Time, Lab . . . . .	4
Geol 350, Invertebrate Paleontology . . . . .	3
Geol 457, Structural Geology OR . . . . .	4
Geol 440, Quaternary Biology	
Geol 410, Sedimentology/Stratigraphy . . . . .	4
Geol 412, Geomorphology . . . . .	3
Geol 420, 421, Mineralogy, Lab . . . . .	6
Geol 422, 423, Petrology/Petrography . . . . .	6
Geol 450, Field Geology <sup>3</sup> . . . . .	3
Geol 491, Seminar . . . . .	2
Soil 444, Soil Genesis and Survey . . . . .	4
Total . . . . .	46

### Chemistry Courses

Chem 121, 121L, General Chem I, Lab OR	
Chem 150, 160, Prin Chem, Lab . . . . .	4
Chem 122, 122L, General II, Chem, Lab <sup>4</sup> OR	
Chem 151, 161, Prin Chem, Lab . . . . .	4
Total . . . . .	8

### Mathematics Courses

Math 103, 105, College Algebra, Trig <sup>5</sup> . . . . .	6
Math 146, 147, Applied Calculus I, II <sup>6</sup> OR	
Math 165, 166, Calculus I, II . . . . .	8
Total . . . . .	8-14

### Physics Courses

Phys 211, 211L, College Physics I, Lab OR	
Phys 251, 251L, Univ Physics I, Lab <sup>7</sup> . . . . .	4-6
Phys 212, 212L, College Physics II, Lab OR	
Phys 252, 252L, Univ Physics II, Lab . . . . .	4-5
Total . . . . .	8-11

### Skills Courses

CSci 122 or 126, BASIC or FORTRAN . . . . .	3
Engl 320, Practical Writing . . . . .	3
Total . . . . .	6

Total Core Requirements . . . . . 77-86

<sup>1</sup>The departmental requirements for graduation are those in existence at the beginning of the junior year of the major. In addition, all University requirements must be met.

<sup>2</sup>The following courses are strongly recommended: Soil Science 210, 217, Geology 300, 301, 302, 303, 304, 413, 426, 427, 428, and Geography 455.

<sup>3</sup>A fee will be charged to offset travel costs associated with Geology 301, 302, 303, 304, 450, and 496.

<sup>4</sup>This sequence is recommended only for those with high school chemistry, a minimum math ACT score in the 60th percentile, and the intention of taking more chemistry.

<sup>5</sup>Some may have had adequate mathematics preparation in high school. For those who have not, Math 103 (College Algebra) and Math 105 (Trigonometry) are recommended.

<sup>6</sup>Majors planning to enter graduate school should note that Applied Calculus (Math 146 and 147) is not considered adequate preparation in calculus by some programs.

<sup>7</sup>Calculus-based physics is recommended for all students planning to pursue advanced degrees and is required for the geochemistry option.

NOTE: Majors planning on graduate studies should be aware that a summer field camp course may be required for graduate admission. This course is recommended to be taken during the summer following the junior or senior year. Information on field camp courses and a small departmental scholarship to support these studies may be obtained from an adviser.

## Mathematics

Mathematics is the language of science and technology. Its explosive development in the 20th century and its history as the oldest and most highly developed discipline make it one of the most exciting and rewarding areas of study.

The use of mathematics and the need for mathematical competence has increased tremendously. Mathematical training is in high demand in such fields as actuarial science, business, economics and commerce, engineering, and statistics, as well as the basic sciences. These disciplines, in turn, feed back new directions to the mathematical community. Trends indicate that students should plan their programs to reflect the increased emphasis on interdisciplinary competency.

Students are able to study theoretical and applied mathematics to prepare for careers or for further schooling while studying with faculty members who have a wide range of interests and expertise. Students may earn academic credit by applying what they have learned in the classroom as they gain on-the-job experience through the Cooperative Education Program. Opportunities also exist for students to work as paper graders and assistants to professors.

The department offers a broad and balanced curriculum of courses. A student may major or minor in mathematics or mathematics education. Students interested in mathematics education should consult with their major adviser and the School of Education for professional education requirements. Special double majors are available with computer science, physics, and statistics. These double majors take advantage of the close relationship between mathematics and other disciplines, and allow students pursuing a major in one of these fields to expand their mathematical background. While the choice of major need not be made during the freshman year, an early decision allows more flexibility in tailoring programs to individual interests. The department also has a graduate program offering an M.S. and a Ph.D. in mathematics.

## Pre-Actuarial Science Option

Actuarial science is the study of the evaluation and measurement of risk. The actuary science

option is a pre-professional program designed to provide the background needed to enter the field. Entrance into the profession is regulated under a system of examinations run by actuarial professional societies. The curriculum of the option is designed to prepare the student to pass several of these examinations. The nature of the actuarial profession requires its practitioners to have a broad knowledge of finance, law, mathematics, management, and statistics. This option leads to a double major in mathematics and statistics with either a minor in economics or additional courses in business. Students selecting this option are requested to visit with the actuarial adviser in the Department of Mathematics early and often to confirm their progress and to inform themselves of changes in the examination curriculum.

## Recommended Curriculum Mathematics

First Year	Credits	
	F	S
Comm 110, Fund of Public Speaking . . . . .		3
CSci 160, Computer Sci I . . . . .	3	3
Engl 110, 120, College Composition I, II . . . . .	3	3
Math 165, 166, Calculus I, II . . . . .	4	4
Univ 189, Skills for Academic Success . . . . .	1	
General Electives <sup>1</sup> . . . . .	3	6
Totals . . . . .	15	16

### Second Year

Math 265, Calculus III . . . . .	4	
Math 266, Differential Equations . . . . .		3
Math 270, Abstract Mathematics <sup>2</sup> . . . . .	3	
Math 329, Linear Algebra . . . . .	3	
Phys 251-L, 252-L, Univ Physics I, II, <sup>3</sup> . . . . .	6	5
Wellness . . . . .		2
General Electives <sup>1</sup> . . . . .	3	3
Totals . . . . .	16	16

### Third Year

Math 420, 421, Abstract Algebra I, II . . . . .	3	3
Math or Related Electives <sup>4</sup> . . . . .	9	9
General Electives <sup>1</sup> . . . . .	3	3
Totals . . . . .	15	15

### Fourth Year

Math 450, 451, Real Analysis I, II . . . . .	3	3
Math 491, Senior Seminar . . . . .	1	
Math or Related Electives <sup>4</sup> . . . . .	9	9
General Electives <sup>1</sup> . . . . .	3	3
Totals . . . . .	16	15
Curriculum Total . . . . .		124

<sup>1</sup>In choosing electives, a student must satisfy the general education requirements for a B.A. or B.S. degree.

<sup>2</sup>Students need to keep in mind that Math 270, (Introduction to Abstract Mathematics), a prerequisite for all upper level mathematics courses, is offered only once a year in the fall semester.

<sup>3</sup>The Physics 251-L/252-L laboratory sequence is one of four approved laboratory sequences (including Chemistry and Computer Science) for this major. For more details on other approved laboratory sequences, students should contact the Department of Mathematics.

<sup>4</sup>Mathematics electives may be chosen to emphasize pure, applied, computational, or actuarial interests. At least one approved upper-division one-year sequence must be elected and at least one course must be chosen from each of lists A and B. Special double-major options with computer science, statistics, and physics are available.

A: Math 340, 374, 430, 436, 440, 446, 452, 472.

B: Math 480, 481, 482, 483, 488, 489, Stat 467, CSci 453.

## Recommended Curriculum Mathematics and Computer Science

	Credits	
	F	S
<b>First Year</b>		
Comm 110, Fund of Public Speaking . . . . .	3	
CSci 160, 161, Computer Science I, II . . . . .	4	
Engl 110, 120, College Composition I, II . . . . .	3	
Math 165, 166, Calculus I, II . . . . .	4	4
Univ 189, Skills for Academic Success . . . . .	1	
General Electives <sup>1</sup> . . . . .	<u>3</u>	<u>3</u>
Totals . . . . .	15	17
<b>Second Year</b>		
CSci 235, 236, Theoretical Comp Sci I, II . . . . .	3	3
Math 265, Calculus III . . . . .	4	
Math 266, Differential Equations . . . . .	3	
Math 270, Abstract Mathematics <sup>2</sup> . . . . .	3	
Math 329, Linear Algebra . . . . .	3	
Phys 251-L, 252-L, Univ Physics I, II <sup>3</sup> . . . . .	6	5
Wellness . . . . .	<u>2</u>	<u>2</u>
Totals . . . . .	16	16

### Third Year

CSci 373, Assembly Programming . . . . .	3	
CSci 374, Computer Architecture . . . . .	3	
CSci 372, Comparative Languages . . . . .	3	
CSci 467, Algorithm Analysis . . . . .	3	
Math 420, 421, Abstract Algebra I, II . . . . .	3	3
General Electives <sup>1</sup> . . . . .	<u>6</u>	<u>6</u>
Totals . . . . .	15	15

### Fourth Year

CSci 366, Database Systems . . . . .	3	
CSci 458, Microcomputer Graphics . . . . .	3	
CSci 474, Operating Systems . . . . .	3	
CSci 489, Capstone Course . . . . .	3	
Math 430, Graph Theory . . . . .	3	
Math 436, Combinatorics . . . . .	3	
Math 491, Senior Seminar . . . . .	1	
Stat 367, Probability . . . . .	3	
Stat 368, Statistics . . . . .	3	
General Electives <sup>1</sup> . . . . .	<u>3</u>	<u>3</u>
Totals . . . . .	16	15
Curriculum Total . . . . .		125

<sup>1</sup> In choosing electives, a student must satisfy the general education requirements for a B.A. or B.S. degree.

<sup>2</sup> Students double majoring in Mathematics and Computer Science can use CSci 222 to satisfy the Math 270 prerequisite for all upper level mathematics courses. Math 270 is offered only once a year in the fall semester.

<sup>3</sup> The Physics 251-L/252-L laboratory sequence is one of three approved laboratory sequences (including Chemistry) for this double major. For more details on other approved laboratory sequences, students should contact the Departments of Mathematics or Computer Science.

## Recommended Curriculum Mathematics and Physics

	Credits	
	F	S
<b>First Year</b>		
Comm 110, Fund of Public Speaking . . . . .	3	
CSci 160, Computer Science I . . . . .	4	
Engl 110, 120, College Composition I, II . . . . .	3	
Math 165, 166, Calculus I, II . . . . .	4	4
Phys 180, Contemporary Concepts . . . . .	1	
Univ 189, Skills for Academic Success . . . . .	1	
General Electives <sup>1</sup> . . . . .	<u>3</u>	<u>3</u>
Totals . . . . .	16	13

### Second Year

Math 265, Calculus III . . . . .	4	
Math 266, Differential Equations . . . . .	3	
Math 270, Abstract Mathematics <sup>2</sup> . . . . .	3	
Math 329, Linear Algebra . . . . .	3	
Phys 251-L, 252-L, Univ Physics I, II . . . . .	6	5
Wellness . . . . .	<u>2</u>	<u>2</u>
General Electives <sup>1</sup> . . . . .	<u>3</u>	<u>3</u>
Totals . . . . .	16	16

	Credits	
	F	S
<b>Third Year</b>		
Math 420, 421, Abstract Algebra I, II . . . . .	3	3
Phys 350, Modern Physics . . . . .	3	
Phys 351, Mechanics I . . . . .	3	
Phys 361, Electromagnetic Theory . . . . .	4	
Phys 401, Properties of Solids . . . . .	3	
Phys 402, Optical Electronics . . . . .	3	
General Electives <sup>1</sup> . . . . .	<u>3</u>	<u>6</u>
Totals . . . . .	16	15

### Fourth Year

Math 450, 451, Real Analysis I, II . . . . .	3	3
Math 488, 489, Numerical Analysis I, II . . . . .	3	3
Math 491, Senior Seminar . . . . .	1	
Phys 462, Thermodynamics . . . . .	3	
Phys 471, Advanced Laboratory . . . . .	2	
Phys 485, 486, Modern Physics I, II . . . . .	3	3
Phys 489, Capstone Course . . . . .	1	
General Electives <sup>1</sup> . . . . .	<u>3</u>	<u>3</u>
Totals . . . . .	16	15
Curriculum Total . . . . .		123

<sup>1</sup> In choosing electives, a student must satisfy the general education requirements for a B.A. or B.S. degree.

<sup>2</sup> Math 270 is offered only once a year in the fall semester.

## Recommended Curriculum Mathematics and Statistics

	Credits	
	F	S
<b>First Year</b>		
Comm 110, Fund of Public Speaking . . . . .	3	
CSci 160, Computer Science I . . . . .	4	
Engl 110, 120, College Composition I, II . . . . .	3	
Math 165, 166, Calculus I, II . . . . .	4	4
Univ 189, Skills for Academic Success . . . . .	1	
General Electives <sup>1</sup> . . . . .	<u>3</u>	<u>6</u>
Totals . . . . .	15	16

### Second Year

Math 265, Calculus III . . . . .	4	
Math 266, Differential Equations . . . . .	3	
Math 270, Abstract Mathematics <sup>2</sup> . . . . .	3	
Math 329, Linear Algebra . . . . .	3	
Phys 251-L, 252-L, Univ Physics I, II <sup>3</sup> . . . . .	6	5
Stat 330, Introductory Statistics . . . . .	3	
Wellness . . . . .	<u>2</u>	<u>2</u>
General Electives <sup>1</sup> . . . . .	<u>3</u>	<u>3</u>
Totals . . . . .	16	16

### Third Year

Math 420, Abstract Algebra I . . . . .	3	
Stat 461, Regression Models . . . . .	3	
Stat 462, Experimental Design . . . . .	3	
Statistics Electives <sup>4</sup> . . . . .	3	
General Electives <sup>1</sup> . . . . .	<u>6</u>	<u>9</u>
Totals . . . . .	15	15

### Fourth Year

Math 450, 451, Real Analysis I, II . . . . .	3	3
Math 491, Senior Seminar . . . . .	1	
Stat 467, 468, Probability & Math Stats I, II . . . . .	3	3
Stat 491, Capstone Seminar . . . . .	1	
Statistics Electives <sup>4</sup> . . . . .	3	3
General Electives <sup>1</sup> . . . . .	<u>6</u>	<u>6</u>
Totals . . . . .	16	16
Curriculum Total . . . . .		123

<sup>1</sup> In choosing electives, a student must satisfy the general education requirements for a B.A. or B.S. degree.

<sup>2</sup> Math 270 is offered only once a year in the fall semester.

<sup>3</sup> The Physics 251-L/252-L laboratory sequence is one of four approved laboratory sequences (including Chemistry and Computer Science) for this double major. For more details on other approved laboratory sequences, students should contact the Departments of Mathematics or Statistics.

<sup>4</sup> Statistics electives include any 400 level 3 credit Statistics courses other than those listed above.

## Recommended Curriculum Mathematics and Statistics (Pre-Actuarial Science Option)

	Credits	
	F	S
<b>First Year</b>		
Comm 110, Fund of Public Speaking . . . . .	3	
CSci 160, 161, Computer Science I, II . . . . .	4	
Engl 110, 120, College Composition I, II . . . . .	3	
Math 165, 166, Calculus I, II . . . . .	4	4
Stat 330, Intro to Statistics . . . . .	3	
Univ 189, Skills for Academic Success . . . . .	1	
Totals . . . . .	15	14

### Second Year

Acct 200,201, Elements of Accounting I, II . . . . .	3	3
Econ 201, Microeconomics . . . . .	3	
Econ 202, Macroeconomics . . . . .	3	
Math 265, Calculus III . . . . .	4	
Math 266, Differential Equations . . . . .	3	
Math 270, Abstract Mathematics <sup>2</sup> . . . . .	3	
Math 329, Linear Algebra . . . . .	3	
Stat 461, Applied Regression Models . . . . .	3	
Stat 462, Intro. Experimental Design . . . . .	<u>3</u>	<u>3</u>
Totals . . . . .	16	15

### Third Year

CSci 453, Linear Prog & Network Flows . . . . .	3	
CSci 454, Operations Research . . . . .	3	
Math 488, Numerical Analysis I . . . . .	3	
Phys 251-L, 252-L, Univ Physics I, II <sup>3</sup> . . . . .	6	5
Stat 467, 468, Probability and . . . . .	3	3
Mathematical Statistics I, II . . . . .		
General Electives <sup>1</sup> . . . . .	3	3
400-level Statistics Elective <sup>4</sup> . . . . .	<u>3</u>	<u>3</u>
Totals . . . . .	18	17

### Fourth Year

Math 376, Actuarial Exam Study/Capstone . . . . .	1	
Math 450, Real Analysis I . . . . .	3	3
Math 451, Real Analysis II or Math 489, . . . . .		
Numerical Analysis II . . . . .	3	
Stat 476, Actuarial Exam Study/Capstone . . . . .	1	
Business and Economics Electives <sup>5</sup> . . . . .	6	3
400-level Statistics Electives <sup>4</sup> . . . . .	3	3
General Electives <sup>1</sup> . . . . .	3	3
Wellness . . . . .	<u>2</u>	<u>2</u>
Totals . . . . .	15	16
Curriculum Total . . . . .		126

<sup>1</sup> In choosing electives, a student must satisfy the general education requirements for a B.A. or B.S. degree.

<sup>2</sup> Math 270 is offered only once a year in the fall semester.

<sup>3</sup> The Physics 251-L/252-L laboratory sequence is one of five approved laboratory sequences (including Chemistry, Computer Science, and Biology) for this major. For more details on other approved laboratory sequences, students should contact the Departments of Mathematics or Statistics.

<sup>4</sup> Statistics electives include any 400 level 3 credit Statistics courses other than those listed above. Business and Economics electives include Busn 340, 441, 442, 444, Econ 341, 343, or any other 400 level Economics

## Natural Resources Management

This multidisciplinary program is available through the College of Science and Mathematics Departments of Biological Sciences and Geosciences. For the program description, refer to the appropriate listing in the College of Agriculture section.

## Physics

Students who complete a major in physics are prepared for industrial and governmental research and development; for graduate study in physics, astronomy, engineering, medicine, oceanography, materials science; and for environmental science. In-depth preparation is also provided for teaching in secondary schools.

The physics program requirements include a minimum of 40 credits in physics; 22 credits in mathematics; 30 in the languages, social sciences, and the humanities; and six credits of chemistry. Students are required to take Physics 251, 251L, 252, 252L, 350, 351, 361, 401, 402, 462, 471, and 485, plus at least two courses selected from Physics 352, 463, 486 or MSUM Phys 340, 360, 380 or 410.

A grade-point average of 2.00 or higher is required in all physics courses. Courses do not count toward the major if the grade is less than a C.

### Recommended Curriculum Physics

	Credits	
	F	S
<b>First Year</b>		
Chem 150, Prin of Chemistry I . . . . .	3	
Chem 160, Prin of Chemistry I Lab . . . . .	1	
Chem 151, Prin of Chemistry II . . . . .		3
Chem 161, Prin of Chemistry II Lab . . . . .		1
CSci 160, Computer Science I . . . . .	4	
Engl 110, College Composition I . . . . .	3	
Engl 120, College Composition II . . . . .		3
Math 165, Calculus I . . . . .	4	
Math 166, Calculus II . . . . .	4	
Phys 180, Contemporary Concepts . . . . .	1	
Phys 251, University Physics I . . . . .	5	
Phys 251L, University Physics I Lab . . . . .	1	
Univ 189, Skills for Academic Success . . . . .	1	
<b>Totals</b> . . . . .	<b>17</b>	<b>17</b>
<b>Second Year</b>		
Comm 110, Fund of Public Speaking . . . . .		3
Math 265, Calculus III . . . . .	4	
Math 266, Intro to Differential Equations . . . . .	3	
Phys 252, University Physics II . . . . .	4	
Phys 252L, University Physics II Lab . . . . .	1	
Phys 350, Intro to Modern Physics . . . . .	3	
Computer Language . . . . .	3	3
Wellness . . . . .	2	
Electives . . . . .	3	3
<b>Totals</b> . . . . .	<b>17</b>	<b>15</b>
<b>Third Year</b>		
Math 488, Numerical Analysis I . . . . .	3	
Math 489, Numerical Analysis II . . . . .		3
Phys 351, Mechanics I . . . . .	3	
Phys 352, Mechanics II . . . . .		3
Phys 361, Electromagnetic Theory . . . . .	4	
Phys 402, Engr Physics II: Optical Electronics	3	
Humanities & Soc & Behavioral Sci Elect. . . . .	6	7
<b>Totals</b> . . . . .	<b>16</b>	<b>16</b>
<b>Fourth Year</b>		
Math 480, Differential Equations . . . . .	3	
Math 483, Partial Differential Equations . . . . .	3	
Phys 401, Engineering Physics I: Fundamental Properties of Solids . . . . .	3	3
Phys 462, Heat and Thermodynamics . . . . .	3	
Phys 471, Advanced Laboratory . . . . .		2
Phys 485, Modern Physics I . . . . .	3	
Phys 486, Modern Physics II . . . . .	3	
Phys 489, Physics Projects . . . . .	3	
Electives/General Education . . . . .	6	3
<b>Totals</b> . . . . .	<b>15</b>	<b>17</b>
<b>Curriculum Total</b> . . . . .	<b>130</b>	

## Engineering Physics Option

Engineering physicists work in a wide variety of fields: optics, electronics, materials science, reactor engineering, chemical physics, biophysics, medical physics, bio-engineering, radiologic science, and even meteorology. The curriculum includes a balanced education in engineering, mathematics, and physics. Research experience is emphasized through student participation in faculty-administered research and a student-initiated research project in the senior year. Research projects may be pursued in engineering, physics, mathematics, or computer science. In addition to a core curriculum of courses in engineering, mathematics, and physics, all students must include 15 semester hours of engineering electives in their studies and a senior design course. These may be in electrical or mechanical engineering, materials science, or another engineering discipline, depending on career goals.

### Recommended Curriculum Engineering Physics

	Credits	
	F	S
<b>First Year</b>		
Chem 150, Prin of Chemistry I . . . . .	3	
Chem 160, Prin of Chemistry I Lab . . . . .	1	
Chem 151, Prin of Chemistry II . . . . .		3
Chem 161, Prin of Chemistry II Lab . . . . .		1
CSci 160, Computer Science I . . . . .	4	
Engl 110, College Composition I . . . . .	3	
Engl 120, College Composition II . . . . .		3
Math 165, Calculus I . . . . .	4	
Math 166, Calculus II . . . . .	4	
Phys 180, Contemporary Concepts . . . . .	1	
Phys 251, University Physics I . . . . .	5	
Phys 251L, University Physics I Lab . . . . .	1	
Univ 189, Skills for Academic Success . . . . .	1	
<b>Totals</b> . . . . .	<b>17</b>	<b>17</b>
<b>Second Year</b>		
Comm 110, Fundamentals of Public Speaking . . . . .		3
Math 265, Calculus III . . . . .	4	
Math 266, Intro to Differential Equations . . . . .	3	
Phys 252, University Physics II . . . . .	4	
Phys 252L, University Physics II Lab . . . . .	1	
Phys 350, Intro to Modern Physics . . . . .	3	
Computer Language . . . . .	3	3
Wellness . . . . .	2	
Electives . . . . .	3	3
<b>Totals</b> . . . . .	<b>17</b>	<b>15</b>
<b>Third Year</b>		
Math 488, Numerical Analysis I . . . . .	3	
Math 489, Numerical Analysis II . . . . .		3
Phys 351, Mechanics I . . . . .	3	
ECE 301, Electrical Engineering I . . . . .		3
ECE 351, Applied Electromagnets . . . . .	3	
Phys 411, Optics . . . . .	3	
Humanities/Social/Behavioral Sci Electives . . . . .	6	7
<b>Totals</b> . . . . .	<b>15</b>	<b>16</b>
<b>Fourth Year</b>		
ECE 457, Optical Signal Transmission . . . . .	3	
IME 440, Engineering Economy . . . . .		2
Phys 401, Fundamental Properties of Solids . . . . .	3	3
Phys 462, Heat and Thermodynamics . . . . .	3	
Phys 471, Advanced Laboratory . . . . .		2
Phys 485, Modern Physics I . . . . .	3	
Phys 486, Modern Physics II . . . . .	3	
Phys 489, Physics Projects . . . . .	2	2
Electives/General Education . . . . .	6	3
<b>Totals</b> . . . . .	<b>17</b>	<b>15</b>
<b>Curriculum Total</b> . . . . .	<b>129</b>	

## Computational Physics Option

Computational physics is a rapidly growing sub-discipline of physics, concerned with computational aspects of physical problems, including computer simulation and numerical techniques for the solution of mathematical equations arising in all areas of physics. As computing power grows, computer modeling is becoming an increasingly important research and development tool. Correspondingly, there is a rising demand for scientists with multidisciplinary training that combines fundamental knowledge of physics with practical skills in computation. The computational physics option recognizes the unique qualifications of students who complete computation-related courses in addition to fulfilling the requirements for the physics majors. Graduates of the option will be qualified to work in industry or to pursue graduate studies in physics, computer science, engineering, or other technical fields.

### Optical Science and Engineering Option

This program is for students who wish to prepare for a career as a physicist in photonics or for graduate school in optics or photonics. Today, light is at the core of technologies ranging from computing and communication to surgical techniques. There are more than 5,000 optics-related companies in the United States alone, but even more important, photonics provides the technical foundation for many more. Optical science and engineering has exploded to encompass nearly all fields of science and technology with a consequent shortage of individuals trained in the field. This option provides the necessary interdisciplinary background in physics and electrical engineering through a structured sequence of courses. This is the only program of this type in the region.

### Mathematics and Physics Double Major

This program is for students who want additional theoretical background and preparation for graduate or a technical career in the sciences. See sample curriculum under Mathematics.

## Polymers and Coatings

The Department of Polymers and Coatings is internationally known for the excellence of its educational and research programs. Close ties with industry and government agencies are maintained to assure that teaching and research programs remain in step with the rapidly changing science and technology of the area.

Knowledge of polymers is a desirable foundation for a career as a professional chemist in industry. More than 80 percent of the industrial chemists work with polymers, and many physicists and engineers also work on polymer-related projects.

Within the broad area of polymers, the department puts special emphasis on coatings. Coatings are encountered so often in everyday life they may be taken for granted. Paint on walls, coatings on the outside of automobiles, aircrafts or space shuttles, liners for the interior of beverage cans, coatings to protect bridges from corrosion, coatings on magnetic tapes and computer chips, and body implants are only a few selected examples. Closely related fields are adhesives, printing inks, plastics, cosmetics, food, and biotechnology. Since only five other universities in the U.S. offer programs in coatings, employment opportunities far exceed the number of graduates.

To encourage students to study in the field, companies and organizations fund undergraduate scholarships of up to \$2,500 a year. Entering freshmen and transfer students apply for these scholarships through the Office of Admission. Undergraduates already enrolled at NDSU apply to the department chair.

The Department of Polymers and Coatings does not offer an undergraduate major. Undergraduates interested in polymers and coatings are encouraged to major in chemistry or mechanical engineering (ME). Refer to the polymers and coatings option in chemistry or the P&C option in mechanical engineering. Individual programs for majors in other disciplines have been worked out.

The polymers and coatings option provides excellent preparation for professional employment at the B.S. level and for graduate school. Students are strongly advised to plan their programs so that the entire coatings course (P&C 474, 475) and laboratory sequence (P&C 484, 485 for chemistry majors) (P&C 484 for ME majors) can be taken during the same academic year. Chemistry majors with the polymers and coatings option are also required to take polymer synthesis (P&C 473) prior to graduation.

Polymers and Coatings offers a major at the graduate level for programs leading to the M.S. and Ph.D. degrees in Polymers and Coatings Science and M.S. and Ph.D. degrees in Chemistry.

## Psychology

Psychology is concerned with behavior, both of human beings and other living organisms. In studying behavior, psychologists rely heavily upon the methods of science. Some areas of psychology are most closely related to the natural and biological sciences while other areas within psychology are more closely related to the social sciences, especially sociology, anthropology, and communication. Both an undergraduate major and an undergraduate minor in psychology are available. Psychology majors may select the degree program that best suits their needs and interests from the B.A. and B.S. tracks outlined in this section.

## Psychology Major

All majors must complete 30 credits in psychology as listed in the outline for the B.S. degree. Additional courses in psychology may be selected, in consultation with the adviser, from any of those listed under the department's offerings. Courses in the major field may not be taken on a pass/fail basis (except Psyc 494 and 496, which may be graded on a satisfactory/unsatisfactory basis by the instructor).

## Career Orientation Overlays

An undergraduate education in psychology leads to a number of career choices following graduation. To assist students in preparing for post-graduate work and careers in psychology or related fields, the department has prepared several Career Orientation OverLays (COOLs). COOLs establish curriculum guidelines and suggestions for students who may be interested in a variety of careers, including medicine and neurosciences, business and industry, graduate school in psychology, or mental health and applied psychology. COOLs, when used in conjunction with the counsel of an adviser, are intended to help a student select the best courses within and outside of psychology (e.g., biology for medicine or business for industrial psychology) to suit particular interests and career goals.

## Advising Centers

Information for students is available on the department Web page ([www.ndsu.nodak.edu/ndsu/advising/](http://www.ndsu.nodak.edu/ndsu/advising/)) and in the department at Minard Hall. Topics include requirements for majors and minors, COOLs, graduate school and career information.

## B.S. with a Major in Psychology

A total of 122 credits is required for a major in psychology leading toward a B.S. degree. The following requirements must be fulfilled:

First-Year Experience: 1 credit (Univ 189, Skills for Academic Success)

A. Communication: 9 credits (must include Engl 110, 120, and Comm 110)

B. Quantitative Reasoning: 6 credits (must include Math 103 or higher and Stat 330 or 368).

C. Science and Technology: 10 credits from courses in natural sciences, physical sciences, or technology. A minimum of 4 credits must be in natural and physical sciences. Courses in this category must include Computer Science 114 and a 1-credit lab course.

D. Social and Behavioral Sciences & Humanities and Fine Arts: 18 credits which must include:

1. Social and Behavioral Science (not psychology): 6 credits
2. Humanities and Fine Arts: 6 credits

E. Wellness: 2 credits

F. Supporting Track: Each student, in consultation with his or her adviser, must select one of the following tracks. Requirements are in addition to those specified in A-E.

1. Natural science track: 14 additional credits in mathematics, computer science, statistics, and/or science.
2. Social science track: 14 additional credits in social science (other than psychology)
3. A minor in an approved area of study.

G. Psychology: 30 credits as follows:

<i>Required:</i>	<b>Credits</b>
Psyc 111, Introduction to Psychology . . . . .	3
Psyc 350, Research Methods I . . . . .	3
Psyc 351, Research Methods II . . . . .	3
<b>Area 1: At least one from the following:</b>	
Psyc 453, Organizational Psychology . . . . .	3
Psyc 468, Personality . . . . .	3
Psyc 470, Experimental Social Psyc. . . . .	3
<b>Area 2: At least one from the following:</b>	
Psyc 460, Sensation & Perception . . . . .	3
Psyc 465, Psychobiology . . . . .	3
Psyc 486, Neuropsychology . . . . .	3
<b>Area 3: At least one from the following:</b>	
Psyc 461, Memory & Knowledge . . . . .	3
Psyc 463, Experimental Developmental Psyc . . . . .	3
Psyc 464, Attention and Thinking . . . . .	3
<b>Area 4: Capstone Experience</b>	
Psyc 480, History and Systems . . . . .	3
Psyc 489, Honors Thesis . . . . .	2-6
<b>Electives:</b>	
Psyc, 400-level courses* . . . . .	6
Psyc, free choice on course level . . . . .	6

\*Three credits may be from any combination of Psyc 489, 494, or 496, but may not be taken pass/fail.

H. Cultural Diversity: 3 credits (may also be counted in Category D)

I. Global Perspectives: 3 credits (may also be counted in Categories C and D)

J. Electives: To total 122 credits

K. At least 37 credits must be obtained in 300- 400-level courses.

## B.A. with Major in Psychology

Requirements for the Bachelor of Arts degree are the same as the Bachelor of Science degree except as follows:

Under category D, Social and Behavioral Sciences and Humanities and Fine Arts, 24 credits (not 18) are required. Credits from the second year of foreign language cannot be used to fill the Humanities and Fine Arts requirement.

The supporting track (F) is replaced by a foreign language requirement: completion of second-year college level in a single language, or equivalent as defined by the Department of Modern Languages.

## Psychology Minor

A minor in psychology offers students electing majors in other disciplines the opportunity to complement their studies with a coherent set of psychology courses. Different courses are compatible with interests and career goals of

students in major areas such as business, child development and family science, and computer science. Students planning a psychology minor should consult with a faculty adviser from the Department of Psychology.

Students selecting a minor in psychology must complete 18 credits in psychology (excluding Psyc 494 or 496). These 18 semester credits must include Psyc 111 (Introduction to Psychology) and at least one 3 credit 300- or 400-level course, and may not be taken pass/fail.

### Recommended Curriculum B.S. with Psychology Major

	Credits	
	F	S
<b>First Year</b>		
Anth 111, Intro Anthropology . . . . .	3	
Biol 126, Human Biology . . . . .	3	
Chem 117, 117L, Chem Concepts & Appli, Lab. . . . .	3,1	
CSci 116, Busn Use of Computers OR CSci 114, Microcomputer Pkgs . . . . .	3-4	
Engl 110, 120, College Composition I, II . . . . .	3	3
Math 103, College Algebra OR Math 104, Finite Math . . . . .	3	
Psyc 111, Intro Psyc . . . . .	3	
Soc 110, Intro Sociology . . . . .		3
Univ 189, Skills for Academic Success . . . . .	1	
Psychology 200-level Elective . . . . .		3
<b>Totals</b> . . . . .	16	16-17
<b>Second Year</b>		
Comm 110, Fund of Public Speaking . . . . .	3	
Psyc 350, Research Meth I . . . . .		3
Stat 330, Statistics . . . . .		3
Humanities Elective . . . . .	3	
Psychology 200-level Electives . . . . .	6	3
Social Science Electives . . . . .	3	6
Wellness . . . . .		2
<b>Totals</b> . . . . .	15	17
<b>Third Year</b>		
Psyc 351, Research Meth II . . . . .	3	
Psychology Required Course . . . . .		3
Psychology 200-300-Level Elect . . . . .	3	
Psychology 400-Level Elective . . . . .		3
Supporting track or minor . . . . .	6	
Electives . . . . .	3	3
<b>Totals</b> . . . . .	15	15
<b>Fourth Year</b>		
Psychology Required Course . . . . .	3	3
Psychology 400-Level Elective . . . . .	3	
Capstone Experience . . . . .	3	
Supporting Track or Minor . . . . .	3	3
Electives . . . . .	6	6
<b>Totals</b> . . . . .	15	15
<b>Curriculum Total</b> . . . . .		124-125

This curriculum is a recommended model. The particular sequence of courses a student chooses will depend upon his or her interests. In choosing electives, a student must satisfy the general requirements for a B.A. or B.S. degree.

### Radiologic Sciences

Radiographers perform diagnostic imaging examinations to assist physicians to diagnose or rule out disease or injury.

The baccalaureate radiologic sciences (RS) program is located in the Department of Biological Sciences. This program includes two or more years of academic course work on

campus and a 24-month professional phase or internship that includes classroom and clinical education specific to radiology. Academic coursework includes chemistry, physics, anatomy and physiology, microbiology, trigonometry, and computer science, in addition to general education requirements.

Each student also completes a minimum of 15 credits of 300-400 level special elective courses on campus related to a specialty area of interest in radiologic sciences. A list of approved special elective courses is available from the RS adviser.

Students who have completed the first two years of course work on campus are eligible to apply for an internship in the MeritCare Radiology program. Admission into the internship is competitive and based upon academic achievement, references, work experience, and an interview.

The internship provides 60 credits of classroom and clinical instruction in patient care procedures, radiation physics and protection, principles of imaging, positioning, radiobiology, and pathology. In addition to routine diagnostic imaging, MeritCare also provides education in mammography, computed tomography, and magnetic resonance imaging. The MeritCare Radiology program is accredited by the Joint Review Committee for Education in Radiologic Technology. Upon completion of the internship, graduates are eligible to write the national certifying examination to become a registered radiologic technologist, RT(R).

Descriptions of professional courses and registration procedures for the year of internship are available from the RS academic director. Grades submitted for each of the courses taken during the internship are attached to the student's official university transcript, but are not included in calculation of grade-point average.

### Recommended Curriculum Radiologic Sciences<sup>1</sup>

	Credits	
	F	S
<b>First Year</b>		
Engl 110, 120, College Composition I, II . . . . .	3	3
Math 105, Trigonometry . . . . .	3	
Chem 117, 117L, Chem Concepts, Lab <sup>2</sup> . . . . .	3,1	
RS 111, Intro Radiologic Sciences . . . . .	1	
Univ 189, Skills for Academic Success . . . . .	1	
CSci 114, Microcomputer Pkgs . . . . .		3
Chem 260, Elem of Biochemistry <sup>2</sup> . . . . .		4
Biol 202, 202L, Intro Microbiology Lab . . . . .		2,1
Psyc 111, Intro Psychology . . . . .	3	
General Education Elective . . . . .		3
Wellness . . . . .	2	
<b>Totals</b> . . . . .	17	16
<b>Second Year</b>		
Biol 220, 221, Hum Anat/Physio I,II . . . . .	3	3
Biol 220, 221, Hum Anat/Physio Lab I,II . . . . .	1	1
Comm 110, Fund. of Public Speaking . . . . .	3	
Phys 211, 211L, College Physics I, II . . . . .	3	3
Phys 211, 212L, College Physics Lab I, II . . . . .	1	1
General Education Electives . . . . .	6	3
Stat 330, Introductory Statistics . . . . .		3
VetS 115, Med. Term for the Paraprofessional . . . . .		1
Phrm 300, Prin Clinical Pharmacology . . . . .		3
<b>Totals</b> . . . . .	17	18

	Credits		
	F	S	Sr
<b>Third Year</b>			
General Education Elective . . . . .	3		
Specialty Option Elective . . . . .	3		
RS 496, Internship <sup>3</sup> . . . . .	12	12	6
<b>Totals</b> . . . . .	15	18	6
<b>Fourth Year</b>			
Specialty Option Elective . . . . .	3	6	
R S 496 ,Internship <sup>3</sup> . . . . .	12	12	6
<b>Totals</b> . . . . .	15	18	6
<b>Curriculum Total</b> . . . . .			146

<sup>1</sup> This is a sample curriculum. Other variations are possible. Students should meet with their advisers to plan schedules.

<sup>2</sup> Chem 117, 117L and Chem 260 is the minimum requirement for RS majors. Students may complete either of the following sequences and substitute them for the minimum requirement: Chem 121, 121L/122, 122L, Chem 240, and Chem 260 OR Chem 121, 121L/122, 122L, Chem 341, 341L, 342, and Bioc 460, 461.

<sup>3</sup> Credits earned in the MeritCare Radiology Program.

### Respiratory Care

Respiratory Care (RC) is an allied health profession that involves the evaluation, treatment, and education of patients with cardiopulmonary disorders. Respiratory therapists work closely with physicians, nurses, and other allied health members in critical care, emergency rooms, nursery and pediatrics, medical units, and home care. RTs perform diagnostic tests, administer a variety of treatments to promote pulmonary hygiene, manage mechanical ventilators and cardiovascular support, and direct pulmonary rehabilitation activities.

The baccalaureate degree respiratory care program, located in the Department of Biological Sciences, includes three years of academic course work at NDSU and a 12-month professional phase or internship in the Respiratory Care department at MeritCare Medical Center, Fargo, N.D.

Academic course work includes chemistry, physics, anatomy and physiology, microbiology, mathematics, psychology, and computer science. Each student also is required to complete a minimum of 12 credits of 300-400 level special elective courses on campus. Special elective courses should be closely related to the clinical area in which the student wishes to specialize. A list of approved special elective courses is available from the RC adviser. Common specialty areas include neonatal/pediatric general or intensive care, adult general or intensive care, diagnostics, pulmonary rehabilitation, home care, education, and management. Specialty training within RC occurs at the end of the internship year (RC 494).

The internship consists of lecture, laboratory, and clinical education that prepare the student to enter the profession of respiratory care. Students are eligible to apply for one of the internships available each year at MeritCare during the semester they plan to complete all prerequisite courses on campus. Admission into the internship is selective and is based upon

successful completion of all internship prerequisites (a minimum of 20 resident credits at NDSU for transfer students), grade point average, references, personal interview, and career motivation. Upon completion of the internship, graduates are eligible to write the national certifying examinations to obtain the certified and registered credentials.

### Recommended Curriculum Respiratory Care

	Credits	
	F	S
<b>First Year</b>		
Biol 202, 202L, Intro to Microbiology, Lab . . .		3
Chem 121, 121L, General Chemistry I, Lab . . .		4
Chem 122, 122L, General Chemistry II, Lab . . .		4
CSci 114, Microcomputer Packages . . . . .		3
Engl 110, 120, College Composition I, II . . . 3		3
Math 103, College Algebra . . . . .		3
RC 111, Intro to Respiratory Care . . . . .		1
Soc 110, Intro to Sociology . . . . .		3
Univ 189, Skills for Academic Success . . . . .		1
Wellness course . . . . .		2
<b>Totals</b> . . . . .	15	15

<b>Second Year</b>		
Biol 220, 220L, Human Anat & Physiol I, Lab . . .		4
Biol 221, 221L, Human Anat & Physiol II, Lab . . .		4
Chem 240, Survey of Organic Chemistry . . . . .		3
Chem 260, Elements of Biochemistry . . . . .		4
Comm 110, Fund of Public Speaking . . . . .		3
HPER 210, First Aid & CPR . . . . .		2
Phys 120, Fund of Physics . . . . .		3
Psyc 111, Intro to Psychology . . . . .		3
Stat 330, Intro Statistics . . . . .		3
Humanities & Fine Arts Elective . . . . .		3
<b>Totals</b> . . . . .	15	17

<b>Third Year</b>		
Summer Session		
RC 496, Internship (12 months including summer session) <sup>1</sup> . . . . .		40
<b>Totals</b> . . . . .		40

<b>Fourth Year</b>		
RC 494, Individual Study . . . . .		4
Humanities & Fine Arts Elective . . . . .		3
Special electives <sup>2</sup> . . . . .		6
General Education Requirements . . . . .	3	3
<b>Totals</b> . . . . .	13	12
<b>Curriculum Total</b> . . . . .		127

<sup>1</sup>Credits earned at MeritCare Medical Center Respiratory Care Program.

<sup>2</sup>Each student will develop a specialty proposal in his/her own area of primary interest. Each specialty will consist of RC 494, Individual Study, four credits, plus a minimum of 12 additional academic credits at the 300-400 level or higher. A list of approved special elective courses is available from the respiratory care adviser. The specialty proposal will be developed in the latter part of the internship year and presented prior to completion of the internship to a respiratory care consorsial committee, or its designates, for approval. Once approved, any changes must occur by petition to the consorsial committee.

### Statistics

Statistics involve the analysis of numerical data. This ranges from the calculation of simple statistics to the mathematical theory behind very sophisticated statistical procedures. Professionals in areas such as agriculture, pharmacy, business, human development, and the social sciences use statistical tools.

The Department of Statistics offers a major leading to a B.S., M.S., or Ph.D. degree, as well as minors in statistics for both undergraduate and graduate students. The program is flexible enough to be individually planned around prior experience and in accord with professional goals. The program emphasis is on applied statistics, consulting, and computational methods.

### Statistics Major

The statistics major requirements include at least 24 credits in statistics. These requirements include the following:

Requirements:	Credits
Stat 367, Probability . . . . .	3
Stat 368, Statistics . . . . .	3
Stat 461, Applied Regression Models . . . . .	3
Stat 462, Intro Experimental Design . . . . .	3
Stat 491, Capstone Seminar . . . . .	1
<b>Five courses from the following:</b>	
CSci 161, Computer Science II OR	
CSci 228, Computing Fund II OR	
CSci 418, Simulation Models . . . . .	3-4
Math 329, Linear Algebra . . . . .	3
Stat 450, Stochastic Processes . . . . .	3
Stat 451, Bayesian Stat Dec Theory . . . . .	3
Stat 460, Applied Survey Sampling . . . . .	3
Stat 463, Nonparametric Statistics . . . . .	3
Stat 464, Discrete Data Analysis . . . . .	3
Stat 465, Meta-Analysis Methods . . . . .	3
Stat 467, Probability/Math Stats I . . . . .	3
Stat 468, Probability/Math Stats II . . . . .	3
Stat 470, Stat SAS Programming . . . . .	3
<b>Additional requirements:</b>	
CSci 126, Beginning Fortran OR	
CSci 160, Computer Science I OR	
CSci 227, Computing Fund I . . . . .	3-4
CSci 222, Discrete Math OR	
Math 270, Intro Abstract Math . . . . .	3
Math 165, Calculus I . . . . .	4
Math 166, Calculus II . . . . .	4
Math 265, Calculus III . . . . .	4

Minor in one of the following: Social science, physical science, biological science, business, mathematics, or computer science (approved by faculty member in that discipline).

If a student were interested in Biostatistics, a possible minor would be biological sciences. This would include the following set of courses: Biol 150, 150L, 151, 151L, and 10 credits at the 300-400 level in Biology, Botany, or Zoology.

If a student were interested in Business Statistics, a possible minor would be Business Administration. (Approval is needed by the College of Business Administration.)

### Recommended Curriculum Statistics Major

	Credits	
	F	S
<b>First Year</b>		
Comm 110, Fund of Public Speaking . . . . .		3
CSci 126, Fortran OR		
CSci 160, Computer Science I OR		
CSci 227, Computing Fund I . . . . .		3-4
Engl 110, 120, College Composition I, II . . . 3		3
Math 165, 166, Calculus I, II . . . . .		4
Univ 189, Skills for Academic Success . . . . .		1
Wellness . . . . .		2
Electives <sup>1</sup> . . . . .		6
<b>Totals</b> . . . . .	17	15-16

	Credits	
	F	S
<b>Second Year</b>		
Math 265, Calculus III . . . . .		4
Stat 367, Probability . . . . .		3
Stat 368, Statistics . . . . .		3
Electives <sup>1</sup> . . . . .		9
<b>Totals</b> . . . . .	16	15

<b>Third Year</b>		
Math 270, Intro Abstract Math OR		
CSci 222, Discrete Math . . . . .		3
Stat 461, Applied Regression Models . . . . .		3
Stat 462, Intro Experimental Design . . . . .		3
Electives <sup>1</sup> . . . . .		6
Stat Electives . . . . .		3
<b>Totals</b> . . . . .	15	15

<b>Fourth Year</b>		
Stat 491, Capstone Seminar . . . . .		1
Electives <sup>1</sup> . . . . .		9
Stat Elective(s) . . . . .		6
<b>Totals</b> . . . . .	15	14
<b>Curriculum Total</b> . . . . .	122-123	

<sup>1</sup>Electives must be used to satisfy the general education requirements including humanities, social/behavioral sciences, science and mathematics (other than major), and a laboratory course. They also must be used to satisfy the minor requirement.

### Mathematics and Statistics Double Major

**Pre-Actuarial Science Option**  
Actuarial science is the study of the evaluation and measurement of risk. The actuarial science option is a pre-professional program designed to provide the background needed to enter the field. Entrance into the profession is regulated under a system of examinations run by actuarial professional societies. The curriculum of the option is designed to prepare the student to pass several of these examinations.

The nature of the actuarial profession requires its practitioners to have a board knowledge of finance, law, mathematics, management, and statistics. This option leads to a double major in mathematics and statistics with either a minor in economics or additional courses in business. Students selecting this option are requested to visit with both the actuarial advisers in the Departments of Mathematics and Statistics early and often to confirm their progress and to inform themselves of changes in the examination curriculum.

### Recommended Curriculum Pre-Actuarial Science Option

	Credits	
	F	S
<b>First Year</b>		
Comm 110, Fund of Public Speaking . . . . .		3
CSci 160, 161, Computer Science I, II . . . . .		4
Engl 110, 120, College Composition I, II . . . 3		3
Math 165, 166, Calculus I, II . . . . .		4
Stat 330, Intro Statistics . . . . .		3
Univ 189, Skills for Academic Success . . . . .		1
<b>Totals</b> . . . . .	15	14

<b>Second Year</b>		
Acct 200, 201, Elements of Acct I, II . . . . .		3
Econ 201, 202, Prin of Micro, Macroecon. . . 3		3
Math 265, Calculus III . . . . .		4
Math 266, Intro to Differential Equations . . . . .		3
Math 270, Intro to Abstract Math . . . . .		3
Math 329, Linear Algebra . . . . .		3
Stat 461, Applied Regression Models . . . . .		3
Stat 462, Intro to Experimental Design . . . . .		3
<b>Totals</b> . . . . .	16	15

	Credits	
Third Year	F	S
CSci 453, Linear Prog & Network Flows . . . . .	3	
CSci 454, Operations Research. . . . .		3
Math 450, Real Analysis I . . . . .	3	
Science Option <sup>4</sup> . . . . .	6	4
Stat 467, 468, Prob and Math Stat I, II. . . . .	3	3
Humanities and Fine Arts <sup>1</sup> . . . . .	3	3
Statistics 400-Level Elective <sup>2</sup> . . . . .		3
Totals . . . . .	18	16

Fourth Year		
Math 376, Actuarial Exam Study/Capstone . . . . .	1	
Math 451, Real Analysis II OR Math 489, Numerical Analysis II . . . . .	3	3
Math 488, Numerical Analysis I. . . . .	3	
Stat 476, Actuary Exam Study II/Capstone . . . . .	1	
Business or Economics Electives <sup>3</sup> . . . . .	6	3
Social/Behavioral Science Electives <sup>1</sup> . . . . .	3	3
Statistics 400-Level Electives <sup>2</sup> . . . . .	3	3
Wellness . . . . .	2	
Totals . . . . .	15	16
Curriculum Total . . . . .		125

A grade of C or better is required in MATH and STAT courses used toward this double major.

To complete a degree, the general education requirements of the College of Science and Mathematics and NDSU need to be met along with this major.

<sup>1</sup>University and College of Science of Mathematics general education requirements include three credits each in courses approved for global perspectives and in cultural diversity.

<sup>2</sup>Statistics electives include any additional 400-level, 3-credit statistics course.

<sup>3</sup>Business or Economics electives must be taken from Busn 340, 441, 442, 444, Econ 341, 343 or any 400-490 level Econ course.

<sup>4</sup>Science Option: take one of the following combinations (10 credits minimum):

Biol 150/150L - General Biology I/L (3/1) and Biol 151/151L - General Biology II/L (3/1); or  
Biol 220/220L - Anatomy & Physiology I/L (3/1) and Biol 221/221L - Anatomy & Physiology II/L (3/1); or  
Chem 121/121L - General Chemistry I/L (3/1) and Chem 122/122L - General Chemistry II/L (3/1); or  
Chem 150/160 - Principles of Chemistry I/L (3/1) and Chem 151/161 - Principles of Chemistry II (3/1); or

\*Plus 2 more credits in Science and Technology category; or  
Phys 251/251L - University Physics I/Lab (5/1) and 252/252L - University Physics II/Lab (4/1).

### Behavioral Statistics

A new degree program in Behavioral Statistics (B.S.) was recently approved. This degree is a joint effort between the Department of Statistics and the Department of Psychology. It is recommended that a student wishing to obtain a degree in Behavioral Statistics consult with an advisor in both departments. This major prepares students for careers involving collecting and analyzing data on human behavior, for example, in Medicare, insurance, market research, or health, educational and social services. Graduates of this program are expected to have good quantitative reasoning skills and to have strong people skills. Please note: this curriculum also fulfills requirements for the B.S. in Psychology. A sample curriculum for this degree is given in the next column.

## Recommended Curriculum Behavioral Statistics

	Credits	
First Year	F	S
Anth 111, Intro to Anthropology . . . . .	3	
Biol 126, Human Biology . . . . .	3	
CSci 116, Business Use of Computers OR CSci 114, Microcomputer Packages . . . . .		3-4
Chem 117, Chemical Concepts & App. . . . .	3	
Chem 117L, Chemical Concepts Lab. . . . .		1
Engl 110, 120, College Composition I & II . . . . .	3	3
Math 103, College Algebra OR Math 104, Finite Mathematics . . . . .		3
Psyc 111, Intro to Psychology . . . . .	3	
Soc 110, Intro to Sociology . . . . .		3
Psyc 200-Level Elective. . . . .		3
Univ 189, Skills for Academic Success . . . . .	1	
Totals . . . . .	16	16-17

Second Year		
Comm 110, Fund. of Public Speaking . . . . .	3	
Psyc 350, Research Methods I . . . . .	3	
Stat 330, Introductory Statistics . . . . .	3	
Stat 331, Regression Analysis . . . . .	2	
Humanities Electives . . . . .	3	3
Psyc 200-Level Electives . . . . .	6	3
Social Science Elective . . . . .	3	
Wellness . . . . .	2	
Totals . . . . .	17	14

Third Year		
Psyc 351, Research Meth II. . . . .	3	
Stat 460, Applied Survey Sampling OR Stat 463, Nonparametric Statistics OR Stat 465, Meta-Analysis Methods . . . . .		3
Stat 462 - Intro to Experimental Design . . . . .	3	
Psyc Required Course <sup>2</sup> . . . . .	3	
Psyc 200- or 300-Level Elective. . . . .	3	
Psyc 400-Level Elective. . . . .	3	
Social Science Elective . . . . .	3	
Electives <sup>1</sup> . . . . .	3	6
Totals . . . . .	15	15

Fourth Year		
Stat 460, Applied Survey Sampling OR Stat 463, Nonparametric Statistics. . . . .		3
Stat 470, Statistical SAS Programming . . . . .	3	
Behavioral Stat Capstone Experience . . . . .	3	
Psyc Required Courses <sup>2</sup> . . . . .	3	3
Psyc 400-Level Elective. . . . .	3	
Electives <sup>1</sup> . . . . .	6	5
Totals . . . . .	15	14
Curriculum Total. . . . .		122-123

<sup>1</sup>Electives must be used to satisfy the general education requirements.

<sup>2</sup>Psychology Requirements:

#### A. Social Bases of Behavior

Psyc 453, Organizational Psyc

Psyc 468, Personality

Psyc 470, Exp Social Psyc

#### B. Biological Bases of Behavior

Psyc 460, Sensation & Perception

Psyc 465, Psychobiology

Psyc 486, Neuropsychology

#### C. Cognitive Bases of Behavior

Psyc 461, Memory & Knowledge

Psyc 463, Experimental Developmental Psyc

Psyc 464, Attention & Thinking

<sup>3</sup>Students need only take two of the following three Statistics courses: Stat 460, 463, 465. Stat 460 and 463 are offered during alternate fall semesters. Stat 465 is offered during alternate spring semesters.

\*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.

### Statistics Minors

Two different minors in statistics are offered.

**Applied Statistics (Track 1):** This minor consists of 17 credits in statistics including Stat 330, 331, and four approved 400-level, three-credit Stat courses.

**Statistics (Track 2):** Requirements for this minor are Stat 331 or 461, 367, 368, 462, and one other approved 400-level, three-credit Stat course. A Department of Statistics (Waldron 201) adviser for minors must approve the program.

### Zoology Major

(See Biological Sciences)

Minimum requirements for the zoology major include 42 credits of biological sciences, of which 14 are "core" credits in zoology and biology. An additional 21 to 26 credits fulfill one of three options including courses in chemistry, physics, mathematics, and statistics. The 42 credits for the major are completed with elective zoology courses. College and University general education requirements constitute the remainder of the curriculum.

Zoology major "core" course requirements include the following:

- Biol 150-150L, General Biology I, Lab
- Biol 151, 151L, General Biology II, Lab
- Zoo 315-315L, Genetics, Lab
- Zoo 491, Seminar

Students may pursue their personal and career interests through one of the following options in zoology.

**Option 1: General Zoology:** This option includes more elective choices than the other options and is designed for students who wish to pursue an area not represented in the other two options.

**Option 2: Physiology, Cell Biology, or Health Sciences:** This option is designed for students who are interested in physiology or cell and molecular biology or who plan to enter medical, dental, or optometry school.

**Option 3: Fisheries, Wildlife, Ecology, and Behavior:** This option is designed for students who are interested in fisheries management, ecology, conservation, natural resource management, or behavior.

Option requirements include one or more courses from each concept category as indicated in the table. (Contact the department for more specific information.)

A grade-point average of 2.0 is required for courses taken to fulfill the 42 credits in the major. A maximum of two credits of Independent Study (494) and/or Field Experience (496) and a maximum of two credits in Seminar (491) may apply to the 42 credits required for the major. All credits taken may apply toward those required for graduation. Graduate work in zoology is offered at both the M.S. and Ph.D. levels.

## Zoology Minor

Requirements for a minor in zoology include Biol 150/150L, 151/151L, Zoo 315/315L, and electives to total 18 credit hours. Electives must be approved by the chair of the Department of Biological Sciences.

Sample curricula for the options in zoology are presented to illustrate a typical sequence in which zoology core courses and supporting courses in other areas may be planned. These sequences are meant only to be a guide; other models or pathways are certainly possible.

### Recommended Curriculum Option 1: General Zoology

		Credits	
First Year	F	S	
Biol 150, 150L, General Biology I, Lab . . .	3,1		
Biol 151, 151L, General Biology II, Lab . . . . .		3,1	
Chem 121, 121L, Gen Chemistry I, Lab . . .	3,1		
Chem 122, 122L, Gen Chemistry II, Lab . . . . .		3,1	
Comm 110, Fund of Public Speaking . . . . .		3	
Engl 110, 120, College Composition I, II . . .	3	3	
Math 146, Applied Calculus I . . . . .	4		
Univ 189, Skills for Academic Success . . . . .	1		
Wellness . . . . .			<u>2</u>
Totals . . . . .	16	16	

#### Second Year

Biol 364, Gen Ecology OR Zoo 360, Animal Behavior . . . . .		3	
Bot 372, Struct & Diversity of Plants & Fungi 4			
Chem 341, 341L, Organic Chem I, Lab . . .	3,1		
Stat 330, Intro Statistics . . . . .		3	
Zoo 315, 315L, Genetics, Lab . . . . .	4		
Zoo 280, Comp Chor Morph OR Zoo 482, Developmental Biology . . . . .		4	
General Education Requirements . . . . .	<u>3</u>	<u>3</u>	
Totals . . . . .	15	13	

#### Third Year

Phys 120, Fund of Physics . . . . .	3		
Zoo 370, Cell Biol OR Zoo 380, Vert Histology . . . . .	3	or 3	
Zoo 450, Invertebrate Zoology . . . . .		3	
Zoo 460, An Phys OR Zoo 462, Physiol Ecology . . . . .	4	or 3	
Zoology Electives . . . . .	3-4	3-4	
Electives . . . . .	<u>3-8</u>	<u>3-6</u>	
Totals . . . . .	13-15	15-16	

#### Fourth Year

Zoo 491, Seminar . . . . .	2	or 2	
Biodiversity Elective . . . . .	3	or 3	
Zoology Electives . . . . .	3-4	3-4	
Electives . . . . .	<u>8-12</u>	<u>8-12</u>	
Totals . . . . .	16	16	
Curriculum Total . . . . .			122

### Recommended Curriculum Option 2: Physiology, Cell Biology, and Pre-Professional

This option is designed to meet the requirements for most professional schools (medical, dental, optometric, chiropractic, and osteopathic) and graduate programs in physiology and cell biology. The emphasis is on additional course work in cell biology, physiology, chemistry, and physics. For clinical laboratory science and respiratory care, see individual programs in this bulletin.

		Credits	
First Year	F	S	
Biol 150, 150L, General Biology I, Lab . . .	3,1		
Biol 151, 151L, General Biology II, Lab . . . . .		3,1	
Chem 121, 121L, Gen Chemistry I, Lab . . .	3,1		
Chem 122, 122L, Gen Chemistry II, Lab . . . . .		3,1	
Comm 110, Fund of Public Speaking . . . . .		3	
Engl 110, 120, College Composition I, II . . .	3	3	
Math 146, Applied Calculus I . . . . .	4		
Univ 189, Skills for Academic Success . . . . .	1		
Wellness . . . . .			<u>2</u>
Totals . . . . .	16	16	

#### Second Year

Biol 364, Gen Ecology OR Zoo 360, An Behavior . . . . .		3	
Chem 341, 341L, Organic Chem I, Lab . . .	3,1		
Chem 342, 342L, Organic Chem II, Lab . . . . .		3,1	
Stat 330, Introductory Statistics . . . . .		3	
Zoo 280, Comp Chor Morph . . . . .		4	
Zoo 315, 315L, Genetics, Lab . . . . .	3,1		
General Education Requirements . . . . .	<u>7</u>	<u>2-3</u>	
Totals . . . . .	15	16-17	

#### Third Year

Bioc 460, Found Biochem and Mol Biol I . . .	4		
Phys 211, 211L, College Physics I, Lab . . .	3,1		
Phys 212, 212L, College Physics II, Lab . . . . .		3,1	
Zoo 370, Cell Biology . . . . .		3	
Zoo 460, Animal Physiology . . . . .	4		
General Education Requirements . . . . .		9	
Zoology Elective . . . . .	<u>3-4</u>		
Totals . . . . .	15-16	16	

#### Fourth Year

Zoo 462, Physiol Ecology OR Zoo 464, Endocrinology . . . . .	3	or 3	
Zoo 491, Seminar . . . . .	2	or 2	
Biodiversity Elective . . . . .	3	or 3	
Cell Biology Elective . . . . .	3-4		
Zoology Elective . . . . .		3-4	
Electives . . . . .	<u>6-12</u>	<u>6-12</u>	
Totals . . . . .	15	15	
Curriculum Total . . . . .			122

### Recommended Curriculum Option 3: Fisheries, Wildlife, Ecology, and Behavior

Courses focused on invertebrates, fish, amphibians, reptiles, birds, mammals, ecology, management, animal behavior, and population dynamics are added to the "core" courses. In addition, a course in physiology and a course in morphology are required. These studies prepare the student for research or management positions with federal, state, or other agencies such as the U.S. Fish and Wildlife Service, State Game and Fish Departments, State Conservation Departments, U.S. and State Forest Services, U.S. Bureau of Land Management, Natural Resources Conservation Service, and the Environmental Protection Agency, as well as national and state parks.

A wildlife or fisheries biologist participates in a wide range of activities including natural history, systematics, aquatic and terrestrial ecology, population dynamics, management techniques, pollution biology, and public relations. Some positions require advanced training at the master's (M.S.) or doctoral (Ph.D.) level. In addition to the curriculum suggested, at least one summer or semester of field experience is recommended. Field experience may be gained either at a biological field station or through employment approved by the adviser.

		Credits	
First Year	F	S	
Biol 150, 150L, General Biology I, Lab . . .	3,1		
Biol 151, 151L, General Biology II, Lab . . . . .		3,1	
Chem 121, 121L, Gen Chemistry I, Lab . . .	3,1		
Chem 122, 122L, Gen Chemistry II, Lab . . . . .		3,1	
Comm 110, Fund of Public Speaking . . . . .		3	
Engl 110, 120, College Composition I, II . . .	3	3	
Math 146, Applied Calculus I . . . . .	4		
Univ 189, Skills for Academic Success . . . . .	1		
Wellness . . . . .			<u>2</u>
Totals . . . . .	16	16	

#### Second Year

Biol 364, Gen Ecology . . . . .		3	
Bot 372, Struct & Diversity Plants & Fungi . .	4		
Chem 240, Survey Organic Chem . . . . .		3	
CSci 114, Microcomputer Packages . . . . .	3	or 3	
Stat 330, Introductory Statistics . . . . .		3	
Zoo 280, Comp Chor Morph . . . . .		4	
Zoo 315, 315L, Genetics, Lab . . . . .	4		
General Education Requirements . . . . .	<u>4-7</u>	<u>0-3</u>	
Totals . . . . .	14-17	14-17	

#### Third Year

Bot 314, Systemic Botany* . . . . .		3	
Phys 120, Fund of Physics . . . . .	3		
Zoo 462, Physiol Ecology . . . . .		3	
Biodiversity Elective . . . . .	3	or 3	
General Education Requirements . . . . .	6-12	3-12	
Management Elective . . . . .	3	or 3	
Totals . . . . .	15	15	

#### Fourth Year

Zoo 491, Seminar . . . . .	2	or 2	
Biodiversity Elective . . . . .	3	or 3	
Botany Elective* . . . . .	3	or 3	
Ecology/Behavior Elective . . . . .	3	or 3	
Management Elective . . . . .	3	or 3	
Zoology Elective . . . . .	3-4	or 3-4	
Electives . . . . .	<u>0-15</u>	<u>0-15</u>	
Totals . . . . .	16	17	
Curriculum Total . . . . .			122

\*Strongly recommended, but not required.

#### Concept Categories

Biodiversity (Zoo 450, 452, 454, 456, 458)	x	x	x
Cell biology (Micc 350-350L; Zoo 370, 380)	x	x	
Ecology/behavior (Biol 364; Zoo 360, 470)	x	x	x
Management (Zoo 472, 474, 475, 476, 477)			x
Morphology (Zoo 280, 482)	x	x	x
Physiology (Zoo 460, 462, 464)	x	x	x

#### Option 1 Option 2 Option 3