Department of Biology

Chair
Dr. Paul Lepp

The Department of Biology offers three degrees (BA, BSE, and BS):

The Bachelor of Arts (BA) in Biology is designed for those students who desire to go to professional schools of medicine, dentistry, optometry, chiropractic, physical, and occupational therapy, mortuary science, and veterinary medicine or who wish to pursue graduate work in biology. The BA degree is also designed for those students who desire employment in the biomedical industry, environmental sciences, or wildlife management.

The Bachelor of Science in Education (BSE) in Biology is designed for students who are interested in careers as biology teachers in junior or senior high schools. Students completing this program meet all the requirements for secondary school certification in North Dakota. Furthermore, the broad-based biology curriculum prepares the students not only to teach biology, but also chemistry and physical science. The students are also fully prepared to pursue the graduate program for the Master of Arts in Teaching (MAT) degree in science.

The Bachelor of Science (BS) in Medical Laboratory Science (MLS) [Medical Technology] is a joint program of Minot State University and the University of North Dakota (UND) and complies with the National Accrediting Agency for MLS. Full-time students can complete coursework in three years, and begin clinical training during the summer session at UND in Grand Forks, ND. MLS majors are required to take a minimum of 38 credits of General Education courses. The General Education math and science requirements are automatically met by taking MLS required courses. Following successful completion of coursework, fourth-year students are guaranteed admission to the clinical year at one of the participating accredited hospitals in North Dakota, Montana, Minnesota, Arizona, Colorado, Iowa, Nebraska, Oklahoma, Oregon, South Dakota, Washington, Wisconsin, and Wyoming. Students who earn the BS-MLS degree obtain employment in a number of different medical areas including hospitals, physicians’ offices, clinics, public health agencies, and pharmaceutical firms.

The Bachelor of Science (BS) in Bioinformatics (also called Computational Biology) prepares students to enter the bioinformatics field in commercial or academic settings. Bioinformatics is a cross-disciplinary field that encompasses computer science, mathematics, and biology in order to extract meaningful information from large biological data sets. The global bioinformatics industry has grown at double-digit rates for the past decade. Minot State University is the only school with the surrounding five state region to offer an undergraduate bioinformatics degree.

For all degrees in Biology, a minimum GPA of 2.50 is required for graduation.

In addition to the degrees, Biology also directs several pre-professional programs (pre-medical, pre-dental, pre-veterinary, pre-mortuary etc.) and provides courses required for professional degrees in nursing, medical technology, radiologic technology, social work, criminal justice, physical education, elementary education, and special education. Biology also offers a number of general education courses that fulfill the FC2 category of general education.

Biology Department Mission:

The mission of the Department of Biology is to equip students with a broad and substantive knowledge of biology. We actively promote the development of critical thinking skills and an ingrained sense of the scientific method among our students. By actively mentoring students in the classroom and in our research labs, we seek to develop the skills that enable them to apply their new found knowledge in a research setting and advance the frontiers of biology.

Biology Department Goals:

The goals of the Department of Biology are:

• to provide research opportunities for our students so that they may contribute meaningfully to the study of Biology;
• to prepare students for advanced study in Biological Sciences and Health Sciences;
• to prepare students for biological careers in teaching, government, business, and industry;
• to support the university and larger community with faculty and student service.

BA Biology Student Learning Goals and Outcome

<table>
<thead>
<tr>
<th>Student Learning Goals</th>
<th>Student Learning Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Biology majors will gain a broad background in fundamental principles of biology.</td>
<td>1.1 Freshmen and sophomores will memorize, recall, and describe biological processes and concepts</td>
</tr>
<tr>
<td></td>
<td>1.2 Juniors and seniors will apply biological processes and content to specific biological topics</td>
</tr>
</tbody>
</table>
2. Biology majors will gain knowledge and experience in the basic methods, instrumentation, and quantitative analytical skills used to conduct scientific research.

2.1 Biology majors will conduct experiments, analyze results, and draw appropriate conclusions related to biological phenomena.

3. Biology majors will develop critical reasoning and communication skills

3.1 Biology majors will plan and engage in original research, produce critical reviews of research, and/or present to local, regional, and national audiences

3.2 Biology graduates will have gained the skills to enter professional programs

## BS Medical Lab Science Student Learning Goals and Outcomes

<table>
<thead>
<tr>
<th>Student Learning Goals</th>
<th>Student Learning Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. First year MLS majors will gain a comprehensive understanding of the curricular requirements, timelines, and career expectations for the MLS professional.</td>
<td>1.1 First-year students will summarize and reconstruct MLS degree requirements, and shadow professionals in the field.</td>
</tr>
<tr>
<td>2. Second and third-year MLS majors will gain proficiency in concepts of biology and chemistry related to human health</td>
<td>2.1 MLS majors will memorize biological and chemical analytical theory and practice laboratory techniques applicable to clinical testing for human disease.</td>
</tr>
<tr>
<td>3. Fourth-year students will gain experience in specific clinical testing for human disease</td>
<td>3.1 MLS majors will practice and interpret laboratory tests in the areas of blood banking, microbiology, clinical chemistry, hematology and immunology</td>
</tr>
</tbody>
</table>

## BS Bioinformatics Student Learning Goals and Outcomes

<table>
<thead>
<tr>
<th>Student Learning Goals</th>
<th>Student Learning Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Bioinformatics majors will explore and demonstrate an understanding of basic molecular biology</td>
<td>1.1 Freshman and sophomore bioinformatics majors will memorize, recognize, recall and describe basic cellular metabolic pathways and mechanisms pertinent to molecular biology.</td>
</tr>
<tr>
<td>1.2 Juniors and seniors will demonstrate, interpret, synthesize, and apply biological processes and content to specific biological topics</td>
<td></td>
</tr>
<tr>
<td>2. Bioinformatics majors will master computer languages used prominently in bioinformatics</td>
<td>2.1 Students will create computer programs that facilitate biological data analysis</td>
</tr>
<tr>
<td>3. Bioinformatics majors will develop critical reasoning and communication skills</td>
<td>3.1 Bioinformatics graduates will engage in original research and present at local, regional and national meetings.</td>
</tr>
<tr>
<td>3.2 Bioinformatics graduates have gained the skills to enter the bioinformatics workforce or enter a professional program</td>
<td></td>
</tr>
</tbody>
</table>

## BSE Biology Education Student Learning Goals and Outcomes

<table>
<thead>
<tr>
<th>Student Learning Goals</th>
<th>Student Learning Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Biology Education majors will gain a broad background in fundamental principles of biology.</td>
<td>1.1 Freshmen and sophomores will memorize, recall, and describe biological processes and concepts</td>
</tr>
<tr>
<td>1.2 Juniors and seniors will demonstrate, interpret, synthesize, and apply biological processes and content to specific biological topics</td>
<td></td>
</tr>
<tr>
<td>2. Biology Education majors will gain an understanding of the scientific method and its historical origins across the sciences</td>
<td>2.1 Biology majors will demonstrate the use of the scientific method</td>
</tr>
<tr>
<td>3. Biology Education majors will gain knowledge and experience in the basic methods, instrumentation, and quantitative analytical skills used to conduct scientific research.</td>
<td>3.1 Biology Education majors will conduct experiments, analyze results, and draw appropriate conclusions related to biological phenomena.</td>
</tr>
<tr>
<td>4. The teacher candidate engages learners in meaningful Application of Content.</td>
<td>4.1 The teacher candidate makes connections among concepts and relates content to real world problems and meaningful applications.</td>
</tr>
<tr>
<td>4.2 The teacher candidate engages learners with higher order thinking about content (i.e. critical thinking, perspective-taking, creativity, collaborative work and communication).</td>
<td></td>
</tr>
<tr>
<td>5. The teacher candidate demonstrates mastery of Content Knowledge useful to student learning.</td>
<td>5.1 The teacher candidate demonstrates knowledge of the central concepts, tools of inquiry, and structures of the discipline(s) he or she teaches.</td>
</tr>
<tr>
<td>5.2 The teacher candidate creates learning experiences that make the discipline accessible and meaningful for learners, to assure mastery of the content.</td>
<td></td>
</tr>
<tr>
<td>6. The teacher candidate uses systematic Planning for Instruction to reach learning goals.</td>
<td>6.1 The teacher candidate selects, creates, plans and sequences varied instructional activities to support the growth of all students toward rigorous curriculum goals.</td>
</tr>
<tr>
<td>6.2 The teacher candidate uses formative and summative assessment information to systematically adjust instruction to assist varied students’ learning needs.</td>
<td></td>
</tr>
</tbody>
</table>
6.3 The teacher candidate collaborates and communicates (i.e. with colleagues, specialists, community resources, families and learners) to meet individual learning needs.

7. The teacher candidate can articulate and use multiple methods of Assessment.

7.1 The teacher candidate can articulate and use multiple methods of assessment, to fairly demonstrate the full extent of student learning.

7.2 The teacher candidate uses, and engages learners in using, assessments aligned with learning expectations, in order to monitor, support and document growth.

8. The teacher candidate creates supportive, collaborative Learning Environments.

8.1 The teacher candidate collaborates and communicates with others to build a positive learning climate marked by respect, rigor and responsibility.

8.2 The teacher candidate manages the learning environment to engage learners actively in individual and collaborative learning.

9. The teacher candidate engages in ongoing Professional Learning and Ethical Practice.

9.1 The teacher candidate takes responsibility for evidence-based strengths and weaknesses in his/her own practices, engaging in ongoing professional learning.

9.2 The teacher candidate practices the profession in an ethical manner, considering the effects of his/her decisions and actions on others.

10. The teacher candidate uses varied Instructional Strategies, including technology, to develop useful learning.

10.1 The teacher candidate can reflectively select and use a variety of instructional strategies, including appropriate, current instructional technologies, to make learning accessible to all learners.

10.2 The teacher candidate applies instructional strategies which encourage learners to develop deep comprehension and apply knowledge in meaningful ways (including students' own digital literacy).

University Teacher Education Policies

Refer to the Teacher Education Policies and Procedure (http://catalog.minotstateu.edu/undergraduate/teachereducationpoliciesandprocedures) pages of the catalog for details regarding Teacher Education at Minot State University. These pages will explain admission, retention, and exit requirements of the program for biology, chemistry, earth science, physical science, and physics majors in Teacher Education.

Department Teacher Education Requirements

In addition to University-wide teacher education retention policies listed above, science majors in the BSE degree programs must:

1. Meet regularly with an advisor within the Department of Biology to coordinate course work within their major.
2. Meet regularly with an advisor within the Department of Biology to coordinate course work within Science Education.
3. Apply to the Department of Biology to be recommended for Admission to Teacher Education. Minimum requirements for recommendation are:
   4. Complete General Education communications requirement with a minimum GPA of 2.50 with no grade lower than a “C.”
5. Complete basic Skills Test (PPST), SAT, or ACT with satisfactory scores.
6. Maintain a minimum cumulative GPA of 2.50 for all course work taken.
7. Complete speech and hearing tests.
8. Complete autobiography, stating reasons teaching was chosen as a profession.
9. Obtain written recommendations from two faculty within the Division of Science.
10. Maintain minimum GPA of 2.50 within the major (at least 8 credits completed).

Once admitted to Teacher Education students must:

1. Maintain a GPA of 2.50 for all course work taken.
2. Maintain a GPA of 2.50 within their major.
3. Maintain a portfolio, which must be completed before application for student teaching will be considered.
4. Apply to the Department of Biology at least two semesters before student teaching.
5. Complete the required science teaching methods courses before student teaching.

All students majoring in another division or department and planning to teach with a minor in the sciences must submit their credentials to the Department of Biology for review at least two semesters before student teaching.

The Department of Biology will initially approve pre-service teachers. In addition, each candidate’s progress is reviewed each semester, in accordance with standards set by the University and the Department.

Bachelor of Arts with a Major in Biology

Two introductory courses (8 cr) must be completed prior to enrolling in 300+ courses required for the degree.
Students must take:
- **BIOL 151** Introduction to Zoology 4
- **BIOL 154** Introduction To Botany 4
- **BIOL 150** Introduction To Cellular Biology 4

200 level Required Courses
- **BIOL 215** Genetics 4
- **BIOL 240** Biometry 4

300 and 400 level Courses
- **BIOL 302** General Microbiology 4

Select four from the following: 14-16
- **BIOL 301** Evolution
- **BIOL 310** Ethnobotany
- **BIOL 325** Entomology
- **BIOL 330** Biogeography
- **BIOL 335** Comparative Vertebrate Anatomy
- **BIOL 340** Systematic Zoology
- **BIOL 346** Developmental Biology
- **BIOL 347** General Ecology
- **BIOL 349** Biogeography
- **BIOL 350** Plant Physiology
- **BIOL 360** Morphology of Vascular Plants
- **BIOL 401** Population Genetics
- **BIOL 402** Bioinformatics
- **BIOL 405** Prokaryotic Physiology
- **BIOL 445** Cancer Biology
- **BIOL 448** Systematic Botany
- **BIOL 450** Parasitology
- **BIOL 455** Hematology
- **BIOL 458** Anatomy of Seed Plants
- **BIOL 460** Herpetology
- **BIOL 465** Immunology
- **BIOL 470** Histology
- **BIOL 480** Molecular Biology
- **BIOL 482** Neurobiology

Remaining Coursework 8
Select one of the following tracks:

Research Track
- **BIOL 492** Directed Research (taken over 2 or more semesters) 1-5

or

Non-Research Track
Any two additional BIOL courses (except BIOL 111, BIOL 115, BIOL 127, and BIOL 202)

Additional Required Courses
- **CHEM 121** General Chemistry I 5
- **CHEM 122** General Chemistry II 5
- **CHEM 240** Fundamentals of Organic Chemistry 5
  or **CHEM 341** Organic Chemistry I

Minor and/or Concentration(s)
- **PHYS 211** College Physics I 8-10
  & **PHYS 212** and College Physics II
  or **PHYS 251** University Physics I 8-10
  & **PHYS 252** and University Physics II

Minor and/or Concentration choice 15-16

Total Hours 85-94
Bachelor of Science in Education with a Major in Biology

Two introductory courses (8 cr) must be completed prior to enrolling in 300+ courses required by the degree. **Note:** If you are transferring in with a degree in Biology that is more than 30 years old and want to earn a BSEd in Biology, you will have to take the coursework of a Biology Minor to update your knowledge.

General Education 38-40

**Students must take:**

<table>
<thead>
<tr>
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**200 level Required Courses**

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<td>Genetics</td>
<td>4</td>
</tr>
<tr>
<td>BIOL 240</td>
<td>Biometry</td>
<td>4</td>
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</tbody>
</table>

**300 and 400 level Courses**

<table>
<thead>
<tr>
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<th>Credits</th>
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<tbody>
<tr>
<td>BIOL 302</td>
<td>General Microbiology</td>
<td>4</td>
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</table>

Select four from the following: 14-16

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<td>BIOL 340</td>
<td>Systematic Zoology</td>
<td></td>
</tr>
<tr>
<td>BIOL 346</td>
<td>Developmental Biology</td>
<td></td>
</tr>
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<td>BIOL 347</td>
<td>General Ecology</td>
<td></td>
</tr>
<tr>
<td>BIOL 349</td>
<td>Plant Physiology</td>
<td></td>
</tr>
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<td>BIOL 360</td>
<td>Morphology of Vascular Plants</td>
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</tr>
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<td>BIOL 401</td>
<td>Population Genetics</td>
<td></td>
</tr>
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<td>BIOL 402</td>
<td>Bioinformatics</td>
<td></td>
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<td>Systematic Botany</td>
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<td>Hematology</td>
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<td>BIOL 458</td>
<td>Anatomy of Seed Plants</td>
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<td>BIOL 465</td>
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<td>BIOL 470</td>
<td>Histology</td>
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<tr>
<td>BIOL 480</td>
<td>Molecular Biology</td>
<td></td>
</tr>
<tr>
<td>BIOL 482</td>
<td>Neurobiology</td>
<td></td>
</tr>
</tbody>
</table>

**Remaining Coursework**

Select one of the following tracks: 8

**Research Track**

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<tbody>
<tr>
<td>BIOL 492</td>
<td>Directed Research (taken over 2 or more semesters)</td>
<td></td>
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</table>

or

**Non-Research Track**

(Any two additional BIOL courses except BIOL 111, BIOL 115, BIOL 127, and BIOL 202)

**Additional Required Courses**

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<thead>
<tr>
<th>Course</th>
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<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>CHEM 121</td>
<td>General Chemistry I</td>
<td>5</td>
</tr>
<tr>
<td>CHEM 122</td>
<td>General Chemistry II</td>
<td>5</td>
</tr>
</tbody>
</table>

**Math: Take either**

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATH 107</td>
<td>Precalculus</td>
<td>3-6</td>
</tr>
<tr>
<td>or MATH 103</td>
<td>College Algebra</td>
<td></td>
</tr>
</tbody>
</table>

AND
Bachelor of Science with a Major in Bioinformatics

Bioinformatics (also called computational biology) is a cross-disciplinary field that encompasses computer science, mathematics, and biology in order to extract meaningful information from large biological datasets. Minot State University is the only school within the surrounding five state region to offer an undergraduate bioinformatics degree.

General Education

General Education Requirements 38

Core Requirements Coursework

Biology

Students must take:

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<tr>
<th>Course</th>
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<td>BIOL 150</td>
<td>Introduction To Cellular Biology</td>
<td>4</td>
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<tr>
<td>BIOL 215</td>
<td>Genetics</td>
<td>4</td>
</tr>
<tr>
<td>BIOL 480</td>
<td>Molecular Biology</td>
<td>4</td>
</tr>
<tr>
<td>BIOL 402</td>
<td>Bioinformatics</td>
<td>4</td>
</tr>
<tr>
<td>BIOL 492</td>
<td>Directed Research</td>
<td>1-5</td>
</tr>
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Select one of the following: 4

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<tr>
<td>BIOL 154</td>
<td>Introduction To Botany</td>
</tr>
<tr>
<td>BIOL 202</td>
<td>Introductory Microbiology</td>
</tr>
</tbody>
</table>

Chemistry

<table>
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<tr>
<td>CHEM 121</td>
<td>General Chemistry I</td>
<td>5</td>
</tr>
<tr>
<td>CHEM 122</td>
<td>General Chemistry II</td>
<td>5</td>
</tr>
</tbody>
</table>

1 Requires admittance to Teacher Education. Refer to Teacher Education Policies and Procedures (http://catalog.minotstateu.edu/undergraduate/teachereducationpoliciesandprocedures).
**Mathematics**

<table>
<thead>
<tr>
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<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATH 165</td>
<td>Calculus I</td>
<td>4</td>
</tr>
<tr>
<td>MATH 166</td>
<td>Calculus II</td>
<td>4</td>
</tr>
<tr>
<td>MATH 208</td>
<td>Discrete Mathematics I</td>
<td>3</td>
</tr>
<tr>
<td>MATH 210</td>
<td>Elementary Statistics</td>
<td>4</td>
</tr>
<tr>
<td>MATH 345</td>
<td>Linear Models</td>
<td>4</td>
</tr>
</tbody>
</table>

**Computer Science**

(16 credits; which would qualify the student for a CS certificate)

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>CSCI 160</td>
<td>Computer Science I</td>
<td>4</td>
</tr>
<tr>
<td>CSCI 161</td>
<td>Computer Science II</td>
<td>4</td>
</tr>
<tr>
<td>CSCI 260</td>
<td>UNIX Environment</td>
<td>4</td>
</tr>
<tr>
<td>CSCI 356</td>
<td>Database Management I</td>
<td>4</td>
</tr>
</tbody>
</table>

**Total Hours** 104-108

The Medical Laboratory Science (MLS) program at Minot State University is a four year program leading to the Bachelor of Science Degree in Medical Laboratory Science/Medical Technology. The program consists of courses that are designed to give the medical laboratory science student the necessary, scientific background to enter clinical training at an accredited hospital laboratory.

The program consists of three years of academic coursework completed at Minot State University. Through an affiliation with the University of North Dakota (UND), students spend 12 months in a clinical internship at one of the many participating accredited hospitals, as a member of the Western College Alliance for MLS.

The academic portion of the program provides the student with a broad-based background in the sciences as well as General Education courses in communications, the humanities and the social and behavioral sciences. The clinical year provides practical, hands on, experience in clinical laboratory techniques.

The first two years of the program primarily involve General Education courses and fundamental courses in chemistry, microbiology, anatomy and physiology. The third year involves the students in courses more directly relevant to their major, such as parasitology, hematology, and immunology. These courses address more specifically what the student will encounter during the clinical internship year. Minot State University’s medical laboratory science program is accredited by the NAAACLS through UND. All affiliated hospitals are accredited by the Council on Medical Education. Upon completion, the student is eligible to take the national examination conducted by the Board of Registry to become a certified clinical laboratory scientist by the American Society of Clinical Pathologists MT (ASCP) and the National Certification Agency for Medical Laboratory Personnel National Exam for certification as Medical Laboratory Scientist.

Acceptance to clinical year requires:

1. Satisfactory completion of required preparatory course work prior to the final year.
3. No more than one grade of “D” in preparatory coursework.
4. Not more than three courses with repeats for “D” or “F” grades.
5. Evidence of professional integrity (letter of recommendation from advisor).
6. Completion of the UND application process by the specified deadline.

**Bachelor of Science with a Major in Medical Laboratory Science**

**Required Courses**

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<thead>
<tr>
<th>Course</th>
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<tr>
<td>BIOL 150</td>
<td>Introduction To Cellular Biology</td>
<td>4</td>
</tr>
<tr>
<td>BIOL 103</td>
<td>Intro to Medical Lab Science</td>
<td>1</td>
</tr>
<tr>
<td>BIOL 202</td>
<td>Introductory Microbiology</td>
<td>4</td>
</tr>
<tr>
<td>BIOL 220</td>
<td>Anatomy And Physiology I</td>
<td>4</td>
</tr>
<tr>
<td>BIOL 221</td>
<td>Anatomy And Physiology II</td>
<td>4</td>
</tr>
<tr>
<td>BIOL 450</td>
<td>Parasitology</td>
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<td>CHEM 121</td>
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<td>5</td>
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<td>5</td>
</tr>
<tr>
<td>CHEM 230</td>
<td>Quantitative Analysis</td>
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<tr>
<td>CHEM 240</td>
<td>Fundamentals of Organic Chemistry</td>
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CHEM 481 Biochemistry I 3
BADM 301 Fundamentals of Management 3
MATH 103 College Algebra 4
CLS Medical Microbiology 2
Total Hours 61

1 Offered as a distance course through UND. May be taken as a collaboratively through Minot State University.

**Biology Minor (Teaching and Non-Teaching)**

Students must take:
- BIOL 150 Introduction To Cellular Biology 4
- BIOL 215 Genetics 4
Select two of the following: 8
  - BIOL 151 Introduction to Zoology
  - BIOL 154 Introduction To Botany
  - BIOL 202 Introductory Microbiology
Choose three 300 or 400 level courses 12
Total Hours 28

**Bioinformatics Minor**

- BIOL 402 Bioinformatics 4

**Mathematics Courses:**
- MATH 146 Applied Calculus 3
- MATH 165 Calculus I 4

**Computer Science**
- CSCI 160 Computer Science I 4
- CSCI 161 Computer Science II 4
- CSCI 260 UNIX Environment 4
- CSCI 356 Database Management I 4
Total Hours 27

**Biology Concentration**

Students must take:
- BIOL 150 Introduction To Cellular Biology 4
Select two of the following: 8
  - BIOL 151 Introduction to Zoology
  - BIOL 154 Introduction To Botany
  - BIOL 202 Introductory Microbiology
  - BIOL 215 Genetics
Total Hours 12

**BIOL Courses**

**BIOL 103. Intro to Medical Lab Science. 1 Hour.**
Designed to acquaint first year student (freshman) medical technology students the the depth and breadth of this field. Students visit medical technology departments at local hospitals. The course is presented by the education coordinators at local hospitals. Lecture, 1 hour.

**BIOL 111. Concepts of Biology. 4 Hours.**
This course is an overview of the science of biology designed for non-majors. The course will focus on a comprehensive survey of modern biology with an emphasis on enhancing the science literacy of the college educated student. Topics will include, but not limited to: cell biology, genetics, evolution by natural selection, systematics, and the impact of human activity on the biosphere. Where appropriate, topics will be illustrated with examples of the human animal. Lecture, 3 hours; laboratory, 2 hours.
BIOL 111H. Honors Concepts of Biology. 4 Hours.
This course is designed to accommodate one semester of the general education requirement for non-science majors at Minot State University. The course will focus on a comprehensive survey of modern biology with an emphasis on enhancing the science literacy of the college-educated student. Topics will include, but are not limited to: cell biology, genetics, evolution by natural selection, systems, and the impact of human activity on the biosphere. Where appropriate, topics will be illustrated with examples of the human animal, and at all times the course will reflect the five strands of a general education course. Laboratory time will focus on small-scale research projects and in-depth discussion. Pre-requisite: admission to the Honors Program.

BIOL 115. Concepts of Anatomy & Physiology. 4 Hours.
This is an introductory level course in the basic principles of anatomy and physiology as they relate to the structure and function of the human body. It is designed for physical education and corporate fitness majors. This course does not count toward any biology major. Lecture, 3 hours; laboratory, 2 hours.

BIOL 127. Enviromental Biology. 4 Hours.
Designed to acquaint students with major principles of ecology and the nature of human interaction with the living world. The course will focus on how human action influences the ecology of the earth. Ecological concepts covered will include community structure, predator-prey interactions, competition, trophic levels, energy flow, the carbon cycle, and adaptation. In this light, students will examine specific issues and problems including those of land use choices, natural resource exploitation, biodiversity, industrialization, and urbanization.

BIOL 150. Introduction To Cellular Biology. 4 Hours.
Introduction to fundamental concepts of biology at the level of the cell including: bioenergetics, cell structure, physiology principles, genetic function and inheritance. Lecture, 3 hours; laboratory, 2 hours.

BIOL 150H. Honors General Biology I. 4 Hours.
Introduction to fundamental concepts of biology at the level of the cell including: bioenergetics, cell structure, physiology principles, genetic function and inheritance. Laboratory time will focus on small-scale research projects and in-depth discussion. Prerequisite: Student must be admitted to the Honors Program and complete CHEM 115 or 121 before enrolling in this course.

BIOL 151. Introduction to Zoology. 4 Hours.
This introductory biology course is intended for science majors interested in animal biology. The course begins with an introduction to the scientific method and some select cellular functions. The course then introduces some basic concepts of genetics, which leads to an exploration of evolutionary theory. This is followed by an exploration of animal diversity, with a heavy emphasis on animal structure, function, and evolutionary relationships. The course ends with a brief exploration of animal ecology. Lab exercises involve some dissections of preserved animals. Lecture, 3 hours; laboratory, 2 hours.

BIOL 151H. Honors General Biology II. 4 Hours.
The biology of animals is covered beginning with an emphasis on the underlying cellular structure and physiology and expanding towards larger whole organism features that are difficult to predict from cell biology. The general patterns of animal life are covered. In an effort to connect the general principles offered in this course to one's daily life (e.g. cellular respiration, excretion, muscle structure and function), an emphasis is placed on a mammalian systems. Laboratory time will focus on small-scale research projects and in-depth discussion. Pre-requisite: admission to the Honors Program.

BIOL 154. Introduction To Botany. 4 Hours.
Introduction to the biology of plants emphasizing evolution and diversity, plant anatomy and development, water and mineral nutrition, photosynthesis, and plant ecology. Lecture, 3 hours; laboratory, 2 hours.

BIOL 154H. Honors Introduction to Botany. 4 Hours.
Introduction to the biology of plants emphasizing evolution and diversity, plant anatomy and development, water and mineral nutrition, photosynthesis, and plant ecology. Laboratory time will focus on small-scale research projects and in-depth discussion. Pre-requisite: admission to the Honors Program.

BIOL 202. Introductory Microbiology. 4 Hours.
A survey of microbial cell biology, microbial genetics, microbial interaction with humans, and the impact of microorganisms on the environment. Lecture, 3 hours; laboratory, 2 hours.

BIOL 215. Genetics, 4 Hours.
Introduction to principles of genetics including: inheritance, DNA and chromosomes, gene regulation, evolution, and genetic engineering. Lecture, 3 hours; laboratory, 3 hours. Prerequisite: BIOL 150.

BIOL 220. Anatomy And Physiology I. 4 Hours.
Structure and function of the human body dealing with the chemical, cellular, and tissue levels of organization and integumentary, skeletal, muscular, and nervous systems. Lecture, 3 hours; laboratory, 3 hours.

BIOL 221. Anatomy And Physiology II. 4 Hours.
Structure and function of the human body dealing with the digestive, cardiovascular, respiratory, lymphatic, endocrine, reproductive, and urinary systems; special senses, metabolism, fluid and electrolyte, and acid-base balance. Lecture, 3 hours; laboratory, 3 hours. Prerequisite: BIOL 220.

BIOL 240. Biometry. 4 Hours.
The course will cover introductory statistic concepts in a form designed specifically for biology majors. It is a practical, software-based examination of concepts of sampling, hypothesis testing (non-parametric and parametric), descriptive statistics, contingency, correlation, analysis of variation, linear models and basic multivariate techniques. Only biological, real-world data will be used. The course will concentrate on underlying principles, applicability and practical use of methods covered. Prerequisites: Students must complete Math 103 or higher and at least two of BIOL 150, 151, and 154.
BIOL 250. Cellular Biology. 4 Hours.
An advanced cell biology designed for biology majors with an emphasis on biological chemistry, membrane and transport, cellular energy metabolism, protein synthesis, and modification, subcellular organelle structure and function, and the cell biology of the nucleus. Lecture, 3 hours; laboratory, 2 hours. Prerequisite: BIOL 150.

BIOL 299. Special Topics. 1-8 Hour.

BIOL 301. Evolution. 3 Hours.
This course details the processes that influence evolutionary change. An emphasis is placed on the methodology for (1) inferring phylogenetic relationships (i.e., history), (2) determining the relative influences of natural selection and genetic drift, and (3) exploring the conditions that lead to various modes of speciation. Topics covered include population genetics, speciation, microevolution vs. macroevolution, punctuated equilibrium, life history theory, and modes of selection. Lecture, 3 hours. Prerequisites: BIOL 150, 151, 154, 215.

BIOL 302. General Microbiology. 4 Hours.
Students will develop a working understanding of the structure, growth, nutrition, metabolism, genetics, diversity and ecology of Bacteria, Archaea and viruses. Prerequisite: Students must complete BIOL 215 before enrolling in this course.

BIOL 310. Ethnobotany. 4 Hours.
This course will focus on the diversity of plant uses, covering approaches of diverse cultures, including introduction to medicinal plants, plant uses specific to North Dakota, and Native American plant use. Lecture, 3 hours, Lab 3 hours.

BIOL 325. Entomology. 4 Hours.
Classification, taxonomy, morphology, identification, life histories, interrelationships, and economic importance of insects. Lecture, 3 hours; laboratory, 3 hours. Prerequisite: Student must complete BIOL 151 before enrolling in this class.

BIOL 330. Biogeography. 4 Hours.
This course will describe the spatial patterns in the distribution of plants and animals and will examine how different factors influence these patterns. Lecture, 3 hours; recitation/lab, 2 hours. Prerequisites: BIOL 151 and 154.

BIOL 335. Comparative Vertebrate Anatomy. 4 Hours.
A study of the structure of vertebrates, with a focus on revealing the evolutionary relationships of major vertebrate groups. The laboratories will involve detailed examination and dissection of a broad range of vertebrate animals, including lampreys, sharks, amphibians, reptiles, and cats. Lecture, 3 hours; Lab, 3 hours. Prerequisites: BIOL 151 or 151H.

BIOL 340. Systematic Zoology. 4 Hours.
Evolution, classification, taxonomy, and identification of invertebrates and vertebrates. Lecture, 3 hours; laboratory, 3 hours. Prerequisite: Students must complete BIOL 151 before enrolling in this class.

BIOL 346. Developmental Biology. 4 Hours.
This course covers the morphological changes occurring during the development of select animals, as well as the current understanding of underlying molecular mechanisms that regulate development and produce those morphological changes. Lecture, 3 hours; laboratory, 3 hours. Prerequisite: Student must complete BIOL 215 before enrolling in this class.

BIOL 347. General Ecology. 4 Hours.
Plants and animals in their environment. An ecosystem approach is used. Lecture, 3 hours; laboratory, 3 hours. Prerequisite: Student must complete BIOL 150 and either 151, 142 or 154 before enrolling in this class.

BIOL 349. Plant Physiology. 4 Hours.
Physiological processes of plants with special emphasis on nutrition, metabolism, growth, and development. Lecture, 3 hours; laboratory, 3 hours. Prerequisites: BIOL 150.

BIOL 350. Freshwater Biology. 4 Hours.
Biological, chemical, and physical characteristics of inland waters including origins, interrelationships and the effect of civilization. Lecture, 3 hours; laboratory, 3 hours. Prerequisite: Students must complete BIOL 142 or 150 or 151 or 154 before enrolling in this class.

BIOL 360. Morphology of Vascular Plants. 4 Hours.
Structure and development of vascular plants with special emphasis on evolutionary trends. Lecture, 3 hours; laboratory, 3 hours. Prerequisite: Students must complete BIOL 150 before enrolling in this class.

BIOL 394. Independent Study General Biol. 1-4 Hour.

BIOL 401. Population Genetics. 4 Hours.
This course explores the mechanics of evolution from the viewpoint of allelic frequencies. It begins with the basic theory of Hardy Weinberg equilibrium and expands that theory to embrace linkage disequilibrium, selection in single-locus and multifocus systems, genetic drift, and the effects of mutation rates, population size, and migration on the genetic structure of populations. Exposure is given to classic ideas (e.g., shifting balance theory and runaway sexual selection) and to applications of theory (e.g., breeding designs, conservation genetics). Lecture, 3 hours; recitation, 1 hour. Prerequisites: BIOL 215.

BIOL 402. Bioinformatics. 4 Hours.
Computational methods for study of biological sequence data in comparative biology and evolution. Analysis of genome content and organization. Techniques for searching sequence databases, pairwise and multiple sequence alignment, phylogenetic methods, and methods for pattern recognition and functional inference from sequence data. Pre-Requisites: Biol 150 and Math 103 or permission of the instructor.
Biol 405. Prokaryotic Physiology. 4 Hours.
Indept examination of the physiology, metabolism, and genetics of bacteria and archaea. Lecture, 3 hours; Laboratory, 3 hours. Prerequisites: BIOL 215 and 151 or 142, or 154.

BIOL 420. Co-Op Practicum. 4-8 Hours.
A cooperative program with industry, state, and federal agencies for an in-depth study of a specialized aspect of biology. Students spend approximately 25 clock hours per semester hour for the practicum. Prerequisites: 2 years of biology or consent of biology coordinator.

BIOL 430. Pre-Veterinary Practicum. 3 Hours.
This program is designed to give MSU students a hands-on experience in veterinary medicine. The students spend about 80 hours per semester for the practicum. Prerequisite: 2 years of biology.

BIOL 440. Pre-Med Practicum. 3 Hours.
This program is designed to give MSU students a basic understanding of the hospital and its functions. Students spend approximately 90 hours per semester in the various departments and the family practice clinic. Students are supervised by the physicians involved in the program while the program is coordinated by a biology professor on campus. Prerequisite: Consent of instructor.

BIOL 445. Cancer Biology. 3 Hours.
This course describes the major aspects of cell cycle control and relates them to the multiple cell cycle defects associated with cancer. Lecture, 3 hours. Prerequisites: BIOL 215.

BIOL 448. Systematic Botany. 4 Hours.
Classification and taxonomy of plants with emphasis on local flora. Lecture, 3 hours; laboratory, 3 hours. Prerequisite: BIOL 154.

BIOL 450. Parasitology. 4 Hours.
Morphology, taxonomy, and life histories of the endemic, exotic, and zoonotic parasites of the animal kingdom. Diseases caused by parasites are also presented. Lecture, 3 hours; laboratory, 3 hours. Prerequisite: Restricted to students who Medical Laboratory Science majors.

BIOL 455. Hematology. 4 Hours.
Study of the blood and hematologic disorders including anemia, leukemia, and other blood dyscrasias. Lecture, 3 hours; laboratory, 3 hours. Prerequisite: Restricted to students who Medical Laboratory Science majors.

BIOL 458. Anatomy of Seed Plants. 4 Hours.
Development of cells, tissues, and organs in seed plants. Lecture, 3 hours; laboratory, 3 hours. Prerequisites: BIOL 150.

BIOL 460. Herpetology. 4 Hours.
Herpetology is the study of reptiles (exclusive of birds) and amphibians; this includes extant groups (e.g., frogs) and extinct groups (e.g., dinosaurs). This course begins with the phylogeny, history, and taxonomy of "herps" (i.e., reptiles and amphibians) and progresses to coverage of physiology, ecology, and behavior. Prerequisite: BIOL151.

BIOL 465. Immunology. 4 Hours.
Principles and techniques of immunology and serology. Lecture, 3 hours; laboratory, 3 hours. Prerequisites: BIOL 150.

BIOL 470. Histology. 4 Hours.
The course presents the microscopic anatomy of vertebrates with an emphasis on humans. Structure-function relationships at the cell and tissue levels are highlighted. Cell and tissue anatomy comprise the structural basis of normal physiology. Knowledge of histology is essential for understanding disease mechanisms in terms of altered structure and function of the body. Students are expected to identify cells, tissues and organs, and understand the structural basis of their function. Emphasis is placed on microscopic study in laboratories. Lecture, 2 hours; laboratory, 4 hours. Prerequisite: BIOL 150 or 220.

BIOL 475. Clinical Microbiology. 4 Hours.
Isolation, identification, and clinical application of pathogenic microorganisms. Lecture, 3 hours; laboratory, 3 hours. Prerequisite: BIOL 142.

BIOL 480. Molecular Biology. 4 Hours.
This course covers a variety of topics concerning the macromolecules of living cells, focusing on nucleic acids and proteins. Major areas of study include: DNA replication and transcription, protein synthesis (translation), and comparison of processes in prokaryotic and eukaryotic cells. The latter part of the course will focus on mechanisms of gene expression, the molecular genetics fo cancer, and applied molecular biology. Lecture, 3 hours; laboratory, 3 hours. Prerequisite: Student must complete BIOL 215 before enrolling in this class.

BIOL 481. Plant Biochemistry. 4 Hours.
This course explores the biochemical pathways of plants with an emphasis carbon and nitrogen metabolism as well as the diverse secondary metabolism of plants. Lecture, 3 hours; Laboratory, 3 hours.

BIOL 482. Neurobiology. 4 Hours.
This course covers the organization and function of the nervous system. Students will learn about the nervous system at the anatomical, neurophysiological and molecular level. The course starts with the study of neuron at the cellular level and how they communicate chemically as individual cells and as a group. We then cover topics in sensation and how the nervous system commands the body. In the later part of the semester we will examine the neurobiology of human behavior, such as motivation, attention etc. and mental illnesses. Lecture, 3 hours. Laboratory, 3 hours. Prerequisites: Students must complete BIOL 150, CHEM 121, and 122 before enrolling in this course. Student must also have sophomore status or higher.
BIOL 492. Directed Research. 1-5 Hour.
The faculty of the Department of Biology considers a valuable component of the curriculum. The content and extent of research projects are determined by the student and a faculty sponsor. The research may be in the lab or field and is intended to help the student develop a greater appreciation of the scientific process. While publication is not a requirement, all projects have a goal of producing publishable results. A successful experience in research can be an asset for graduate studies and many careers in biology. Prerequisites: BIOL 150 and 151, or 142, or 154.

BIOL 499. Special Topics. 1-8 Hour.

CHEM Courses

CHEM 110. Survey of Chemistry. 4 Hours.
An introductory course covering topics that concern students’ everyday lives. This course is designed for liberal arts and general education students. The course consists of an introduction to the science and includes historical perspectives. The course is intended to present chemistry in its broad culture, social, and economic context. Lecture, 3 hours; laboratory, 2 hours.

CHEM 110H. Honors Survey of Chemistry. 4 Hours.
An introductory course covering topics that concern students’ everyday lives. This course is designed for liberal arts and general education students. The course consists of an introduction to the science and includes historical perspectives. The course is designed to present chemistry in its broad cultural, social, and economic context. Assignments will include investigation of specific topics and written descriptions of the findings. Lecture, 3 hours; laboratory, 3 hours. Prerequisite: Honors program admission or 3.30 cumulative GPA and permission of the instructor.

CHEM 115. Introductory Chemistry. 4 Hours.
Presents knowledge of concepts of chemical principles in greater depth and with more mathematical applications than in CHEM 110. Includes studies of general inorganic principles. Lecture, 3 hours; laboratory, 2 hours.

CHEM 115H. Honors Introductory Chemistry. 4 Hours.
This course introduces concepts in general, organic, and biochemistry. Topics likely to be covered include: measurement, atoms, molecules, elements, the periodic table, nuclear chemistry, compounds, bonds, molecular geometry, classes of organic compounds, gases, liquids, solutions, chemical reactions, solutions, acids, bases, and biochemical compounds. Assignments will include investigation of specific topics and written descriptions of the findings. Lecture, 3 hours; laboratory, 3 hours. Corequisite: Math 102 or 103. Prerequisite: Honors program admission or 3.30 cumulative GPA and permission of the instructor.

CHEM 121. General Chemistry I. 5 Hours.
This course is the first of two-semester sequence primarily intended for students majoring in science and science-related fields. Topics likely to be covered in this semester include: matter, measurement, atoms, ions, molecules, reactions, chemical calculations, thermochemistry, bonding, molecular geometry, periodicity, and gases. Lecture, 3 hours; recitation, 1 hour; laboratory, 3 hours. Corequisite: MATH 103.

CHEM 121H. Honors General Chemistry I. 5 Hours.
This course is the first of a two-semester sequence primarily intended for students majoring in science and science-related fields. Topics likely to be covered in this semester include: matter, measurement, atoms, ions, molecules, reactions, chemical calculations, thermochemistry, bonding, molecular geometry, periodicity, and gases. Note: Chem 121 and 121L must be taken concurrently. Assignments will include investigations of specific topics and written descriptions of the findings. Lecture, 3 hours; recitation, 1 hour; laboratory, 3 hours. Corequisite: Math 103. Prerequisite: Honors program admission or 3.30 cumulative GPA and permission of the instructor.

CHEM 122. General Chemistry II. 5 Hours.
This course in the second of a two-semester sequence primarily intended for students majoring in science and science-related fields. Topics likely to be covered in this semester include: intermolecular forces, liquids, solids, kinetics, equilibria, acids, bases, solution chemistry, precipitation, thermodynamics, and electrochemistry. Lecture, 3 hours; recitation, 1 hour; laboratory, 3 hours. Prerequisite: CHEM 121.

CHEM 122H. Honors General Chemistry II. 5 Hours.
This course is the second of a two-semester sequence primarily intended for students majoring in science and science-related fields. Topics likely to be covered in this semester include: intermolecular forces, liquids, solids, kinetics, equilibria, acids, bases, solution chemistry, precipitation, thermodynamics, and electrochemistry. Assignments will include investigation of specific topics and written descriptions of the findings. Lecture, 3 hours; recitation, 1 hour; laboratory, 3 hours. Corequisite: Math 103. Prerequisites: CHEM 121H/121HL, Honors program admission or 3.30 cumulative GPA and permission of the instructor.

CHEM 127. Chemistry of the Environment. 4 Hours.
This course is unique in that it uses topics of concern/interest to facilitate the learning and understanding of the scientific concepts behind them. The course will use current environmental topics, such as our atmosphere, global warming, energy, the ozone layer and water quality, to bring forward important chemical concepts as naming, bonding, stoichiometry, energetics, pH and chemical reactions. The course will also bring an interdisciplinary flavor to the material, discussing such topics as the carbon cycle and biological contributions, how earth processes may affect the quality of our drinking water and the effect of acid rain on the earth (both in terms of the geology and the ecosystem).

CHEM 227. Principles of Environmental Chemistry. 4 Hours.
Designed to provide students with a basic introduction to Environmental Chemistry. The course will introduce students to the environmental pathways, toxicology, and organic and inorganic environmental contaminants. The students will also study various processes in the environment, including those in air, soil, and water. Depending on time, the students may also be introduced to the managment of hazardous chemicals. Prerequisite: Student must complete CHEM 127 before enrolling in this course.
CHEM 230. Quantitative Analysis. 5 Hours.
A course in quantitative chemistry including gravimetric and volumetric analysis, statistical treatment of data, and an introduction to some instrumental analysis. Lecture, 3 hours; laboratory, 6 hours. Prerequisites: CHEM 122.

CHEM 240. Fundamentals of Organic Chemistry. 5 Hours.
Theory of bonding and structure in organic molecules and their reactions. An emphasis on functional groups related to biological molecules. This course presents the minimum preparation for CHEM 480. Offered in the spring. Lecture, 4 hours; laboratory, 2 hours. Prerequisite: CHEM 122.

CHEM 299. Special Topics. 1-8 Hour.

CHEM 341. Organic Chemistry I. 5 Hours.
A study of different classes of organic functional groups, their nomenclature, reactions, and properties. An introduction to Infrared and Nuclear Magnetic Resonance Spectroscopy is included. Offered in the fall. Lecture, 3 hours; laboratory, 3 hours; recitation, 1 hour. Prerequisite: CHEM 122.

CHEM 342. Organic Chemistry II. 5 Hours.
A continuation of CHEM 341. A study of the chemical and mechanistic properties of organic functional groups. Offered in the spring. Lecture, 3 hours; laboratory, 3 hours; recitation, 1 hour. Prerequisite: CHEM 122.

CHEM 360. Principles of Physical Chemistry. 4 Hours.
This course is designed for students interested in chemical education at the secondary level. Topics include gas laws, thermodynamics, equilibria, kinetics, quantum mechanism and spectroscopy. Offered alternate years. Lecture, 3 hours; laboratory, 3 hours. Prerequisites: CHEM 230 and MATH 107.

CHEM 380. Environmental Chemistry. 4 Hours.
The course examines the interaction of chemical substances with the environment. Emphasis is placed on water quality and air quality. Offered alternate years. Lecture, 3 hours; laboratory, 3 hours. Prerequisite: CHEM 230.

CHEM 420. Inorganic Chemistry. 3 Hours.
An advanced course in inorganic chemistry, including theories of covalent and ionic bonding, crystalline structure, coordinate covalent bonding, group theory, and coordination chemistry. Offered alternate years. Lecture, 3 hours. Prerequisites: CHEM 122, MATH 165.

CHEM 422. Inorganic Synthesis. 1 Hour.
Applied techniques in inorganic synthesis and compound characterization. Offered on demand. Laboratory, 3 hours. Prerequisite: Consent of instructor. Corequisite: CHEM 420.

CHEM 430. Instrumental Analysis. 5 Hours.
A survey of instrumental methods used for chemical analysis. These methods include molecular absorption, atomic absorption and emission, fluorescence and phosphorescence, infrared absorption chromatography, nuclear magnetic resonance and mass spectrometry. Offered alternate years. Lecture, 3 hours; laboratory, 6 hours. Prerequisite: CHEM 230.

CHEM 436. Methods of Analysis and QC of Medicinal Plant Products. 5 Hours.
A study of methods for chemical analysis and quality assurance/quality control of medicinal botanical products and their extracts. Methods studied will include spectroscopy, gas and liquid chromatography, and gravimetric analysis. Aspects of quality assurance, calibration, and method validation will also be discussed and applied. Lecture, 3 hours; laboratory, 6 hours. Prerequisites: CHEM 230. CHEM 430 recommended.

CHEM 440. Organic Spectroscopy. 3 Hours.
Identification of organic molecules via spectroscopic methods. Methods studied include infrared, UV-visible, proton and carbon-13 nuclear magnetic resonance, and mass spectrometry. Offered alternate years. Lecture, 2 hours; laboratory, 2 hours. Prerequisite: CHEM 342.

CHEM 442. Medicinal Chemistry. 4 Hours.
This course is designed for students interested in medicinal applications of organic chemistry and for students interested in continuing their education in medicine, pharmacy, and other health related fields. The course offers the study of major classes of medicinal compounds presented in a broad historic and cultural perspective of the development of medicinal chemistry from the first attempt to synthesize quinine in the early XIX century to modern days' antibiotics. Offered alternate years. Lecture, 3 hours. Laboratory, 3 hours. Prerequisite: CHEM 342 and junior or senior status.

CHEM 461. Physical Chemistry I. 4 Hours.
This course is the first of a two-semester sequence of calculus-based physical chemistry for chemistry majors. Topics covered include thermodynamics and equilibrium. Offered alternate years. Lecture, 3 hours; laboratory, 3 hours. Prerequisites: CHEM 122, MATH 166, and PHYS 222.

CHEM 462. Physical Chemistry II. 4 Hours.
A continuation of CHEM 461. Topics include: quantum mechanics, molecular orbital theory, group theory, and spectroscopy. Offered alternate spring terms. Lecture, 3 hours; laboratory, 3 hours. Prerequisite: CHEM 461.

CHEM 480L. Biochemistry Laboratory. 2 Hours.
A course covering theory and laboratory experience with a variety of techniques used in biochemistry. Laboratory, 6 hours. Prerequisite: CHEM 230. Corequisite: CHEM 481.

CHEM 481. Biochemistry I. 3 Hours.
Study of major classes of biological compounds, synthesis of macromolecules, enzyme kinetics, intermediary metabolism, and control mechanisms. Lecture, 3 hours. Prerequisite: BIOL 150 and CHEM 240 or 342.
CHEM 482. Biochemistry II. 3 Hours.
A continuation of Chem 481 with more in-depth studies of particular pathways; particular emphasis is placed on medicinal chemistry and on corresponding clinical applications associated with the various pathways. Lecture 3 hours; Pre-requisite Chem 481.

CHEM 494. Directed Research in Chemistry. 1-6 Hour.
Students conduct research under the direction of a faculty mentor. The general topic and specific goals and activities are agreed upon by the student and the mentor. The number of credits is proportional to the time committed to the research.

CHEM 497. Internship in Chemistry. 1-4 Hour.
A cooperative occupational training program in the field of chemistry or a related area. The course may be repeated in the same or different position. Prerequisite(s): Departmental approval and student must be a Chemistry or Chemistry Education major. Student must be at Junior or Senior status.

CHEM 499. Special Topics. 1-8 Hour.