Department of Molecular Biology and Chemistry

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Faculty

Professor: Abdel-Fattah, Brunke
Associate Professor: J. M. Carney, Grau, Klein, Meighan, Webb
Assistant Professor: Bogenpohl, K. Cole, Gruber, Knies, Mitrano, Patterson, Quinlan, Wiens
Visiting Assistant Professor: S. Harris, Quinlan
Lecturer: Brown, Knight, Lasseter, Liskin, Shima Tombolato-Terzić
Emeriti: Chang, Hammer, Sacks

Mission Statement

The Department of Molecular Biology and Chemistry (MBCH) will develop a meaningful level of scientific literacy in all students through exploration of fundamental concepts and processes of the natural world. Majors build upon this foundation and gain the necessary background, understanding, and experience to be successful in the fields of biology, chemistry and biochemistry; this is achieved through coursework complemented by research and independent study opportunities. The MBCH faculty members are actively engaged in quality teaching, research, mentoring and service. These traditions provide the model for our goal to instill motivation, intellectual drive, dedication, integrity, and professionalism in all of our graduates.

The aims of the curriculum and faculty in the Department of Molecular Biology and Chemistry are to acquaint students with the body of knowledge in these disciplines and to teach them to apply this knowledge usefully and responsibly. Coursework includes discussion of historical and philosophical developments of biology and chemistry. The biology program is organized to enable majors to survey the entire field of biology and also to focus in one of a number of areas including molecular biology, cellular biology, microbiology, physiology and genetics. The chemistry program allows the major student to develop a solid foundation in the core areas of chemistry and provides upper-level coursework in more specialized areas such as biochemistry and environmental, atmospheric, and advanced organic chemistry. Both programs offer excellent preparation for one of the many health professional programs.

The Department offers two degrees: the Bachelor of Science in biology and the Bachelor of Science in chemistry. Within the Bachelor of Science in Biology there are four possible majors and within the Bachelor of Science in chemistry there are two possible majors. Additional information about the department, the degrees offered, and other opportunities can be obtained from the department office or the department website at mbch.cnu.edu.

Note that the Department of Organismal and Environmental Biology offers the Bachelor of Arts in biology. Additional biology courses and more details on the environmental biology and organismal biology majors can be found in the Department of Organismal and Environmental Biology section.

Health-Related Professions

The CNU Pre-med and Pre-health Program can help students from any academic major prepare for application to medical school and other health profession programs. Many students find that a biology or chemistry major provides excellent preparation for these career choices. The Program offers a variety of resources, such as academic and career advising, mentoring, clinical internship opportunities, workshops and seminars to help any highly motivated student gain admission to the professional school of her or his choice. Additional information can be obtained at prehealth.cnu.edu or by contacting the Director of Pre-health Programs, Dr. Gwynne D. Brown, at (757) 594-8255 or gwynne.brown@cnu.edu.

The Bachelor of Arts Degree in Biology

The Bachelor of Arts degree in biology, which is overseen by the Department of Organismal and Environmental Biology, requires a minimum of 35 credits in biology. Students may present no more than two biology courses with grades lower than *C*- for the degree.

In addition to the successful completion of the liberal learning curriculum and the Senior Assessment Test in Biology, the Bachelor of Arts degree in biology requires the successful completion of:

1. Biology Core*: BIOL 211/211L-212/212L- 213/213L, 391W, 491W;
2. CHEM 103/103L-104/104L*;
3. MATH 125 and 130 or higher;
4. 21 credits of biology courses with a minimum of four credits chosen from each of the required course lists: cellular, molecular & physiological biology major, environmental biology major, organismal biology major. At least three of the courses taken must have a laboratory component. Only three of those credits can be at the 200-level.

* The biology degree requires that students have a *C* or better in BIOL 211/211L-212/212L-213/213L and a *C*- or higher in BIOL 391W and 491W and CHEM 103/103L-104/104L.

The Bachelor of Science Degree in Biology

The Bachelor of Science degree in biology requires a minimum of 35 credits in Biology. In the B.S. in biology, students must choose an area of focus called a major. Three of the majors build upon the introductory biology and chemistry courses by way of specific sets of courses in the area of focus: cellular, molecular and physiological biology; environmental biology; and organismal biology. The fourth major, integrative biology, allows students to continue to build upon the breadth of the foundation courses at the upper level.

Students may present no more than two biology courses with grades lower than *C*- for the degree. **Earning a double major within the Bachelor of Science degree in biology is not possible.**

In addition to successful completion of the liberal learning curriculum and completion of the Senior Assessment Test in Biology, the Bachelor of Science degree in biology requires successful completion of the following courses:

The Major in Cellular, Molecular and Physiological Biology

1. Biology Core*: BIOL 211/211L-212/212L-213/213L, 391W, 491W;
2. CHEM 121/121L-122/122L*, 321/321L-322/322L;
3. MATH 125 and 130 or higher;
4. PHYS 151/151L-152/152L;
5. 21 credits of biology courses, only three of those credits can be at the 200-level. Of these 21 credits at least 15 must come from the following courses, and three of these courses must have a laboratory component: BIOL 301/301L, 307/307L, 313, 314/314L, 315/315L, 412/412L, 420/420L; and BCHM 414/414L**, 415/415L.

* The biology degree requires that students have a *C* or higher in BIOL 211/211L-212/212L-213/213L and a *C*- or higher in BIOL 391W and 491W and CHEM 121/121L-122/122L.

**BCHM 414/414L is equivalent to both BIOL 414/414L and CHEM 414/414L; credit can be given for only one set of these courses.

The Major in Environmental Biology

See catalog description for Department of Organismal and Environmental Biology

The Major in Integrative Biology

See catalog description for Department of Organismal and Environmental Biology

The Major in Organismal Biology

See Catalog description for Department of Organismal and Environmental Biology

The Minor in Biology (27 Credits)

A minor in biology requires BIOL 211/211L-212/212L-213/213L all with a grade of C or higher, (requires the completion of CHEM 103/103L-104/104L or CHEM 121/121L-122/122L) and a minimum of seven BIOL credits at the 300- or 400-level, including one course with a laboratory component.

The Bachelor of Science Degree in Chemistry

For the Bachelor of Science degree in Chemistry, students can choose a major in either chemistry or biochemistry. The B.S. in chemistry requires a minimum of 41 credits above the 100-level. Majors should select, with the aid of their adviser, electives from chemistry and university courses as appropriate for their interests and goals.

The Major in Chemistry

In addition to the liberal learning curriculum, successful completion of the Bachelor of Science degree in chemistry requires successful completion of the following courses:

1. CHEM 121/121L-122/122L;
2. MATH 140 or 148 and 240;
3. PHYS 201/201L-202/202L.
4. CHEM 321/321L-322/322L;
5. CHEM 341-342/342L;
6. CHEM 361/361L;
7. CHEM 445/445L;
8. CHEM 401/401L;
9. CHEM 391W;
10. CHEM 492W;
11. Select 6 additional credits of CHEM at the 300- or 400-level.

The Major in Biochemistry

In addition to the liberal learning curriculum, successful completion of the Bachelor of Science degree in chemistry with a major in biochemistry requires successful completion of the following courses:

1. CHEM 121/121L-122/122L;
2. BIOL 211/211L;
3. MATH 140 or 148 and 240;
4. PHYS 201/201L-202/202L;
5. CHEM 321/321L-322/322L;
6. CHEM 341;
7. CHEM 361/361L;
8. CHEM 391W;
9. BCHM 414/414L, 415/415L;
10. BIOL 307/307L, 313, 412/412L.

The Minor in Chemistry (23 Credits)

A minor in chemistry requires CHEM 121/121L-122/122L, 321/321L-322/322L and at least seven additional credit hours in chemistry at the 300- or 400-level.

Five-Year Program: Master of Science in Environmental Science

The Master of Science in environmental science is designed for current and prospective students in the new, rapidly growing field of environmental monitoring and conservation. This five-year program leads to both a Bachelor of Science in biology or chemistry and a Master of Science in environmental science and provides a solid background in ecological and environmental conservation theory.

This degree program is flexible enough to fit the interest and needs of a wide variety of students and is designed for students planning to pursue a Ph.D., teachers desiring a Master of Science in a biological science, and students interested in careers involving environmental assessment, monitoring, or conservation.

How and When to Apply

After completion of 65 credit hours of undergraduate study, the application to the Five-Year B.S./M.S. Program is submitted no later than February 1 of the junior year. Applications for admission to the Five-Year Program are available from gradstudies.cnu.edu/fiveyear. Formal acceptance by the Office of Graduate Studies will constitute admission to the Master of Science in environmental science program as long as the student has the required 3.00 GPA upon undergradute graduation.

Requirements for Admission

Criteria for student admission into the five-year program:

1. Undergraduate cumulative GPA of 3.00 or higher.
2. GPA in the student's major of at least 3.00.
3. Submission of one of the following:
   a. A minimum SAT Score of 1100 with a minimum of 530 in the verbal and quantitative sections (must be less than five years old);
   b. A Graduate Record Examination (GRE) General Test score of at least 295 for the verbal and quantitative sections combined. It is highly desirable to have a reasonably balanced score between the verbal and quantitative sections.
   c. Two letters of recommendation. One must be from a faculty member in the major who has taught mentored the student in a major course or research project.

More information about this program can be found at gradstudies.cnu.edu/fiveyear.

Teacher Preparation in Biology

Those students who wish to become teachers may apply to the Five-Year Master of Arts in Teaching (M.A.T.) Program as an undergraduate or after completion of a bachelor's degree in biology. Application to the Five-Year Program must be made in spring of the junior year. See the *Graduate Catalog* for application instructions and requirements. Students will earn a bachelor's degree in biology during the first four years and complete an additional year of study leading to the M.A.T. degree. Students majoring in biology can prepare to teach all core subjects of elementary school, pre-kindergarten through grade six**;** students earning a B.S. in biology can prepare to teach in the content area of biology in secondary school grades six through 12. Students accepted into this program must complete one of the following tracks for graduation with the bachelor's degree:

Elementary level (PK-6) Track

Major courses required:

See major requirements for the B.A. or B.S. in Biology.

Support courses required:

- ENGL 123, 223; 310 or 430, and 316;
- COMM 201 or THEA 230;
- CPSC 110;
- MATH 109, 125;
- HIST 111, 121;
- GOVT 101;
- GEOG 201;
- PSYC 208, 312;
- SOCL 314/314L;
- NSCI 310;
- and other support courses for the B.A. or B.S. degree in biology.

Graduate courses* required (senior year):

Select six credits from a), b), or c):

a) MATH 570;
b) PSYC/TCHG 544;
c) MLAN 511, ENGL 530 or 532.

Secondary level (6-12) Track

Major courses required:

1. BIOL 211/211L, 212/212L, 213/213L, 391W, 491W;
2. BIOL 313;
3. BIOL 407/407L;
4. Fifteen additional credits above the 100-level in BIOL are required. Twelve of these credits must be at the 300-/400-level and must have laboratory components. (BIOL 215 and 314/314L, or BIOL 420/420L are recommended for all secondary biology teachers.)

Support courses required:

CHEM 121/121L, 122/122L; 321/321L, 322/322L;
CPSC 210; COMM 201 or THEA 230;
PHYS 151/151L, 152/152L; MATH 125 and 130 or higher;
PSYC 207 or 208, 312; SOCL 314/314L.

Graduate courses* required (senior year);

Select six credits: ENVS 510/510L, 518, 522, 530, 532/532L, 536/536L, 540/540L, 550, 590 or 595.

* See the graduate catalog for course descriptions.

Teacher Preparation in Chemistry

Those students who wish to become teachers should

apply to the Five-Year Master of Arts in Teaching (M.A.T.) program. Application to the program must be made in spring of the junior year. See the *Graduate Catalog* for application instructions and requirements. Students will earn a B.S. in chemistry during the first four years and complete an additional year of study leading to a M.A.T. degree. Students majoring in chemistry can prepare to teach all core subjects of elementary school, pre-kindergarten through grade six, or in the content area of chemistry of secondary school, grade six through 12. Students accepted into this program must complete one of the following tracks for graduation with the bachelor's degree:

Elementary level (PK – 6)

Major courses required:

See major requirements for the B.S. in chemistry.

Support courses required:

- ENGL 123, 223; 310 or 430, and 316;
- COMM 201 or THEA 230;
- CPSC 110;
- MATH 109, 125;
- HIST 111, 121;
- GOVT 101;
- GEOG 201;
- PSYC 208, 312;
- SOCL 314/314L;
- NSCI 310;
- and other support courses for the B.S. degree in chemistry.

Graduate courses* required (senior year):

Select six credits from a), b), or c):

a) MATH 570;
b) PSYC/TCHG 544;
c) MLAN 511, ENGL 530 or 532.

Secondary level (6 -12)

Major courses required:

See major requirements for the B.S. in chemistry.

Support courses required:

BIOL 107 or 108, or higher; PHYS 201/201L, 202/202L; MATH 125,140 or 148 and 240; CPSC 110;
PSYC 207 or 208 and 312; COMM 201 or THEA 230; SOCL 314/314L.

Graduate courses* required (senior year):

Select eight credits from CHEM 5xx (except CHEM 545). Graduate CHEM electives must include 543, 540, or 565 unless taken at the 400-level.

* See the graduate catalog for course descriptions.

THE CURRICULUM IN BIOLOGY

BIOL 107. General Biology I (3-3-0) AINW

Fall, Summer.

Does not count toward any biology major degree program.

BIOL 107 is managed and taught by the OENB Department. First semester of introductory biology sequence for nonmajors; major topics covered are ecology, genetics, evolution, and diversity.

BIOL 108. General Biology II (3-3-0) AINW

Spring, Summer.

Does not count toward any biology major degree program.

BIOL 108 is managed and taught by the OENB Department. Second semester of introductory biology sequence for nonmajors; major topics covered are energy metabolism, cell biology, biotechnology, plant biology, and animal biology.

BIOL 109L. General Biology Laboratory (1-0-2) AINW

Fall, Spring and Summer.

Pre or Corequisite: BIOL 107 or 108 or 111 or 112 or 113 or 115.

Does not count toward any biology major degree program.

BIOL 109L is managed and taught by the OENB Department. Laboratory exercises to accompany any BIOL-AINW Area of Inquiry course. Lab fees apply each term.

BIOL 113. Topics in Medicine and Health (3-3-0) AINW

Does not count toward any biology major degree program.

Through a biomedical topic, this Area of Inquiry course will examine the process of science, history of science, and how science affects contemporary thought and society. The particular topics covered will vary each semester.

BIOL 195. Special Topics (credits vary 1-3)

Topics vary, determined by the special interests and needs of students and the expertise of faculty. May require prerequisites as set by instructor.

BIOL 211. Principles of Biology I (3-3-0)

Pre or Corequisite: CHEM 103/103L or 121/121L.

Restricted to students in biology, biochemistry and neuroscience degree programs.

BIOL 211 is managed and taught by the MBCH Department. Principles of Biology I is the first course in the three course sequence for students seeking degrees in biology. This course introduces fundamental chemical concepts to allow discussion of the composition and functioning of cells. Topics include respiration, photosynthesis, Mendelian genetics, DNA replication, and gene functioning.

BIOL 211L. Principles of Biology I Laboratory (1-0-4)
Pre or Corequisite: BIOL 211.
Restricted to students in the biology degree programs.
BIOL 211L is managed and taught by the MBCH Department. Principles of Biology I Lab is the laboratory component of the first course in the three course sequence for students seeking degrees in biology. This course introduces students to basic laboratory techniques and fundamental cellular and molecular topics. Lab fees apply each term.

BIOL 212. Principles of Biology II (3-3-0)
Prerequisite: BIOL 211/211L with a C or better and CHEM 103/103L or 121/121L with a C- or higher; or EVST 220.
Restricted to students in biology degree programs.
BIOL 212 is managed and taught by the OENB Department. Principles of Biology II is the second course in the three course sequence for students seeking degrees in biology. This course introduces evolutionary and ecological topics as well as provides an overview to the diversity of life.

BIOL 212L. Principles of Biology II Laboratory (1-0-4)
Pre or Corequisite: BIOL 212. Restricted to students in the biology degree programs.
BIOL 212L is managed and taught by the OENB Department. Principles of Biology II Lab is the laboratory component of the second course in the three course sequence for students seeking degrees in biology. This course covers evolutionary, diversity, and ecological topics by way of in-class and in-the-field exercises. As per instructions given in class students should expect to be in the field for some lab activities. Lab fees apply each term.

BIOL 213. Principles of Biology III (3-3-0)
Prerequisite: BIOL 212/212L with a C or higher and CHEM 104/104L or 122/122L with a C- or higher. Restricted to students in the biology degree programs.
BIOL 213 is managed and taught by the OENB Department. Principles of Biology III is the third course in the three course sequence for students seeking degrees in biology. This course covers form and function of botanical and zoological organisms in some detail.

BIOL 213L. Principles of Biology III Laboratory (1-0-4)
Pre or Corequisite: BIOL 213. Restricted to students in the biology degree programs.
BIOL 213L is managed and taught by the OENB Department. Principles of Biology III Lab is the laboratory component of the third course in the three course sequence for students seeking degrees in biology. This course covers aspects of the form and function of botanical and zoological organisms by way of in-class and in-the-field exercises. Lab fees apply each term.

BIOL 271. Medical Terminology (3-3-0)
May term only.
This course is designed to provide the student with an understanding of the terminology used in medicine. This course covers the definitions, spelling, pronunciation, usage, abbreviations, and origins of a wide range of medical terms, generally organized by anatomical organ systems and medical specialties.

BIOL 295. Special Topics (credits vary 1-6)
Fall and Spring.
Topics vary, determined by the special interests and needs of students and the expertise of faculty. Biology majors may apply no more than nine credits in elementary, intermediate, or advanced topics toward graduation. May require prerequisites as set by instructor.

BIOL 301. Microbiology (4-3-0)
Prerequisites: BIOL 213/213L with a C or better. Corequisite: BIOL 301L.
Fall.
Introduction to the morphology, physiology, and genetics of bacteria, fungi and viruses.

BIOL 301L. Microbiology Laboratory (0-0-4)
Corequisite: BIOL 301.
Fall.
Lab fees apply each term.

BIOL 307. Cell Biology (3-3-0)
Prerequisites: BIOL 213/213L with a C or better; or CHEM 321/321L and NEUR 301/301L and 305; or BIOL 211 and CHEM 322/322L.
Fall.
Physiology at cellular levels of organization: cell structure and function, enzyme action, cell energy transformations, cell regulatory processes, and cell differentiation.

BIOL 307L. Cell Biology Laboratory (1-0-4)
Pre or Corequisite: BIOL 307.
Fall.
Lab fees apply each term.

BIOL 313. Genetics (3-3-0)
Prerequisites: BIOL 213/213L with a C or better; or CHEM 321/321L and NEUR 301/301L and 305; or BIOL 211 and CHEM 322/322L.
Fall.
Mechanisms of inheritance, mutation, recombination, genetic expression, and regulation at all levels of biological organization.

BIOL 314. Human Anatomy and Physiology I (3-3-0)
Prerequisites: BIOL 213/213L with a C or better; or CHEM 321/321L and NEUR 301/301L and 305.
Corequisite: BIOL 314L.
Fall.
A study of the structure and function of the human body that includes concepts of relevant cellular and molecular biology and histology before investigating the major organ systems. Systems included in this course are: integumentary, skeletal, muscular, nervous, sensory, and endocrine.

BIOL 314L. Human Anatomy and Physiology I Laboratory (1-0-4)
Pre or corequisite: BIOL 314.
Fall.
Course includes dissection of preserved animals and animal organs. Students are responsible for providing their own dissection tools. Lab fees apply each term.

BIOL 315. Human Anatomy and Physiology II (3-3-0)
Prerequisite: BIOL 314. Pre or corequisite: BIOL 315L.
Spring.
A continuation of BIOL 314 that covers the cardiovascular, respiratory, renal/osmoregulatory, digestive, and reproductive systems and concepts of metabolism.

BIOL 315L. Human Anatomy and Physiology II Laboratory (1-0-4)
Prerequisite: BIOL 314L; Pre or corequisite: BIOL 315.
Spring.
Course includes dissection of preserved animals and animal organs. Students are responsible for providing their own dissection tools. Lab fees apply each term.

BIOL 319. Nutrition and Energy Homeostasis (3-3-0)
Prerequisites: BIOL 213/213L with a C or better; OR BIOL 211/211L with a C or better and CHEM 322/322L; OR CHEM 321/321L and NEUR 301/301L and NEUR 305.
Summer.
Students will explore the basic inputs and outputs of energy homeostasis in humans. The course begins with an introduction to the basic principles of nutrition and appetite. From there, students will gain specific understanding of body metabolism of carbohydrates, proteins, fats, and alcohol as well as the roles of vitamins and minerals. Focus areas such as physical activity, clinical significance, public health, and lifespan nutrition may also be emphasized throughout the course.

BIOL 326. Genomics, Proteomics and Bioinformatics (3-3-0)
Prerequisites: BIOL 213/213L with a C or better.
This course is designed to introduce the fields of genomics, proteomics and bioinformatics. Students will utilize existing bioinformatic tools to analyze genomic and proteomic data to determine the specific functions of genes and proteins and to compare the genomes and proteomes of various organisms.

BIOL 391. WI: Junior Seminar (1-1-0)
Prerequisites: ENGL 223 with a C- or higher; BIOL 213/213L with a C or higher.
Fall and Spring.
A seminar format course with each section having a different topic. Students will present reports orally and write short papers focusing on both the process of writing and the subject matter. Partially satisfies the writing intensive requirement.

BIOL 395. Special Topics (credits vary 1-3)
Prerequisites: as announced.
Fall and Spring.
Topics vary, determined by the special interests and needs of students and the expertise of faculty. Biology majors may apply no more than nine credits in elementary, intermediate, or advanced topics toward graduation. May require additional prerequisites as set by instructor.

BIOL 405. Disease Biology (3-3-0)
Prerequisite: BIOL 213/213L with a C or better.
Spring.
This course covers the vital structural and functional characteristics of common and important human diseases, as well as the principles of diagnosis and treatment.

BIOL 411. Immunology (3-3-0)
Prerequisite: BIOL 213/213L with a C or better; or CHEM 321/321L and NEUR 301/301L and 305.
Immunology includes a survey of molecules, cells, and tissues that comprise the immune system and the mechanism by which they protect organisms from disease. The functions of the immune system are illustrated by examining the normal immune response to an infective agent as well as by examining immune deficiencies and diseases that target the immune system. An upper level cell biology or molecular biology course is strongly suggested as a prerequisite, but not required.

BIOL 412. Fundamental Molecular Biology (4-3-0)
Prerequisites: BIOL 307 or BIOL 313 with a C- or higher.
Corequisite: BIOL 412L.
Molecular biology is a discipline based upon a reductionist logic that supports the concept that structure and function are intimately related. The primary goals for any molecular biologist are to understand the molecular basis for how prokaryotic and eukaryotic cells grow, divide, specialize, and interact.

BIOL 412L. Fundamental Molecular Biology Laboratory (0-0-4)
Corequisite: BIOL 412.
Lab fees apply each term.

BIOL 420. Animal Physiology (4-3-0)
Prerequisites: BIOL 213/213L with a C or better; and one of the following: BIOL 307 or 312 or 409 or 425 or 440 or 445 or 457. Corequisite: BIOL 420L.
Spring, odd years.
An introductory course in animal physiology emphasizing fundamental principles, concepts, and mechanisms responsible for homeostatic regulation of animal functions.

BIOL 420L. Animal Physiology Laboratory (0-0-4)
Corequisite: BIOL 420.
Spring, odd years.
Lab exercises will complement and reinforce lecture concepts, as well as provide students with the opportunity to perform physiology experiments and data analysis. Lab fees apply each term.

BIOL 422. Field Trip Experience (2-1-8)
Prerequisite: BIOL 213/213L with a C or better.
Extended field trip courses, each of which is preceded by classroom instruction. Includes hands-on classroom exercises and on- and off-campus field exercises. May involve additional fees. (A maximum of 4 credit hours can be counted toward a biology degree.)

BIOL 450. Environmental Microbiology (4-3-0)
Prerequisites: BIOL 213/213L with a C or better. Corequisite: BIOL 450L.
Spring.
This course investigates the role microorganisms play in the terrestrial, aquatic, and marine ecosystems. The course explores the dynamics of microbial populations and communities; normal microbiota and their interactions with other organisms; and environmental pathologies in air, water, and soil.

BIOL 450L. Environmental Microbiology Laboratory (0-0-4)
Corequisite: BIOL 450.
Spring.
In the laboratory students will learn classic environmental testing procedures and novel new assessment procedures that have their roots in biochemistry and molecular biology. Lab fees apply each term.

BIOL 491. WI: Senior Seminar (1-1-0)
Prerequisites: ENGL 223 and BIOL 391W each with a C- or higher.
Fall and Spring.
A seminar format course dealing with different topics in each section each semester. Students will give in-class presentations. A synthesis paper written by the student on some aspect of the topic will also be required. Presentation of this paper will occur on a Saturday late in the semester. Partially satisfies the writing intensive requirement.

BIOL 492. Undergraduate Research Experience (credits vary 1-4)
Prerequisites: BIOL 213/213L with a C or better; minimum 2.5 GPA and Junior standing.
Fall, Spring and Summer.
This course is designed to provide the qualified student the opportunity for scientific research under the supervision of a departmental faculty member. The topic, time-line, and criteria for evaluation are agreed upon in writing by the student and supervising instructor before the student can register for the course. *Course may be repeated for a total of 4 credits. (A maximum of six credit hours from any combination of BIOL 492, BIOL 496, and BIOL 499 can be counted toward the biology degree.)*

BIOL 495. Special Topics (credits vary 1-4)
Prerequisites: as announced.
Fall, Spring and Summer.
Topics vary, determined by the special interests and needs of students and the expertise of faculty. Biology majors may apply no more than nine credits of elementary, intermediate, or advanced topics toward graduation. May require additional prerequisites as set by instructor.

BIOL 496. Practicum (credits vary 1-3)
Prerequisites: BIOL 213/213L with a C or better; minimum 2.5 GPA and Junior standing.
Fall, Spring and Summer.
This course consists of an internship with an organization, usually external to the University, in which the student gains applied experience in some area of the biological sciences. Specific details of course requirements can be found in the agreement file maintained in the OEMB Office. A maximum of three credits can be counted toward the degree. *(A maximum of six credit hours from any combination of BIOL 492, BIOL 496, and BIOL 499 can be counted toward the biology degree.)*

BIOL 499. Problems in Biology (credits vary 1-3)
Prerequisites: BIOL 213/213L with a C or better; minimum 2.5 GPA; Junior standing; consent of instructor and department chair.
Fall, Spring and Summer.
An opportunity for independent study or literature review with guidance of a faculty adviser. No more than three credits may be applied to the degree. *(A maximum of six credit hours from any combination of BIOL 492, BIOL 496, and BIOL 499 can be counted toward the biology degree.)*

THE CURRICULUM IN BIOCHEMISTRY

BCHM 395. Special Topics in Biochemistry (3-3-0)
Prerequisites: as announced.
Fall, Spring, Summer.
Topics vary, determined by the special interests and needs of students and the expertise of faculty. May require additional prerequisites set by the instructor.

BCHM 414. Biochemistry I (3-3-0)
[Formerly BIOL/CHEM 414, equivalent]
Prerequisites: CHEM 322/322L.
Fall.
A survey of the principal molecular constituents of living organisms, including carbohydrates, lipids, nucleic acids and proteins. Macromolecular structure-function relationships and enzyme kinetics are emphasized.

BCHM 414L. Biochemistry I Lab (1-0-4)
[Formerly BIOL/CHEM 414L, equivalent]
Pre or Corequisite: BCHM 414 or BIOL 414 or CHEM 414.
Fall.
This is the accompanying lab for BCHM 414. Experiments emphasize molecular techniques and enzyme kinetics. Lab fees apply each term.

BCHM 415. Biochemistry II (3-3-0)
Prerequisite: BCHM 414 or BIOL 414 or CHEM 414.
Spring.
This course will cover the major catabolic pathways, oxidative phosphorylation, and selected anabolic pathways. Special attention will be placed on enzyme regulation and enzyme reaction mechanisms common to metabolism. The course will conclude with a look at how the chemistry relates to the division of labor among the major mammalian organs.

BCHM 415L. Biochemistry II Lab (1-0-4)
Pre or Corequisite: BCHM 415.
Spring.
This is the accompanying lab for BCHM 415. Laboratory exercises utilize common techniques encountered in biochemical research to give students practical experience performing biochemical experiments. Lab fees apply each term.

BCHM 495. Special Topics in Biochemistry (3-3-0)
Prerequisites: as announced.
Fall, Spring, Summer.
Topics vary, determined by the special interests and needs of students and the expertise of faculty. May require additional prerequisites set by the instructor.

THE CURRICULUM IN CHEMISTRY

Note: The following course listing includes alternate year offerings of junior- and senior-level courses. Though it is recommended that labs be taken at the same time as lecture, labs can be taken at any time after the lecture course for CHEM 103/104, CHEM 121/122, and CHEM 321/322.

CHEM 103. Introductory Chemistry I (3-3-0) AINW
Fall.
The fundamentals of general and inorganic chemistry. (CHEM 103 with or without CHEM 103L may be taken for elective credit as an introductory course to CHEM 121 and CHEM 121L.)

CHEM 103L. Introductory Chemistry Laboratory I (1-0-3) AINW
Pre or Corequisite: CHEM 103.
Fall.
An introduction to the experimental techniques and methods of chemistry. Lab fees apply each term.

CHEM 104. Introductory Chemistry II (3-3-0) AINW
Prerequisite: CHEM 103 or 121.
Spring.
The fundamentals of organic and biochemistry.

CHEM 104L. Introductory Chemistry Laboratory II (1-0-3) AINW
Pre or Corequisite: CHEM 104.
Spring.
An introduction to the experimental techniques and methods of organic and biochemistry. Lab fees apply each term.

CHEM 110. Chemistry and Society (3-3-0) AINW
Fall, Spring.
CHEM 110 is for nonscience majors only; it is not intended for chemistry or biology majors. This course integrates fundamental concepts of chemistry with contemporary issues facing society. Sufficient technical background will be presented to enable an informed appreciation of the impact of chemistry within various topics selected by the instructor. The critical thinking methods developed will provide critical pathways for approaching other challenges in a rapidly changing world.

CHEM 111L. Environmental Studies Chemistry Lab (1-0-4)
Pre or Corequisite: CHEM 103 or 121. Restricted to environmental studies minors.
This lab introduces environmental studies minor to basic laboratory practices related to environmental chemistry issues. Basic Laboratory practices will be provided for each experiment with fundamental concepts and theories. Students will learn how to apply basic chemistry concepts in order to understand environmental issues.

CHEM 121. General Chemistry I (3-3-0) AINW
Fall and Spring.
The first half of the general chemistry sequence covers topics in atoms, stoichiometry, gases, thermochemistry, electronic structure, periodic properties, bonding and molecular geometry. Emphasis is placed on the development of problem solving skills. Strong algebra skills recommended.

CHEM 121L. General Chemistry I Laboratory (1-0-4) AINW
Pre or Corequisite: CHEM 121.
Fall and Spring.
The first semester of the general chemistry laboratory sequence introduces students to various chemical lab techniques and provides hands-on experience with the chemical concepts covered in the general chemistry lecture. This course also focuses on the development of scientific writing skills in the form of formal lab reports. Lab fees apply each term.

CHEM 122. General Chemistry II (3-3-0) AINW
Prerequisite: CHEM 121.
Fall and Spring.
The second half of the general chemistry sequence covers topics in intermolecular forces, properties of solutions, chemical kinetics, chemical equilibrium, acid/base equilibrium, chemical thermodynamics and electrochemistry. Emphasis is placed on the development of problem solving skills. Strong algebra skills recommended.

CHEM 122L. General Chemistry II Laboratory (1-0-4) AINW
Pre or Corequisite: CHEM 122.
Prerequisite: CHEM 121L.
Fall and Spring.
The second semester of the general chemistry laboratory sequence introduces students to various chemical lab techniques, such as titration, and provides hands-on experience with the chemical concepts covered in the general chemistry lecture. This course also focuses on the development of scientific writing skills in the form of formal lab reports. Lab fees apply each term.

CHEM 195. Special Topics (credits vary 1-3)
Topics vary, determined by the special interests and needs of students and the expertise of faculty.

CHEM 295. Special Topics (credits vary 1-3)
Topics vary, determined by the special interests and needs of students and the expertise of faculty.

CHEM 321. Organic Chemistry I (3-3-0)
Prerequisite: CHEM 122/122L.
Chemistry of the organic compounds. Structure, reactivity, and reaction mechanisms.

CHEM 321L. Organic Chemistry Laboratory I (1-0-4)
Pre- or Corequisite: CHEM 321.
Introduction to common techniques and qualitative organic analysis. Lab fees apply each term.

CHEM 322. Organic Chemistry II (3-3-0)
Prerequisite: CHEM 321.
Chemistry of organic compounds. Structure, reactivity and reaction mechanisms.

CHEM 322L. Organic Chemistry Laboratory II (1-0-4)
Prerequisite: CHEM 321L.
Pre or Corequisite: CHEM 322.
Spring.
The study and analysis of organic reactions with emphasis on instrumental methods. Lab fees apply each term.

CHEM 341. Physical Chemistry I (3-3-0)
Prerequisite: CHEM 322/322L, MATH 240, PHYS 202/202L.
Fall.
This course will focus on the development of the fundamental concepts used to explain other areas of chemistry. The properties of gases, chemical thermodynamics, properties of mixtures, phase and chemical equilibrium, kinetics and electrochemistry are studied.

CHEM 342. Physical Chemistry II (3-3-0)
Prerequisite: CHEM 341; Corequisite: CHEM 342L.
Spring.
This course will focus on the development of the fundamental concepts used to explain other areas of chemistry, with an emphasis on molecular structure. Quantum theory, molecular structure, symmetry, spectroscopy and statistical thermodynamics are studied.

CHEM 342L. Physical Chemistry Lab (1-0-4)
Pre or corequisite: CHEM 342.
Spring.
This course explores the physical properties of matter. An emphasis is placed on the analysis of materials at the atomic and molecular level. Lab fees apply each term.

CHEM 361. Analytical Chemistry (3-3-0)
Prerequisite Courses: CHEM 122/122L.
Spring.
This course addresses the fundamental principles of analytical problem-solving process, volumetric and gravimetric analysis, electrochemistry, systematic treatment of chemical equilibrium, and the treatment of experimental data. Strong algebra skills are required

CHEM 361L. Analytical Chemistry Lab (1-0-4)
Corequisite: CHEM 361.
Restricted to chemistry and biochemistry majors.
Spring.
The laboratory course, to accompany Analytical Chemistry, involves an introduction to analytical laboratory techniques, such as volumetric and gravimetric analysis, electro-chemistry, and the treatment of experimental data. Lab fees apply each term.

CHEM 391. WI: Investigating Chemical Literature (3-3-0)
Prerequisite: ENGL 223 with a C- or higher, CHEM 322, junior standing.
Restricted to chemistry and biochemistry majors.
Fall.
In this course, students will choose a current research topic in chemistry, learn to search for and read scientific literature relevant to the chosen topic and learn to write a technical paper. Students will also have the opportunity to become skilled in making technical oral presentation. Partially satisfies the writing intensive requirement.

CHEM 395. Special Topics (credits vary 1-3)
Prerequisite: as announced.
Topics vary, determined by the special interests and needs of students and the expertise of faculty.

CHEM 401. Inorganic Chemistry (3-3-0)
Prerequisites: CHEM 322/322L.
Fall.
Inorganic Chemistry will cover the topics of valence and molecular orbital theories; bonding in inorganic compounds; solid-state structures; properties of the representative elements; coordination chemistry of the transition elements; inorganic catalysis; silicate materials and their applications in environmental remediation.

CHEM 401L. Inorganic Chemistry Lab (1-0-4)
Corequisite: CHEM 401.
Fall.
Restricted to chemistry majors. Inorganic Chemistry Lab will focus on methods of synthesizing some inorganic compounds**.** Lab fees apply each term.

CHEM 435. Nanochemistry and Nanotechnology (3-3-0)
Prerequisite: CHEM 322.
This course will introduce the fundamental principles of nanochemistry including synthesis, characterization, and application of nanomaterials such as nanosensors, nanobiology, nanomedicine and nanomachines.

CHEM 443. Atmospheric Chemistry (3-3-0)
Prerequisites: CHEM 321.
This course presents an introduction to the chemistry of the troposphere and stratosphere. Emphasis is placed on the structure of the atmosphere, photochemical smog, global climate change and greenhouse gases, stratospheric ozone depletion, and particulate matter in the troposphere.

CHEM 445. Instrumental Analysis (3-3-0)
Prerequisite: CHEM 322/322L and 361.
Fall.
Theory and practice in the use of modern instrumentation for the solution of analytical problems.

CHEM 445L. Instrumental Analysis Lab (1-0-4)
Prerequisite: CHEM 361L or consent of instructor. Corequisite: CHEM 445.
Fall.
This course addresses the fundamental principles of chemical instrumentation, including electronics, signal, and noise. The course also focuses on the fundamental theories of the major instrumental methods, such as spectroscopy and separations, and current applications. Completion of this course will afford students a working knowledge of analytical instrumentation typically employed in chemical, biochemical, and environmental research laboratories. Lab fees apply each term.

CHEM 465. Environmental Chemistry (3-3-0)
Prerequisite: CHEM 321.
Environmental Chemistry will cover the topics of air, water and soil chemistry. This will include ozone depletion, air pollution, global warming, energy use, elementary toxicology and risk assessment, ground water contamination, modern methods for treatment of wastewater and sewage, soil characteristics, environmental remediation and green chemistry.

CHEM 470. Advanced Organic Chemistry (3-3-0)
Prerequisite: CHEM 322.
Synthesis is a central part of organic chemistry and is, therefore, an important part of the undergraduate education. In this course we will study the recent developments in organic chemistry and learn how to keep abreast of this ever-changing subject.

CHEM 492. WI: POGIA-A Chemistry Capstone Course (3-3-0)
Prerequisites: CHEM 391W, ENGL 223 with a C- or higher and senior standing.
Spring.
A senior-level capstone course surveying the fundamentals of chemistry. Select topics and principles from Physical, Organic, General, Instrumental, and Analytical Chemistry will be reviewed through a series of lectures, student-led seminars, guest speakers, and possible field trips. Partially satisfies the writing intensive requirement.

CHEM 495. Special Topics (credits vary 1-3)
Prerequisite: as announced.
Topics vary, determined by the special interests and needs of students and the expertise of faculty.

CHEM 499. Independent Study and Research (credits vary 1-3)
Prerequisite: consent of instructor and department chair. (See section on Independent Study Procedures).

The Curriculum in Natural Science

NSCI 310. The Study of Science (3-3-2)
Prerequisite: PSYC 312 or SOCL 314, junior standing, completion of a three credit AINW.
This course is designed for prospective elementary school teachers to study fundamental scientific concepts such as models, change, structure and function, systems, variation, cause and effect, diversity, and scale through various topics (i.e., motion, energy, heat, electricity and magnetism, light, atoms, solar system, cell, respiration, plants, animals, evolution, environmental science, taxonomy, ecology). Students will have opportunities to examine exemplary science curricula, review characteristics of the learner, and develop effective instructional strategies and assessment instruments needed to teach science.