Department of Biological and Physical Sciences

Professors: Elizabeth A. Colby Davie, Stuart I. Cromarty, David Crowley, Edward J. Dix, Georgi Y. Georgiev, Michele L. Lemons, Jessica A. McCready, Brian K. Niece (Chairperson), Steven J. Theroux; *Associate Professors*: Karolina Fučíková (on leave 2024-25), Teresa Herd, 3:2 Engineering Director, Benjamin J. Knurr; *Assistant Professors*: Nikos Lessios, Laura Marcotte, Erin Tuttle; *Assistant Professors of Practice*: Soraya Betancourt-Calle, Anthony Sacino, Jessica Whitt, Director of the Center for Neuroscience; *Lecturer*: Sandra Nedelescu.

MISSION STATEMENT

The Department of Biological and Physical Sciences is dedicated to preparing students to live and work in a changing world by ensuring competency in the natural sciences and scientific inquiry. The department strives to provide a basic understanding of classical and contemporary scientific concepts in these areas. While developing an understanding of the scientific process and its application, the following critical skills are stressed: observation, inquiry, data collection, analysis, communication, and correlation of scientific concepts. The department prepares students for careers and professional opportunities in the sciences as well as for life-long learning in the context of a liberal arts curriculum in the Catholic tradition.

PROGRAMS OF STUDY AND CAREER OPTIONS

The Department of Biological and Physical Sciences offers majors in the following disciplines:

- Biology
- Biology with a Concentration in Neuroscience and Behavior
- Biotechnology and Molecular Biology
- Chemistry
- Environmental Science
- Neuroscience
- Pre-Clinical Health Science

The Department also offers minors in Biology, Environmental Science, Chemistry, and Physics, and it co-sponsors concentrations in Pre-Physical Therapy and Pre-Occupational Therapy with the Department of Health and Human Services. Research opportunities are available at the University and at nearby institutions (e.g., University of Massachusetts Medical School and the Biotechnology Park). Students interested in teaching science in the public schools should work with a science faculty member and a member of the Education Department in planning their course of study. The Department also offers courses for non-majors.

Students who wish to pursue careers in medicine, dentistry or one of the many other health professions must complete the necessary prerequisites for admission to the health profession schools of their choice. These individuals should consult their academic advisors and the Health Professions Advisor, Dr. Steven Theroux, when designing their course of study. The Health Professions Program helps students meet the admissions requirements for these professional programs. The Department has agreements with several institutions that offer degrees in the health professions. Students interested in Allopathic or Osteopathic Medicine, Podiatric Medicine, Pharmacy, Physical Therapy, Optometry, Physician Assistant Studies, Nursing, or Biotechnology should discuss these agreements with the Health Professions Advisor, Prof. Steven Theroux.

The University has established collaborative programs of study in Engineering with the University of Notre Dame and with Washington University in St. Louis. Students spend three years at Assumption University completing foundational courses in math and science before transferring to Notre Dame or Washington University to complete engineering studies. Interested students should contact Professor Teresa Herd, Director of the 3:2 Engineering Program.

The University also has agreements with several graduate schools. In conjunction with Duke University, we offer combined B.A. and Master's degree programs in Environmental Science Management and Forestry Management. There are several options for

students interested in the legal profession, especially those interested in practicing environmental law or intellectual property law. Science students interested in learning more about these programs should see Professor Erin Tuttle.

The Department offers a post-graduate program for those who have a bachelor's degree in an area other than Biology and who are interested in pursuing admission to a health professions program (e.g., medicine, dentistry, pharmacy, etc.) Details about this certificate program can be obtained from the Health Professions Advisor, Dr. Steven Theroux.

Students who graduate with an undergraduate degree in science can pursue employment in industry, government, or in an educational setting. Some of our students pursue graduate studies in science, one of the health professions, business or law. Upon the completion of the appropriate graduate program our students can pursue research careers in environmental management, or in the biotechnology, pharmaceutical and chemical industries. They can also develop careers in elementary, secondary and higher education, or in the health professions, business management, government, or legal profession.

MAJOR IN BIOLOGY, B.S. DEGREE (16)

A major in Biology teaches students how to investigate and appreciate the unity of function that underlies the diversity of life forms. Lectures encourage students to synthesize the best of classical and contemporary ideas in Biology. Laboratory work gives students technical expertise and helps them to observe, ask questions, test hypotheses, analyze results, and present their conclusions orally and in writing. The Bachelor of Science degree provides a foundational core in the biological science. The B.S. in Biology focuses on Chemistry and Physics course work that prepares students for advanced studies in Medical, Dental, Veterinary, Physical Therapy, and Ph.D. programs, as well as a variety of other paths in research and biotechnology. Elective courses provide a guided choice of advanced study in Biology and related areas. Students may participate in seminars, independent study, internships and summer research.

FOUNDATIONAL CORE (11)

BIO 160 Concepts in Biology
BIO 210 Genetics
BIO 320 Evolution or BIO 360 Ecology
BIO 340 Molecular and Cellular Biology
CHE 131–132 General Chemistry I and II
CHE 201–202 Organic Chemistry I and II
MAT 114 Elementary Functions (or higher if placed higher)
PHY 201–202 General Physics I and II

ONE OF THE FOLLOWING ORGANISMAL BIOLOGY COURSES (1)

BIO 220 Invertebrate Zoology
BIO 230 Plant Biology
BIO 250 Microbiology
BIO 280 Sensory Systems
BIO 310 Animal Behavior
BIO 370 Physiology
BIO 420 Developmental Biology
BIO 415 Principles of Neuroscience
BIO 430 Comparative Physiology

TWO BIOLOGY ELECTIVES (2)

Two additional biology courses numbered 212 or higher. One BIO elective must be at the 400-level that includes lab work.

TWO QUANTITATIVE ELECTIVES (2)

Any two additional courses in BIO, CHE, PHY, ENV numbered 212 or higher

Statistics

A maximum of two independent study (i.e., BIO 490 and 491) courses may be taken. Additional independent study credits will count toward degree requirements but will not count toward the major in Biology.

FOUR-YEAR PLAN FOR THE B.S. IN BIOLOGY

The following is a possible four-year schedule for classes in the biology major. It is important that first year students enroll in both BIO 160 and another biology core course (BIO 210 or Organismal biology course) AND the CHE 131-132 sequence to start the major and to best balance the remaining three years of the curriculum. Students should work closely with an advisor in the science department to tailor course selection to their interests and goals and to be confident of course availability and sequencing.

First Year

Fall	Spring
BIO 160 Concepts in Biology and lab	BIO 210 Genetics and lab
CHE 131 General Chemistry I and lab	CHE 132 General Chemistry II and Lab
MAT 114 Elementary Functions or MAT117/131 Calculus I	

Sophomore Year

Fall	Spring
CHE 201 Organic Chemistry I and lab	CHE 202 Organic Chemistry II and lab
BIO course in Organismal Grouping	BIO 340 Molecular and Cellular Biology and lab
	BIO 320 Evolution (if BIO 360 was not taken in the fall)

Junior Year

Fall	Spring
PHY 201 General Physics I and lab	PHY 202 General Physics II and lab
	BIO elective

Senior Year

Fall	Spring
BIO elective (400 level)	Quantitative elective 2
Quantitative elective 1	

ADVISING TIPS FOR THE B.S. IN BIOLOGY

- BIO 360 Ecology and several upper-level biology courses are offered on an every-other-year schedule.
- Students interested in medical school, dental, and veterinary school should consider a B.S. in Biology as the requirements for these health profession programs and their entrance exam align more closely with course work in the B.S. Biology track.
- Students interested in pursuing medical school or affiliated careers should consider PHY 201 and 202 in the sophomore year and CHE 414 in the junior year to prepare for the MCAT exam after junior year.

MAJOR IN BIOLOGY, B.A. DEGREE (16)

A major in Biology teaches students how to investigate and appreciate the unity of function that underlies the diversity of life forms. Lectures encourage students to synthesize the best of classical and contemporary ideas in Biology. Laboratory work gives students technical expertise, and helps them to observe, ask questions, test hypotheses, analyze results, and present their conclusions orally and in writing. The Bachelor of Arts (B.A.) degree is designed to provide a foundational core in biological concepts while also providing flexibility for students to pursue courses in interdisciplinary fields like environmental science, psychology, health sciences, and education. The B.A. in Biology provides a wide breadth of electives in disciplines related to the biological sciences that draw connections to the natural world. With its flexibility, the major prepares students for a variety of

careers in industry, education, and others and enables double majors in several fields. Students may participate in seminars, independent study, internships and summer research.

FOUNDATIONAL CORE COURSES (9)

BIO 160 Concepts in Biology
BIO 210 Genetics
BIO 320 Evolution or BIO 360 Ecology
BIO 340 Molecular and Cellular Biology
CHE 131–132 General Chemistry I and II
CHE 201 Organic Chemistry I
MAT 114 Elementary Functions (or higher if placed higher)
PHY 201 General Physics I

ONE OF THE FOLLOWING ORGANISMAL BIOLOGY COURSES (1)

BIO 220 Invertebrate Zoology
BIO 230 Plant Biology
BIO 250 Microbiology
BIO 280 Sensory Systems
BIO 310 Animal Behavior
BIO 370 Physiology
BIO 420 Developmental Biology
BIO 415 Principles of Neuroscience
BIO 430 Comparative Physiology

TWO BIOLOGY ELECTIVES (2)

Two additional biology courses at the 200 level or higher. One BIO elective must be at the 400-level that includes lab work.

FOUR INTERDISCIPLINARY ELECTIVES (4)

Any additional courses in BIO at BIO 200 or higher,
Up to three additional CHE courses at CHE 200 or higher,
PHY 202, PHY 213
Up to one course in each of the following categories:

- Environmental Science (200 or higher)
- Health Sciences (200 or higher)
- ECO 115 Statistics with Excel OR PSY 224 Statistics OR SOC 300 Statistics
- Psychology (PSY 250, 251, 252, 402)

For EDU majors, up to two of the following: BIO 140, EDU 221, EDU 346

A maximum of two independent study (i.e., BIO 490 and 491) courses may be taken. Additional independent study credits will count toward degree requirements but will not count toward the major in Biology.

EXAMPLE FOUR-YEAR PLAN FOR THE B.A. IN BIOLOGY

The following is a possible four-year schedule for classes in the biology major. It is important that first year students enroll BIO 160, the CHE 131-132 sequence, and BIO 210 or an organismal biology course to start the major and to best balance the remaining three years of the curriculum. Students should work closely with an advisor in the science department to tailor course selection to their interests and goals and to be confident of course availability and sequencing.

First Year

Fall	Spring
BIO 160 Concepts in Biology and lab	BIO 210 Genetics and lab
CHE 131 General Chemistry I and lab	CHE 132 General Chemistry II and Lab
MAT 114 Elementary Functions or MAT117/131 Calculus I	

Sophomore Year

Fall	Spring
CHE 201 Organic Chemistry I and lab	BIO 340 Molecular and Cellular Biology and lab
BIO course in Organismal Grouping	BIO 320 Evolution (or BIO360: Ecology offered in the fall)

Junior Year

Fall	Spring
Interdisciplinary elective 1	BIO elective
PHY 201 General Physics I and lab	Interdisciplinary elective 2

Senior Year

Fall	Spring
BIO elective (400 level)	Interdisciplinary elective 3
	Interdisciplinary elective 4

ADVISING TIPS FOR THE B.A. IN BIOLOGY

- BIO 360: Ecology and several upper level biology courses are offered on an every-other-year schedule.
- The B.A. in Biology is NOT intended for students interested in pursuing medical school, dental, and veterinary school. These students should consider a B.S. in Biology as the requirements for these health profession programs and their entrance exams align more closely with course work in our B.S. Biology track. (See B.S. in Biology above.)

MAJOR IN BIOLOGY WITH A CONCENTRATION IN NEUROSCIENCE AND BEHAVIOR, B.S. DEGREE (17)

This concentration allows students to complete a Biology Major and also pursue interests in neuroscience. This is done by completing the foundational courses required for a Biology Major and completing neuroscience-focused courses as electives. In addition, students also take an Animal Behavior course and select two psychology courses that have a neuroscience-focus, as appropriate for the interdisciplinary study of neuroscience. Students who choose this concentration are encouraged to do internships or independent studies in neurobiology laboratories. Students who complete the requirements of this concentration will be well prepared for advanced studies in Medical, Dental, Veterinary, Physical Therapy, Occupational Therapy, Optometry and Ph.D. programs, as well as a variety of other paths in research and biotechnology. It should be noted that requirements for entry into graduate programs are varied, and it is each student's responsibility to learn the requirements of all programs to which he/she may wish to apply. Students are encouraged to work with their academic advisor to align their coursework with their post graduate goals.

FOUNDATIONAL COURSES (13)

BIO 160 Concepts in Biology (with lab)
PSY 101 General Psychology
MAT 114 (or higher) Elementary Functions (or higher)
CHE 131-132 General Chemistry I and II (with lab)
BIO 210 Genetics (with lab)
CHE 201-202 Organic Chemistry I and II (with lab)

BIO 320 Organic Evolution OR BIO 360 Ecology (with lab)
BIO 310 Animal Behavior (with lab)
BIO 340 Molecular and Cellular Biology (with lab)
PHY 201-202 General Physics 1 and 2 (with lab)

NEUROSCIENCE CAPSTONE COURSES (2)

BIO 415 Principles of Neuroscience (with lab)
PSY 402 Social and Affective Neuroscience OR PSY 403 Cognitive Neuroscience

BIOLOGY ELECTIVE, CHOOSE ONE OF THE FOLLOWING (1)

BIO 220 Invertebrate Zoology (with lab)
BIO 240 Human Anatomy (with lab)
BIO 250 Microbiology (with lab)
BIO 370 General Physiology (with lab)
BIO 280 Sensory Systems (with lab)
BIO 375 Milestones in Neuroscience
CHE 414 Biochemistry (with lab)
BIO 480 Seminar in Life Sciences: Neuroscience topic
BIO 430 Comparative Physiology
BIO 420 Developmental Biology

PSYCHOLOGY ELECTIVE, CHOOSE ONE OF THE FOLLOWING (1)

PSY 250 Perception
PSY 351 Introduction to Brain and Behavior
PSY 252 Cognitive Psychology

RECOMMENDED BUT NOT REQUIRED

PSY 224 Statistics
PSY 225 Research Methods
PHI 302 Person, Mind and Brain
BIO 490–491 Independent Study in Biology

FOUR YEAR PLAN FOR THE MAJOR IN BIOLOGY WITH A CONCENTRATION IN NEUROSCIENCE AND BEHAVIOR, B.S. DEGREE

First Year

Fall	Spring
BIO 160 Concepts in Biology and lab	BIO 210 Genetics and lab
CHE 131 General Chemistry I and Lab	CHE 132 General Chemistry II and Lab
MAT 114 Elementary Functions or higher	PSY101 General Psychology

Sophomore Year

Fall	Spring
Psychology elective	BIO 340 Molecular and Cellular Biology and lab
CHE 201 Organic Chemistry I and lab	CHE 202 Organic Chemistry II and lab

Junior Year

Fall	Spring
BIO 310 Animal Behavior and lab	BIO 320 Organic Evolution
PHY 201 Physics I and lab	PHY 202 Physics II and lab

Senior Year

Fall	Spring
BIO 415 Principles of Neuroscience and lab	PSY 402 Social and Affective Neuroscience OR PSY403 Cognitive Neuroscience
Biology elective	

ADVISING TIPS FOR BIOLOGY WITH A CONCENTRATION IN NEUROSCIENCE AND BEHAVIOR, B.S. DEGREE

- Students should take CHE 131, BIO 160, and MAT 114 (or higher) in their first semester
- Students are advised to take no more than two laboratory courses in a given semester.

MAJOR IN BIOTECHNOLOGY AND MOLECULAR BIOLOGY, B.S. DEGREE (17)

Biotechnology has developed around the study of living things at the molecular level. The chemistry of genetics has found applications in medicine and industry. Techniques of molecular genetics have allowed dramatic advances in our understanding of developmental biology, physiology, immunology, and evolution. This major provides a balanced foundation in biology, plus an introduction to the theory and methods of biotechnology and molecular biology. Students in the major are encouraged to do internships at biotechnology laboratories in the Worcester area. When they graduate, students can pursue graduate study in the biological sciences or in the health sciences. The major is also excellent preparation for a teaching career or employment in a biotechnology-based field.

REQUIRED COURSES (14)

Biotechnology and Molecular Biology majors should take CHE 131 and BIO 160 in their first semester.

BIO 160 Concepts in Biology
BIO 210 Genetics
BIO 250 Microbiology
BIO 340 Molecular and Cellular Biology
BIO 440 Biotechnology: Theory and Practice
CHE 131–132 General Chemistry I and II (Note: MAT 114 is a pre-requisite for CHE 132)
CHE 201–202 Organic Chemistry I and II
CHE 414 Biochemistry
MAT 114 Elementary Functions, or higher if placed higher
PHY 201–202 General Physics I and II
PHI 151 Ethics and the Good Life

ELECTIVES (3)

Three additional electives in Biology numbered 212 or higher. A maximum of two of these electives can be selected from internships or BIO 490 or 491. Additional internship or independent study credits will count toward degree requirements but will not count toward the major in Biology. PHI 310 Biomedical Ethics is strongly recommended, but not required.

RECOMMENDED FOUR-YEAR PLAN FOR THE MAJOR IN BIOTECHNOLOGY AND MOLECULAR BIOLOGY, B.S. DEGREE

The following is a possible four-year schedule for classes in the biotechnology major. It is important that first year students enroll in both the BIO 160-210 sequence AND the CHE 131-132 sequence to get started in the major and to best balance the remaining three years of the curriculum. Students should work closely with an advisor in the science department to tailor course selection to their interests and goals and be confident of course availability and sequencing.

First Year

Fall	Spring
BIO 160 Concepts in Biology and lab	BIO 210 Genetics and lab

CHE 131 General Chemistry II and Lab	CHE 132 General Chemistry II and Lab
MAT 114 Elementary Functions or MAT 117/131 Calculus I	

Sophomore Year

Fall	Spring
CHE 201 Organic Chemistry I and lab	CHE 202 Organic Chemistry II and lab
BIO 250 Microbiology and lab	BIO 340 Molecular and Cellular Biology and lab

Junior Year

Fall	Spring
BIO elective	CHE 414 Biochemistry and lab
PHY 201 General Physics I and lab (see notes below)	PHY 202 General Physics II and lab
PHI 151 Ethics and the Good Life	BIO elective

Senior Year

Fall	Spring
BIO elective	BIO 440 Biotechnology and lab
BIO elective	

ADVISING TIPS FOR THE MAJOR IN BIOTECHNOLOGY AND MOLECULAR BIOLOGY, B.S. DEGREE

- Several upper level biology courses are offered on an every-other-year schedule.
- Students interested in pursuing medical school or affiliated careers should consider PHY 201 and 202 in the sophomore year and CHE 414 in the junior year to prepare for the MCAT exam after junior year.

MAJOR IN CHEMISTRY, AMERICAN CHEMICAL SOCIETY CERTIFIED, B.S. DEGREE (17)

The American Chemical Society (ACS) Certification B.S. option serves as evidence that a graduate has completed a rigorous program in chemistry approved by a national scientific organization. Employers and graduate schools recognize ACS certification as a sign of the high quality of a student's preparation for employment or further study in the chemical sciences. Completion of the ACS Certified program is determined by the department.

The Bachelor of Science degree will be attractive to those students intending to pursue graduate study in chemistry or a career as a chemist. This degree option leads the student to a degree certified by the American Chemical Society and as such is a more rigorous program, particularly with respect to hands-on laboratory experience.

REQUIRED COURSES (15)

Chemistry majors should take CHE 131, BIO 160, and MAT 114 (or higher) in their first semester.

BIO 160 Concepts in Biology
CHE 131- 132 General Chemistry I and II

MAT 117–118 Calculus I and II
OR
MAT 131–132 Honors Calculus I and I

CHE 201–202 Organic Chemistry I and II
PHY 201H–202H Honors General Physics I and II

CHE 311–312 Physical Chemistry I and II
CHE 315 Analytical Chemistry
CHE 316 Inorganic Chemistry
CHE 414 Biochemistry
CHE450 Instrumental Chemistry

ELECTIVE (1)

One additional three- or four-credit course from among CHE 318 or CHE 416.

RESEARCH (1)

Complete at least 3 credits of laboratory research with report submitted to the department as a final project in CHE 480 Seminar in Chemistry or as part of CHE 491 or 492 if the research is undertaken on campus.

RECOMMENDED FOUR-YEAR PLAN FOR THE ACS CERTIFIED B.S. IN CHEMISTRY

The following plan is recommended for chemistry majors. It prepares students for the workforce or for graduate school. The General Chemistry sequence is an important part of the student's first year at Assumption University. It is important to work with an advisor to be confident in the timing of course offerings in the department.

First Year

Fall	Spring
CHE 131 General Chemistry I and lab	CHE 132 General Chemistry II and lab
BIO 160 Concepts in Biology and lab (either semester of the first year)	MAT 117/131 Calculus 1 or MAT 118/132 Calculus 2
MAT 114 Elementary Functions or MAT 117/131 Calculus 1	

Sophomore Year

Fall	Spring
CHE 201 Organic Chemistry I and lab	CHE 202 Organic Chemistry II and lab
PHY 201H Honors General Physics I and lab	PHY 202H Honors General Physics II and lab

Junior Year

Fall	Spring
CHE 311 Physical Chemistry I and lab	CHE 312 Physical Chemistry II and lab
CHE 315 Analytical Chemistry and lab* OR CHE 313 Inorganic Chemistry and lab*	CHE 450 Instrumental Chemistry and lab* OR 3-credit research

Senior Year

Fall	Spring
CHE 315 Analytical Chemistry and lab* OR CHE 313 Inorganic Chemistry and lab*	CHE 450 Instrumental Chemistry and lab* OR 3-credit research
CHE 414 Biochemistry and lab	Upper-level CHE elective*

ADVISING TIPS FOR THE ACS CERTIFIED B.S. IN CHEMISTRY

- Upper level chemistry courses noted with an asterisk* are offered on an every-other-year schedule.
- BIO 160 may be taken at any point in the curriculum prior to taking CHE 414 Biochemistry.

MAJOR IN CHEMISTRY, B.A. DEGREE (16)

The objective of the chemistry major is to provide the student with knowledge of the fundamental principles governing the structure of matter. The courses are organized to establish a foundation in the basic areas of inorganic chemistry, organic chemistry, physical chemistry, biochemistry, and analytical chemistry, and to develop an understanding of the unity of Chemistry by relating these basic areas to each other and to other scientific disciplines. The laboratories are designed to develop a degree of proficiency in the practical aspects of experimentation and instrumentation.

Through a well-planned choice of electives, a student can prepare for graduate study in chemistry, biochemistry, or some other area of science; for industrial employment; for teaching Chemistry; or for professional study in medicine, dentistry, or other health sciences. Qualified chemistry majors may also pursue a dual degree program leading to a B.A. in Chemistry from Assumption University and a B.S. in Chemical Engineering from The University of Notre Dame. Interested students should contact Professor Teresa Herd, Director of the 3:2 Engineering Program.

The Bachelor of Arts degree may be attractive to those students interested in enhancing their undergraduate experience with a second major to prepare for other career paths, the clinical medical sciences in particular.

REQUIRED COURSES (14)

Chemistry majors should take CHE 131, BIO 160, and MAT 114 (or higher) in their first semester.

BIO 160 Concepts in Biology
CHE 131- 132 General Chemistry I and II

MAT 117–118 Calculus I and II
OR
MAT 131–132 Honors Calculus I and I

CHE 201–202 Organic Chemistry I and II
PHY 201–202 General Physics I and II
CHE 311–312 Physical Chemistry I and II
CHE 315 Analytical Chemistry
CHE 316 Inorganic Chemistry
CHE 414 Biochemistry

ELECTIVES (2)

Two additional three- or four-credit courses from among: CHE 318, CHE 416, CHE 450, CHE 460, CHE 470, CHE 480, CHE 491–492. At least one of the electives must include a lab. Only one Independent Study course (CHE 491 or CHE 492) or Internship may be counted towards the Chemistry Elective requirement.

RECOMMENDED FOUR-YEAR PLAN FOR THE B.A. IN CHEMISTRY

The following plan is recommended for chemistry majors. It prepares students for the workforce or for graduate school. The General Chemistry sequence is an important part of the student's first year at Assumption University. It is important to work with an advisor to be confident in the timing of course offerings in the department.

First Year

Fall	Spring
CHE 131 General Chemistry I and lab	CHE 132 General Chemistry II and lab
BIO 160 Concepts in Biology and lab (either semester of the first year)	MAT 117/131 Calculus 1 or MAT118/132 Calculus 2

MAT 114 Elementary Functions or MAT117/131 Calculus 1	

Sophomore Year

Fall	Spring
CHE 201 Organic Chemistry I and lab	CHE 202 Organic Chemistry II and lab
PHY 201 General Physics I and lab	PHY 202 General Physics II and lab

Junior Year

Fall	Spring
CHE 311 Physical Chemistry I and lab	CHE 312 Physical Chemistry II and lab
CHE 315 Analytical Chemistry and lab* OR CHE 313 Inorganic Chemistry and lab*	CHE 450 Instrumental Chemistry and lab* OR Upper-level CHE elective*

Senior Year

Fall	Spring
CHE 315 Analytical Chemistry and lab* OR CHE 313 Inorganic Chemistry and lab*	CHE 450 Instrumental Chemistry and lab* OR Upper-level CHE elective*
CHE 414 Biochemistry and lab	Upper-level CHE elective*

ADVISING TIPS FOR THE B.A. IN CHEMISTRY

- Upper level chemistry courses noted with an asterisk* are offered on an every-other-year schedule.
- BIO 160 may be taken at any point in the curriculum prior to taking CHE 414 Biochemistry.

MAJOR IN NEUROSCIENCE WITH A CELLULAR PATH, B.S. DEGREE (19)

A Major in Neuroscience with a Cellular Path utilizes an interdisciplinary approach to empower students to: 1) develop and refine skills of inquiry with a focus on the brain and mind, 2) gain a strong understanding of the classic and contemporary findings in neuroscience, 3)comprehend and appreciate the dynamic, multidisciplinary nature of this field 4) to ask thoughtful questions and strategically select approaches to answer questions, 5) develop informed hypotheses and design/execute experiments to test hypotheses, and 6) critically analyze data and determine if data supports hypotheses, and 7) explore philosophical questions about the nature of human life, human consciousness, and free will.

Neuroscience also involves exploring the complex interactions between the distinct aspects of brain, mind, and behavior. The major in Neuroscience engages students through a holistic, interdisciplinary approach rooted in rigorous science and augmented by philosophical perspectives that address the brain, mind, and human nature.

Neuroscience majors engage in numerous, interdisciplinary neuroscience-focused courses throughout their undergraduate career. These courses span from an introductory 100-level to highly rigorous 400-level neuroscience courses. Students are encouraged to engage in independent research and internships in addition to successful completion of the required coursework. Students will be well prepared for research positions in both academic and industry settings and numerous careers in health professions. Students are poised to pursue advanced graduate studies in medical, dental, veterinary, physical therapy, occupational therapy, and optometry programs. Students will also be prepared for Master programs and Ph.D. programs. It should be noted that requirements for entry into graduate programs are varied and it is each student's responsibility to learn the requirements of all programs to which he/she may wish to apply. Students are encouraged to work with their academic advisors to help with their post graduate goals.

The Major in Neuroscience with a Cellular Path features curriculum that employs molecular, cellular, genetic, and organismal approaches to understand neuroanatomy and function of the nervous system; the biological basis of behavior and sensation; the underpinnings of diseases and injuries that impact the brain, spinal cord and nervous system; research techniques used to enhance our understanding of the field; how to conduct and critically evaluate scientific research; and philosophical conversations about the relationship between brain and mind, free will, and human consciousness.

REQUIRED COURSES (15)

BIO 160 Concepts in Biology (with lab)
BIO 210 Genetics (with lab)
MAT 114 (or higher) Elementary Functions (or higher)
CHE 131-132 General Chemistry I and II (with lab)
CHE 201 Organic Chemistry I (with lab)
PSY 101 General Psychology
BIO 240 Human Anatomy (with lab)
PSY 251 Introduction to Brain and Behavior
PSY 224 Statistics
PHI 302 Person, Mind, and Brain
BIO 280 Sensory systems (with lab)
BIO 340 Molecular and Cellular Biology (with lab)
BIO 370 General Physiology (with lab)
BIO 375 Milestones in Neuroscience

NEUROSCIENCE CAPSTONE COURSES (2)

BIO 415 Principles of Neuroscience (with lab)
PSY 402 Social and Affective Neuroscience OR PSY 403 Cognitive Neuroscience

BIOLOGY ELECTIVE, CHOOSE ONE OF THE FOLLOWING (1)

BIO 220 Invertebrate Zoology (with lab)
BIO 250 Microbiology (with lab)
BIO 310 Animal Behavior (with lab)
BIO 260 Bioinformatics (with lab)
BIO 320 Organic Evolution
BIO 420 Developmental Biology (with lab)
BIO 430 Comparative Physiology (with lab)
BIO 490 Independent Study with neuroscience focus
CHE 414 Biochemistry (with lab)

PSYCHOLOGY ELECTIVE, CHOOSE ONE OF THE FOLLOWING (1)

PSY 250 Perception
PSY 252 Cognitive Psychology
PSY 391 Experimental Techniques in Human Neuroscience (with lab)

RECOMMENDED BUT NOT REQUIRED COURSES

PHI 152 The Human Difference OR PHI 153 The Book of Nature

RECOMMENDED FOUR-YEAR PLAN FOR THE MAJOR IN NEUROSCIENCE WITH A CELLULAR PATH, B.S. DEGREE

First Year

Fall	Spring
BIO 160 Concepts in Biology and lab	BIO 210 Genetics and lab
CHE 131 General Chemistry I and lab	CHE 132 General Chemistry II and lab
PSY 101 General Psychology	PSY 251 Introduction to Brain and Behavior
MAT 114 or higher	

Sophomore Year

Fall	Spring
BIO 280 Sensory Systems and lab	BIO 340 Molecular and Cellular Biology and lab
CHE 201 Organic Chemistry I and lab	PSY 302 Person, Mind and Brain
PSY 224 Statistics	
PHI 152 The Human Difference OR PHI 153 The Book of Nature	

Junior Year

Fall	Spring
BIO 240 Anatomy and lab	BIO 370 General Physiology
BIO elective Psychology elective	BIO 375 Milestones in Neuroscience

Senior Year

Fall	Spring
BIO 415 Principles of Neuroscience and lab	PSY 402 Social and Affective Neuroscience OR PSY403 Cognitive Neuroscience
Biology elective	

ADVISING TIPS FOR THE B.S. IN NEUROSCIENCE WITH A CELLULAR PATH

- Students should take CHE 131, BIO 160, and MAT 114 (or higher) in their first semester.
- Students majoring in Neuroscience with a Cellular path are encouraged to take PHI 152 The Human Difference or PHI153 The Book of Nature before taking PHI 302 Person, Mind, and Brain
- Students are advised to take no more than 2 laboratory courses in a given semester.
- Students pursuing advanced programs in medicine should consider taking CHE414 as a biology elective for this major and in addition, take CHE202, PHY201, and PHY202. Requirements for programs are varied, and it is each student's responsibility to learn the requirements of all programs to which he/she may wish to apply.

MAJOR IN ENVIRONMENTAL SCIENCE, B.S. DEGREE (16)

Environmental Science students will receive a broad foundation in the fundamentals of environmental science, including chemistry, biology, physics, and mathematics. The program also allows the students the flexibility to explore different interests such as resource conservation or botany. Students interested in this major are eligible to take courses off campus through the Marine Studies Consortium, the Duke University Marine Biology Consortium, and the Higher Education Consortium of Central Massachusetts.

After graduation, students can seek employment in government agencies or industry, or they can pursue graduate studies in environmental engineering, environmental science, environmental management, law, education or the health sciences. To facilitate entry into these areas of study the University has established agreements that allow qualified Assumption Environmental Science students to participate in a dual degree program with the University of Notre Dame or Washington University in St. Louis, which will result in two degrees: a B.S. in Environmental Science and a B.S. in Environmental Engineering. Assumption also has agreements that can help students gain acceptance to earn a M.S. in Environmental Management or Forestry Management from Duke University, world-renowned for its work in Environmental Science, or a J.D. in Environmental Law from the Vermont Law School, which U.S. News and World Report currently ranks as the nation's leading environmental law program.

REQUIRED COURSES (13)

ENV 150 Introduction to Environmental Science
GEO 101 OR GEO 103 OR Dynamic Earth Systems/ Biogeochemistry

ENV 480 Environmental Science Seminar
BIO 160 Concepts in Biology
BIO 360 Ecology
CHE 131–132 General Chemistry I and II (Note CHE 132 requires MAT 114 or higher as a pre-requisite.)
CHE 201 Organic Chemistry I
CHE 318 Environmental Chemistry
PHY 201 General Physics I
PHY 202 General Physics II OR PHY 213 Introduction to Engineering Problem Solving (PHY 213 requires MAT 118 or 132)
MAT 114 Elementary Functions OR MAT 117/131 Calculus I
ECO 115 Statistics with Excel OR PSY 224 Statistics OR SOC 300 Statistics

BIOLOGY ELECTIVE (1)

BIO 220 Invertebrate Zoology
BIO 230 Plant Biology
BIO 250 Microbiology (requires BIO 210)
BIO 260 Bioinformatics
BIO 350 Marine Mammals: Biology and Conservation

POLICY, MANAGEMENT, AND SOCIAL SCIENCE ELECTIVE (1)

ECO 235 Environmental Economics (requires ECO 110)
GEO 108 World Population Issues
GEO 252 Introduction to Land Use Policy
HSC 150 Introduction to Public Health
POL 321 Public Policy
ENV 260 Water Resources Planning and Management (consortium)
ENV 280 Coastal Zone Management (consortium)

ADDITIONAL ELECTIVE 300-LEVEL or ABOVE (1)

ENV 491 Environmental Science Independent Study
BIO 310 Animal Behavior (requires BIO 220 or BIO 240 or BIO 280)
BIO 320 Organic Evolution (requires BIO 210)
ENV 350 Wetlands (consortium, requires CHE 132 and two BIO courses)
CHE 315 Analytical Chemistry (requires CHE 202)
CHE 450 Instrumental Analysis (requires CHE 202)
Pre-approved HECCMA or transfer course.

Students who wish to pursue careers in environmental engineering or want to apply to certain graduate programs should consider MAT 117 as an additional recommended course.

RECOMMENDED FOUR-YEAR PLAN FOR THE B.S. IN ENVIRONMENTAL SCIENCE

The following plan is recommended for environmental science majors. It prepares students for the workforce or for graduate school. The General Chemistry sequence is an important part of the student's first year at Assumption University. Students should work closely with an advisor in the science department to tailor course selection to their interests and goals and be confident of course availability and sequencing.

First Year

Fall	Spring
CHE 131 General Chemistry I and lab	CHE 132 General Chemistry II and lab
ENV 150 Introduction to Environmental Science	BIO 160 Concepts in Biology and lab
MAT 114 Elementary Functions or MAT 117/131 Calculus I	

Sophomore Year

Fall	Spring
CHE 201 Organic Chemistry I and lab	Major elective
Statistics	GEO 101 or GEO 103
Major elective	

Junior Year

Fall	Spring
BIO 360 Ecology and lab	CHE 318 Environmental Chemistry and lab
PHY 201 or PHY 201H General Physics I and lab	PHY 202 or PHY 213 Intro to Engineering
	Major elective

Senior Year

Fall	Spring
Major elective	ENV 480 Environmental Science Seminar

ADVISING TIPS FOR THE B.S. IN ENVIRONMENTAL SCIENCE

- Upper level courses are often offered on an every-other-year schedule.
- ENV 150 may be offered in other semesters. Students should work with an advisor for planning course sequencing.

MAJOR IN PRE-CLINICAL HEALTH SCIENCE, B.S. DEGREE (19)

The Major in Pre-Clinical Health Science is designed to prepare students for graduate study in one of the many clinical health professions, such as medicine, dentistry, veterinary medicine, physician assistant, and optometry. This interdisciplinary major provides the student with a strong background in the biological and physical sciences and the health sciences.

REQUIRED COURSES (15)

Pre-Clinical Health Science Majors should take CHE 131, BIO 160, and MAT 114 (or higher) in their first semester.

BIO 160 Concepts in Biology
BIO 210 Genetics
BIO 240 Human Anatomy
BIO 250 Microbiology or BIO 340 Molecular and Cellular Biology
BIO 370 General Physiology
CHE 131-132 General Chemistry I and II (Note CHE 132 requires MAT 114 or higher as a pre-requisite.)
CHE 201-202 Organic Chemistry I and II
CHE 414 Biochemistry
MAT 114 Elementary Functions or MAT 117 Calculus I
PHY 201-202 General Physics I and II
PSY 101 General Psychology
PSY 224 or SOC 300 or ECO 115 Statistics

HEALTH SCIENCE ELECTIVES (4)

HEALTH CARE DELIVERY, HEALTH CARE DATA ACQUISITION, AND HEALTH CARE SYSTEMS ELECTIVES (2)

HSC 100 Systems Approach to Delivering Health Care
HSC 150 Introduction to Public Health
HSC 222 Advocacy for Patient Centered Care,
HSC 310 Evidence-Based Health Care (Fall/Spring)
HSC 360 Legal and Ethical Aspects of Health Care (Fall/Spring)
HSC 370 Health Promotion and Education

HSC 450 Internship in Health Sciences (6 credits)
HUS 230: Applied Interviewing Skills for Health and Human Service Practitioners

HEALTH AND HUMAN SERVICES ELECTIVES (2)

HUS 119 Introduction to Health and, Human Services
HUS 121 Human Development Across the Lifespan
HUS 210 Medical Aspects of Human Functionality (Fall/Spring)
HUS/HSC 220 Psychosocial Prevention, Intervention, and Advocacy (Fall/Spring)

Please note: Admission requirements for clinical health science programs (e.g., medical school, optometry, dentistry, physician assistant studies, etc.) vary widely, and even within a given area of study different institutions will have different prerequisites for admission. Therefore, students are strongly encouraged to review the specific prerequisites listed for the programs they hope to enter, and then they should work with their advisor to ensure that they complete the requirements prior to graduation.

RECOMMENDED FOUR-YEAR PLAN FOR THE B.S. IN PRE-CLINICAL HEALTH SCIENCE

The following is a possible four-year schedule for classes in the Pre-Clinical Health Science major. It is important that first year students enroll in both BIO160 and another biology core course (BIO210 or Organismal biology course) AND the CHE131-132 sequence to start the major and to best balance the remaining three years of the curriculum. Students should work closely with an advisor in the science department to tailor course selection to their interests and goals and to be confident of course availability and sequencing.

First Year

Fall	Spring
BIO 160 Concepts in Biology and lab CHE 131 General Chemistry I and lab MAT 114 Elementary Functions or MAT 117/131 Calculus I PSY 101 General Psychology	BIO 210 Genetics and lab CHE 132 General Chemistry II and lab

Sophomore Year

Fall	Spring
BIO 240 Human Anatomy CHE 201 Organic Chemistry I and lab PSY 224/SOC 300/ECO 115 Statistics	BIO 370 General Physiology CHE 202 Organic Chemistry II and lab Health Science Elective

Junior Year

Fall	Spring
PHY 201 General Physics I and lab BIO 250 Microbiology or CHE 414 Biochemistry Health Science Elective	PHY 202 General Physics II and lab CHE 414 Biochemistry or BIO 340 Molecular and Cellular Bio Health Science Elective

Senior Year

Fall	Spring
Health Science Elective	

ADVISING TIPS FOR THE B.S. IN PRE-CLINICAL HEALTH SCIENCE

- Students interested in pursuing medical school or affiliated careers should consider PHY 201 and 202 in the sophomore year and CHE 414 in the junior year to prepare for the MCAT exam after junior year.

CONCENTRATION IN PRE-OCCUPATIONAL THERAPY (11)

The minimal entry-level degree for practice as an Occupational Therapist is a clinical master's degree in Occupational Therapy. The Concentration in Occupational Therapy is designed to prepare students for graduate study in Occupational Therapy. The

concentration **is not a major**, and all students completing the concentration must also complete the requirements of a major prior to graduation. Many students interested in Occupational Therapy have majored in Biology, Health and Human Services, or Psychology, and many of the courses required for the concentration are also required for completion of these majors.

REQUIRED COURSES (10)

HUS 125 Professional Orientation to Physical and Occupational Therapy (Spring)
HUS 345 Occupational Therapy: Occupation, Theory, Intervention and Assessment Across the Lifespan (Fall)
BIO 160 Concepts in Biology with Lab (Fall/Spring)
BIO 240 Human Anatomy with Lab (Fall)
BIO 370 General Physiology with Lab (Spring)
PSY 101 General Psychology (Fall/Spring)
PSY 216 Psychological Disorders (Fall/Spring)
HUS 121 Human Development and Disability (Fall/Spring)
PSY 224 Statistics or SOC 300 or ECO 115 (Fall/Spring)

SOC 121 Principles of Sociology
or
ANT 131 Cultural Anthropology

FIELD BASED COURSE (1)

HUS 490 Internship in Health and Human Services (HUS Majors-12 Credits)
HUS 400 Health and Human Services (non-HUS Major-3 credits)
HSC 450 Health Sciences Internship (HSC majors – 6 credits)

Some programs may require a course in Neuroscience, Kinesiology and/or Neuroanatomy with a focus on the Central and Peripheral Nervous System. First semester freshmen who want to complete the concentration should enroll in BIO 160 and HUS 125. First-year students should also consult with the Health Professions Advisor, Dr. Steven Theroux, at the beginning of the fall semester to plan out the remainder of their course of study. A significant number of hours (as many as 1,000) in fieldwork related to health care may be required for admission to some OT programs. The internship experience required for our program may not provide all of the hours needed to satisfy this requirement. Additional experience can be gained by volunteer work or by acquiring a paid position as a rehabilitation aide. It may also be possible to obtain additional fieldwork experience by completing additional internships within the major.

It is also important to note that some graduate programs have atypical course requirements. Students who are considering applying to graduate school for Occupational Therapy should review the admission requirements of the schools they plan to apply to by the beginning of their junior year in order to be certain they will have time to complete all of the necessary coursework before graduation.

CONCENTRATION IN PRE-PHYSICAL THERAPY (16)

The minimal entry-level degree for practice as a Physical Therapist is a clinical doctoral degree in Physical Therapy. The Concentration in Physical Therapy is designed to prepare students for graduate study in Physical Therapy. The concentration is not a major, and all students completing the concentration must also complete the requirements of a major prior to graduation. A student may complete any major while also completing the concentration. Many students interested in Physical Therapy have majored in Biology, Health and Human Services, or Psychology, and many of the courses required for the concentration are also required for completion of these majors.

REQUIRED COURSES (13)

HUS 125 Professional Orientation to Physical and Occupational Therapy (Spring)
BIO 160 Concepts in Biology
BIO 240 Human Anatomy (Fall)
BIO 370 General Physiology (Spring)
CHE 131 General Chemistry I (Fall)

CHE 132 General Chemistry II (Spring) (Note: MAT 114 is a pre-requisite for CHE 132)
PHY 201 General Physics I (Fall)
PHY 202 General Physics II (Spring)
BIO/HUS 390 Exercise Physiology (Fall)
PSY 101 General Psychology
PSY 216 Psychological Disorders
PSY 290 Psychology of Development
SOC 121 Principles of Sociology

ONE OF THE TWO HUS COURSES LISTED BELOW

HUS 490 Internship in Human Services (if HUS Major-12 Credits)
HUS 400 Health and Human Services (if Non-HUS Major-3 credits)

ONE OF THE FOLLOWING STATISTICS COURSES

PSY 224 Statistics
ECO 115 Statistics with Excel

ONE OF THE FOLLOWING MATH COURSES

MAT 114 Elementary Functions
MAT 117 Calculus I

RECOMMENDED BUT NOT REQUIRED

BIO 415 Principles of Neuroscience
PSY 251 Introduction to Brain and Behavior

Students who wish to complete the concentration should enroll in BIO 160 and its lab in their first semester at the University, as well as HUS 125 in the spring semester. First-year students should also consult with the Health Professions Advisor, Dr. Steven Theroux, or the chair of Health and Human Services.at the beginning of the fall semester to plan out the remainder of their course of study. A significant number of hours (as many as 1,000) in fieldwork related to health care may be required for admission to some PT programs. The internship experience required for our program may not provide all of the hours needed to satisfy this requirement. Additional experience can be gained by volunteer work or by acquiring a paid position as a rehabilitation aide. It may also be possible to obtain additional fieldwork experience by completing additional internships within the major. It is also important to note that some graduate programs have atypical course requirements. Students who are considering applying to graduate school for Physical Therapy should review the admission requirements of the schools they plan to apply to by the beginning of their junior year in order to be certain they will have time to complete all of the necessary coursework before graduation.

MINOR IN BIOLOGY (5)

Students who wish to pursue the study of life forms and functions may elect a minor in Biology. This course of study may appeal to students majoring in the behavioral sciences who plan a career in a health-related field. Ordinarily the student will begin with BIO 160 Concepts in Biology, adding at least four Biology courses numbered above 200 in consultation with an advisor from the department. Courses taken numbered below BIO 160 require the approval of the department chairperson. NUR 304 Pathopharmacological Therapeutics may be counted as one of the four additional biology courses. Please note that the double-counting rule applies to this minor and three courses in it must be distinct from a major, another minor, or a concentration.

MINOR IN CHEMISTRY (8)

Students who wish to pursue the study of the structure of matter beyond the level of an introductory may elect to minor in Chemistry.

REQUIRED COURSES (7)

CHE 131–132 General Chemistry I and II (Note: MAT114 is a pre-requisite for CHE 132)
CHE 201–202 Organic Chemistry I and II
CHE 311 Physical Chemistry I
MAT 117 and 118 **or** MAT 131 and 132 Calculus I and II

ANALYTICAL CHEMISTRY COURSE (1)

CHE 315 Analytical Chemistry
CHE 316 Inorganic Chemistry
CHE 450 Instrumental Chemistry

MINOR IN PHYSICS (6)

Students interested in furthering their knowledge of physics can choose to minor in this discipline. Required courses for the minor are: PHY 201–202, and PHY 480. Students must also complete three of the following eleven courses, and no more than two of the three may be from the mathematics offerings: CHE 311, CHE 312, PHY 213, PHY 275, PHY 301, PHY 302, PHY 491, PHY 492, MAT 331, MAT 351, MAT 355.

MINOR IN ENGINEERING SCIENCE (6)

This minor is for students who are interested in gaining a foundation in engineering, but do not wish to transfer to one of our 3-2 engineering partner schools. Students who do transfer to a partner school and graduate with an engineering degree are not eligible for the minor. The minor is a good option for those considering obtaining a graduate degree in engineering. The minor consists of 6 courses:

REQUIRED COURSES (4)

PHY 213 Introduction to Engineering Problem Solving
MAT 355 Differential Equations
CSC 117 Introduction to Programming
PHY 301 Statics

ELECTIVES (2) MUST BE FROM DIFFERENT DISCIPLINES

MAT 356 Numerical Analysis
CSC 317 Java Programming
PHY 275 Applied Optics
PHY 302 Dynamics
CHE 311 Physical Chemistry I or equivalent Thermodynamics course
Approved engineering courses, transfer credit or HECCMA consortium

MINOR IN ENVIRONMENTAL SCIENCE (6)

Students may expand their study of environmental problems with a Minor in Environmental Science. This program will appeal to students who have an interest in the science behind environmental issues.

REQUIRED COURSES (6)

ENV 150 Introduction to Environmental Science
BIO 160 Concepts in Biology
ENV 480 Environmental Science Seminar
1 200 level course from Section A below
1 300 level course from Section A below
1 course from Section B below

Section A

BIO 220 Invertebrate Zoology
BIO 230 Plant Biology
BIO 350 Marine Mammals: Biology and Conservation
BIO 360 Ecology
CHE 318 Environmental Chemistry
ENV 350 Wetlands
ENV 491 Independent Study in Environmental Science

Section B

GEO 101 Physical Oceanography
GEO 103 Climate and Weather
GEO 134 Conservation of Natural Resources
GEO 252 Land Use and Planning Law
ECO 235 Environmental Economics
ENV 260 Water Resources Planning and Management (consortium)
ENV 280 Coastal Zone Management (consortium)

STUDENT RESEARCH—SUMMER OPPORTUNITIES

Department faculty members oversee research programs on campus that engage upper-level students in the projects associated with their research interests. Summer research positions that provide a stipend are available on a competitive basis. Assumption students have been accepted into prestigious summer research programs at major research institutions around the country. The sponsoring institutions for this research include the National Science Foundation, the National Institutes of Health, and the American Cancer Society.

ARTICULATION AGREEMENTS IN THE SCIENCE AND HEALTH PROFESSIONS

Assumption University holds a wide range of agreements with graduate institutions in the health sciences. For a complete list, see the "Articulation Agreements" section above and/or contact the Health Professions Advisor, Prof. Steven Theroux, stheroux@assumption.edu.

THREE/TWO ENGINEERING PROGRAMS WITH THE UNIVERSITY OF NOTRE DAME AND WASHINGTON UNIVERSITY, ST. LOUIS

Students interested in pursuing one of the 3:2 engineering programs should take the technical courses listed below in their first year at Assumption. Careful planning is important to meet the prerequisites for admission to Notre Dame or Washington University. Interested students should meet with the dual degree engineering program director, Prof. Teresa Herd, to start planning their curriculum.

FIRST YEAR COURSES FOR 3:2 ENGINEERING, VARIOUS FIELDS

Assumption Major	Notre Dame/Washington University Engineering Major	Recommended first-year technical courses	
		Fall	**Spring**
Biology	Biomedical Engineering	MAT 117 OR MAT 131H Calculus I CHE 131 Chemistry I BIO 160 Concepts in Biology	MAT 118 OR MAT 132H Calculus II CHE 132 Chemistry II BIO 210 Genetics PHY 213 Introduction to Engineering
Chemistry	Chemical Engineering	MAT 117 OR MAT 131H Calculus I CHE 131 Chemistry I BIO 160 Concepts in Biology	MAT 118 OR MAT 132H Calculus II CHE 132 Chemistry II PHY 213 Introduction to Engineering
Environmental Science	Environmental Engineering	MAT 117 OR MAT131H Calculus I CHE 131 Chemistry I ENV 150 Introduction to Environmental Science	MAT 118 OR MAT132H Calculus II CHE 132 Chemistry II PHY 213 Introduction to Engineering BIO 160 Concepts in Biology
Math	Aerospace Engineering Civil Engineering Electrical Engineering Mechanical Engineering	MAT 117 OR MAT 131H Calculus I PHY 201H Honors Physics I CSC 120 Statistics Programming in Python	MAT 118 OR MAT 132H Calculus II PHY 202H Honors Physics II PHY 213 Introduction to Engineering
	Systems Engineering	MAT 117 OR MAT131H Calculus I PHY 201H Honors Physics I CSC 117 Introduction to Programming in C++	MAT 118 OR MAT132H Calculus II PHY 202H Honors Physics II PHY 213 Introduction to Engineering CSC 250 Intermediate Programming
Computer Science	Computer Engineering	MAT 117 OR MAT131H Calculus I PHY 201H Honors Physics I CSC 117 Introduction to Programming in C++	MAT 118 OR MAT132H Calculus II PHY 202H Honors Physics II PHY 213 Introduction to Engineering CSC 250 Intermediate Programming

PREPARATION FOR TEACHING SCIENCE AT THE SECONDARY LEVEL

Students interested in seeking certification to teach high school biology or chemistry should consider a Major in Biology or Chemistry and a Major in Education, Secondary License. Application to the Education Major must be made by April 30 of the sophomore year. Please see a complete description of procedures and policies in the Department of Education section of the catalog. A student should carefully plan a course of study in conjunction with advisors in both departments (Education and Biological and Physical Sciences).

Biology – Field of Knowledge Competencies:

BIO 160 Concepts in Biology
BIO 210 Genetics
BIO 230 Botany
BIO 220 Zoology
BIO 240 Human Anatomy
BIO 370 General Physiology
BIO 360 Ecology
CHE 131–132 General Chemistry I and II

Chemistry – Field of Knowledge Competencies:

CHE 131–132 General Chemistry I and II
CHE 201–202 Organic Chemistry I and II
CHE 316 Inorganic Chemistry
CHE 315 Analytical Chemistry
CHE 311–312 Physical Chemistry I and II
PHY 201–202 Physics I and II
MAT 117–118 Calculus I and II **OR**
MAT 131–132 Honors Calculus I and II

PRE-MEDICAL/PRE-DENTAL

As a liberal arts university, Assumption offers students the knowledge necessary for entrance to and success in medical and/or dental school. Most students interested in pursuing a career in Medicine or Dentistry major in Biology or Pre-Clinical Health Science. However, it is possible to choose other majors and still prepare for such a career. Although there is no universal standard for medical school admissions, most school requirements would be fulfilled by inclusion of the following courses:

BIO 160 Concepts in Biology
One from the following three Biology courses:
    BIO 210 Genetics
    BIO 240 Human Anatomy
    BIO 340 Molecular and Cellular Biology
CHE 131–132 General Chemistry I and II (Note: MAT114 is a pre-requisite for CHE 132)
CHE 201–202 Organic Chemistry I and II
PHY 201–202 General Physics I and II
ENG 130 Writing in the University
ENG 140 Literature and Its Interpretations

Additional courses that are usually highly recommended include:

CHE 414 Biochemistry
MAT 117 Calculus I or MAT 131 Honors Calculus I
ECO 115 Statistics with Excel or PSY 224 Statistics
Courses in Psychology and Computer Science
Additional courses in Biology, Chemistry, and Mathematics are helpful.

Note these courses reflect a suggested course load. Students should contact their desired schools and Dr. Steven Theroux before committing to a plan of study.

MEDICAL TECHNOLOGY OPTION (BIOLOGY MAJOR)

The Medical Technology Option is designed to offer students the background necessary to apply for admission to a hospital-affiliated school of Medical Technology. This option can be completed in three or four years at Assumption before entering a school of Medical Technology. The three-year program is described here. During the first three years while the student is at Assumption University, he/she should complete:

- Four courses in Chemistry, including Organic Chemistry
- Two courses in Physics
- Seven courses in Biology , including Microbiology and Immunology
- One course in Mathematics at the level of MAT 114 or above

In addition, other curriculum requirements to fulfill the Bachelor of Arts program at Assumption must be taken during the first three years of the program when planned in conjunction with a faculty advisor in the Department of Biological and Physical Sciences. It is important for a student interested in this option to indicate his/her interest in the first year and to plan the program carefully. Three years of study (30 courses) as a Biology major at Assumption are followed by one year of training and study in an approved hospital school of Medical Technology. Upon completion of the hospital year, the student will receive a Bachelor's

degree from Assumption and will be eligible to take the National Registry Exam in Medical Technology. Participation in Assumption's undergraduate Medical Technology Option does not guarantee admission to a School of Medical Technology.

HEALTH PROFESSIONS PREPARATION

Students who wish to pursue careers in medicine, dentistry or one of the many other health professions must complete the necessary prerequisites for admission to the health profession schools of their choice. These individuals should consult their academic advisors and the Health Professions Advisor, Dr. Steven Theroux, when designing their course of study. The Department has agreements with several institutions that offer degrees in the health professions. Students interested in Allopathic or Osteopathic Medicine, Podiatric Medicine, Pharmacy, Physical Therapy, Optometry, Physician Assistant Studies, Nursing, or Biotechnology should discuss these agreements with the Health Professions Advisor, Prof. Steven Theroux. Students who plan to pursue a graduate degree in a health profession should be aware of the timetable in which to fulfill their requirements, which include admissions exams and letters of reference from the Health Sciences Committee. Students should be prepared for entrance exams in their junior year and request a letter of reference at that time. Students must contact Dr. Theroux at least two weeks before the scheduled Committee meeting times in the second week of October, the second week of February, and the second week of May. The letters will usually be ready within four to five weeks of the meeting.

COURSE DESCRIPTIONS

BIOLOGY (BIO)

BIO 102 HUMAN BIOLOGY IN HEALTH AND DISEASE

A course for non-science majors that focuses on selected functional systems of the body, the organs that compose them, and the interactions among them. Special attention will be given to disease processes. In these systems laboratory work (one three-hour session per week) will include studies of physiological concepts at the cellular and systems levels. This course is especially designed for students majoring in Social and Rehabilitation Services or Psychology, or students seeking background for courses in Anthropology and other social sciences. Lab Fee: $470. This course fulfills a Foundations Program requirement. (Fall, Spring)
Staff/*Four credits*

BIO 105 HUMAN HEREDITY

This course presents an introduction to the principles of human genetics. Major topics covered include cell division and the distribution of genetic material, embryonic development and the role of teratogens; Mendel's experiments, inheritance patterns in human families; the interaction of genes and the environment; the structure and function of DNA; personal genomics; and genetic technologies. An historical approach is used and most genetic principles are introduced by examples from human medical genetics. Two or three integrated lecture-laboratory sessions per week. Lab fee: $235. This course fulfills the Foundations Program requirement for a natural science. (Fall, Spring)
Staff/*Three credits.*

BIO 110 NUTRITION

This course will explore the basic principles of human nutrition. Topics to be covered include nutrient classes, nutritional guidelines, nutrition-related diseases and disparities in access to healthy foods. This course will also cover controversial topics in nutrition such as GMOs and fad dieting. This will be an interactive course that will require students to use the scientific method and will include in-class research, data collection, presentations and discussions. Two or three integrated lecture-laboratory sessions per week. Lab fee: $235. This course fulfills the Foundations Program requirement for a natural science. (Fall, Spring)
Staff/*Three credits*

BIO 115 MATTERS AND MYSTERIES OF YOUR BRAIN

The brain is the most complex and least understood organ in our bodies. It is fascinating to consider that the brain is required for a vast array of functions including learning and memory, motor movement, and perception of our environment. The brain's vital role in our daily life is indisputable, yet we do not fully understand the fundamental underpinnings of brain function. For this reason, the brain is referred to as the last frontier of science. In this course, student-driven approaches will be used to explore

what is known and what is not yet fully understood about brain function through the use of case studies of humans suffering from brain injury, hypothesis-driven experimentation, and critical examination of recent science findings as described by the media. Students will refine their practice of the scientific method while enhancing critical thinking skills. Two or three integrated lecture-laboratory sessions per week. Lab fee: $235. This course fulfills the Foundations Program requirement for a natural science. (Spring)
Staff/*Three credits*

BIO 125 BACKYARD BIOLOGY
Biology is the science of life – and life happens all around us. In this course, we will explore fundamental concepts of biology using real-life examples encountered for example in your kitchen or backyard. We will focus on the principles of ecology and evolution, while tackling contemporary problems of global importance – climate change and biodiversity decline. The integrated laboratory experience consists of self-guided explorations of plants, animals, and other organisms commonly found in the Northeastern USA, as well as simple at-home experiments and simulations. This course aims to broaden your horizons and instill an appreciation for the creatures large and small with whom we share the world. By exploring the life that happens right outside your door, you will not only learn basic biological facts, but more importantly the ecological connections that make life on Earth possible and enjoyable! Two or three integrated lecture-laboratory sessions per week. Lab fee: $235. This course fulfills the Foundations Program requirement for a natural science. (Summer)
Staff/*Three credits*

BIO 140 INQUIRY BIOLOGY FOR EDUCATORS
In this course, students learn fundamental concepts and models associated with three major sub-disciplines of biology – genetics, ecology, and evolution. The course heavily emphasizes the use of open-ended, problem-solving methods of teaching and learning to help students develop their own functional understanding of the major concepts. A significant part of students' problem-solving work involves the use of computer technology, including the use of concept mapping and computer simulations to facilitate concept development. The course is intended for students planning on pursuing a career in elementary or middle school education. As such, particular attention is given to understanding common misconceptions that children have concerning learning about biological phenomena and considering the ramifications of these misconceptions for the development of effective classroom instruction. At least twice during the term, students will be expected to teach "mini" lessons in the biological sciences. The course includes a lab component and meets six hours a week. This course fulfills the Foundations Program requirement for a natural science. (Fall, Spring)
Scibelli/*Four credits*

BIO 150 BIOLOGICAL PRINCIPLES
An introductory course that provides a strong foundation in aspects of biological science that are particularly relevant to nursing students. The course focuses on the chemical basis of life, cell structure and function, genetic information, and energetics and regulation of living systems. Together with the laboratory, this class introduces students to techniques and approaches used in science. Three lecture periods and one laboratory meeting per week. Should be taken by nursing students in their first year. This course is not intended for science majors, health science majors, or students on track to attend medical school, dental school, veterinary school, or those intending to become physician assistants or physical therapists. The course fulfills the Foundations Program requirement for a natural science. (Fall)
Staff/*Four credits*

BIO 160 CONCEPTS IN BIOLOGY
An introductory course required of all science majors that emphasizes major concepts in biological science: structure and function, homeostasis, energetics, perpetuation, and evolution of living organisms. The laboratory will introduce students to the techniques and approaches used in biology. Three lectures and one laboratory period each week. Should be taken by intended science majors in the first year. Lab Fee: $470. This course fulfills the Foundations Program requirement for a natural science. (Fall, Spring)
Staff/*Four credits*

BIO 207 DARWIN'S *DESCENT OF MAN*
People have long struggled with the notion that humans have descended from non-human ancestors. In his 1871 volume *Descent of Man*, Charles Darwin comprehensively applies his views on evolutionary theory and shared ancestry, including his adaptive mechanisms of natural and sexual selection, to human beings. Using countless examples, rational arguments, and the voice and

writing style of a Victorian gentleman, Darwin convincingly demonstrates that humans gradually evolved from animals. The book, therefore, challenges its readers with what it means to be human as Darwin addresses the emergence of language, culture, morality, notions of beauty, sexual attraction, and the origin of race from our animal ancestors. This course helps students learn to read Darwin's rich text, to understand the extraordinary depth, collaborative style, and limitations of his science, to engage critically with the enduring questions and tensions the text raises, and to reflect on the ways that Darwin's work still resonates in biology and culture today. Prerequisite: completion of a Foundations Program natural science course. (Fall)
Crowley/*Three credits*

BIO 210 GENETICS

A brief survey of Mendelian and cytological genetics with most emphasis placed on recent advances in molecular genetics. Replication, translation, and transcription of the genetic material receive detailed study. Three lectures and one laboratory per week. Prerequisite: BIO 160 and a course in Biology or Chemistry. Should be taken before the Junior year. Lab Fee: $470 (Fall, Spring)
Crowley, Theroux/*Four credits*

BIO 220 INVERTEBRATE ZOOLOGY

A survey of invertebrate animals from protozoans through invertebrate chordates, emphasizing their functional organization, modes of reproduction, ecological roles, and evolutionary relationships. In the laboratory, we will examine representative living and preserved specimens, concentrating on their structure and behavior. Three lectures and one laboratory or field trip each week. Prerequisite: BIO 160 or equivalent. Lab Fee: $470. (Spring)
Staff/*Four credits*

BIO 230 PLANT BIOLOGY

This course provides an introduction to the biology of plants. Among the topics considered are the role of plants in the biosphere, plant form and function, and the evolution of plants. In the laboratory, students examine representatives of the major groups of plants and learn the fundamentals of plant tissue culture techniques in order to study plant growth and development. Field work includes trips to a variety of local habitats. Three lectures and one laboratory or field trip each week. Prerequisite: BIO 160 or equivalent. Lab Fee: $470. (Fall, even-numbered years)
Staff/*Four credits*

BIO 240 HUMAN ANATOMY

Anatomy is the study of the structure of organisms. In this course we will study human anatomy in four regions: (i) back, (ii) upper and lower limbs, (iii) thorax, abdomen and pelvis, and (iv) head and neck. We will focus on anatomy of the human body and emphasize how structure affects function. Major topics covered in each region include muscles, bones, blood vessels and nerves. This course will consist of three one-hour lectures and one three-hour laboratory each week. Prerequisite: BIO 160 or BIO 150. Lab Fee $470. (Fall, Spring)
McCready, Sacino/*Four credits*

BIO 250 MICROBIOLOGY

Microorganisms, especially bacteria and viruses, are studied with respect to their morphological characteristics, growth and metabolism, genetics and environmental significance. The role of microorganisms as pathogens and the control of microorganisms are also considered. Laboratory techniques include sterilization, isolation, and culturing. Three lectures and one laboratory per week. Prerequisite: BIO 210 or BIO 150. Lab Fee: $470. (Fall, Spring)
Betancourt-Calle/*Four credits*

BIO 260 BIOINFORMATICS

Bioinformatics is the umbrella term for a wide range of methods and tools used to analyze large and complex biological data sets, especially DNA and RNA sequence data. This course introduces students to broadly applicable bioinformatic methods. Students will learn to access and use information from public databases, align homologous sequences, construct and interpret phylogenetic trees, and extract information from genomes using a variety of computational tools, including the use of basic command line interface. Relevant primary literature will be analyzed and discussed. The laboratory portion of the course is dedicated to practice with the analysis tools introduced in lectures, and to student projects. Students will work in groups to explore real data sets, select and apply suitable bioinformatic methods, interpret analysis results in the context of published works, and present their

findings to the class. This course counts as an elective towards the Biology, Biotechnology, and Data Analytics majors. Three lectures and one laboratory per week. Prerequisites: BIO 160 Concepts in Biology or CSC 120 Statistical Programming or permission of instructor. Lab Fee: $470. (Spring, even-numbered years)
Staff/*Four credits*

BIO 275 SPECIAL TOPICS IN BIOLOGY
This special topics course will explore an area of biology using the literature, and if appropriate, a cross-disciplinary approach. The course will allow the students and faculty an opportunity to investigate areas of biology that are not part of the regular curriculum.
Staff/*Three credits*

BIO 280 SENSORY SYSTEMS
Sensory Systems provides an understanding of how organisms see, hear, smell, taste, and feel sensations. In this course, we discuss the physiological and cellular mechanisms that allow organisms to receive sensory information. We introduce reflex pathways in organisms with complex nervous systems, and then compare these to how organisms with reduced nervous systems carry out stereotyped behavior. These simpler examples of sensory processing and behavior provide a foundation to understand how information is processed by the early stages of central nervous systems for more complex behavior. Our focus is on the mechanisms and sensory pathways the nervous system uses to process sensory information and control movement. Using comparative animal model systems, topics include sensory transduction and the sensory physiology for the best known sensory systems (olfactory, visual, somatosensory, auditory, gustatory) and models of sensory processing. We also ask: what can we learn from animals with senses that primates are currently not known to have, such as magnetic and electric senses? These are currently active areas of animal research. Prerequisites: BIO 160 and a 4-credit course in biological or physical science, OR BIO 160 and PSY 225 and PSY 251, OR BIO 160 and PSY 225 and PSY 250. Fee: $470. (Fall)
Cromarty, Lessios/*Four credits*

BIO 291 INTERNSHIP IN BIOLOGY
Directed study within an internship program. The student will be expected to keep a journal detailing the internship. The student will also be expected to write a paper, usually approximately 10 pages in length, summarizing an area related to the internship experience. An evaluation by the on-site supervisor will be considered when determining the grade. The student will be required to have a cumulative G.P.A. of 3.0 to enroll.
Staff/*Three credits*

BIO 310 ANIMAL BEHAVIOR
This course will initially approach the study of animal behavior from the physiological perspective: the neural basis of behavior (the nervous circuits responsible for sensory input and integration and motor output) will be studied in some detail. Subsequently, the emphasis will shift to the contribution of ecological, developmental, and evolutionary forces to shaping the ultimate behavior output. Three lectures and one three-hour laboratory each week. Lab fee $470. Prerequisite: BIO 220 or BIO 240 or BIO 280. (Fall)
Cromarty/*Four credits*

BIO 320 ORGANIC EVOLUTION
This course is an introduction to genetic changes in populations over time and to the models and evidence we use to identify and explain those changes. Topics include: influence of the environment, genotype-phenotype connections, Hardy-Weinberg equilibrium, genetic variation, genetic drift, in-breeding, natural selection, gene flow, speciation, phylogeny, macro-evolutionary trends, and the fossil record. Prerequisite: BIO 210. (Spring)
Staff/*Three credits*

BIO 340 MOLECULAR AND CELLULAR BIOLOGY
This course focuses on the structure and function of the eukaryotic cell. The role of cellular membranes in basic physiological processes is discussed in detail. The physiological roles of the extracellular matrix, the cytoskeleton, and various subcellular structures are also addressed. Finally, the student will be introduced to the processes that govern cellular division and cellular evolution. When possible, the course topics are related to the development of various human maladies, such as cancer and AIDS.

The laboratory exposes the students to several classical techniques used in cell biology and to a number of modern methods used by protein chemists and molecular biologists. Prerequisite: BIO 210 or permission of the instructor. Lab Fee: $470. (Spring)
Crowley, McCready/*Four credits*

BIO 350 MARINE MAMMALS: BIOLOGY AND CONSERVATION

This course is designed to familiarize students with the biology and natural history of marine mammals. Emphasis is placed on whales, dolphins, and seals of the western North Atlantic, but species from all over the world will be discussed. Topics to be considered include evolution, anatomy, behavior, field identification, the history of whaling, and contemporary conservation problems. Hands-on activities include one evening laboratory work (harbor porpoise or seal dissection) and marine mammal survey on Massachusetts Bay. Prerequisites: BIO 160 and two additional biology course. (Fall)
Marine Studies Consortium/*Three credits*

BIO 360 ECOLOGY

In this course, students interpret published data, critique some original papers, and participate in class discussion on the following topics: limits on species distributions, demography, population growth and regulation, interactions of species, energy flow, nutrient cycling, community dynamics, succession, and patterns of species diversity. In laboratory, students participate in class exercises, and design, perform, and report their own group field projects. Three lectures and one three-hour laboratory per week. Lab Fee: $470. Prerequisite: Two Biology courses or permission of instructor. (Fall, odd-numbered years)
Staff/*Four credits*

BIO 370 GENERAL PHYSIOLOGY

Human and animal physiology, with a comparative approach to the study of muscle contraction; blood circulation and respiration; metabolic and temperature controls; digestion and excretion; and nervous, sensory, and endocrine functions. The laboratory exercises focus on the investigation of basic concepts of animal and human physiology at the cellular and systems levels. Three lectures and one three-hour laboratory period each week. Lab Fee: $470. Prerequisites: BIO 240 and either CHE 102 or CHE 132. (Fall, Spring)
Cromarty, Lemons, Lessios/*Four credits*

BIO 375 MILESTONES IN NEUROSCIENCE

Using a critical examination of the primary literature as a tool, this course explores landmark advances within the field of neuroscience. Students gain a deeper understanding of neurobiological themes such as neurophysiology, neuroplasticity, neural development and communication between select model animal systems. Classic articles that are foundational to the field of neuroscience are thoroughly dissected to gain an historical appreciation of advances in the field. These are contrasted with recent articles to appreciate the advances in neuroscience research techniques. By contrasting major historical advances with more recent work, students weigh the implications of these findings at the time of publication and learn to critically assess the significance of recent findings. Students gain a deeper understanding of highlighted milestone advances in neurobiology. Prerequisites: BIO 340 or BIO 370 or BIO 280. (Spring, even-numbered years)
Lessios/*Three credits*

BIO 380 THE BIOLOGY OF CANCER

This course will explore the biology of cancer. Beginning with an examination of the personal, social and economic consequences of this disease, it will move to a focus on the cellular and molecular biology of cancer. Specially, it will study the nature of cancer, the role of viruses in cancer, cellular oncogenes, cellular signaling mechanisms, tumor suppressor genes, and the maintenance of genomic integrity. Other topics to be examined include: the cell cycle, apoptosis, cellular immortalization, tumorigenesis, angiogenesis and metastasis. Finally, this course will examine how modern molecular medicine is being used to treat cancer. Prerequisites: BIO 160, BIO 210, BIO 340. (Fall)
Theroux/*Three credits.*

BIO 390 EXERCISE PHYSIOLOGY

This advanced course is designed to provide students with applied knowledge relative to the human's physiologic responses to acute and chronic exercise stress. Students' basic knowledge of neuromuscular physiology, energy metabolism, cardiovascular and respiratory physiology will be honed to focus on human exercise response, with the focus of the course being on applications to exercise training and programming, sport, nutrition, youth, aging, and disease. Laboratory exercises will enable practical skills

to be gained in measuring and testing for physiological markers of human readiness and response to exercise. Lab Fee: $470. Prerequisites: BIO 240 and BIO 370. (Fall)
Staff/*Four credits*

BIO 415 PRINCIPLES OF NEUROSCIENCE
This course introduces students to the rapidly growing field of neuroscience, which is the study of the nervous system. Our nervous system shapes our every thought, emotion and sensation. Students will gain an understanding of the underlying neural basis of how we perceive the world. This course begins with an anatomical approach and then integrates physiological, cellular, molecular and functional approaches. Topics range from how cells in the brain communicate with one another, to current diagnostic and research technology, to the biological basis of movement, and includes the study of disease and injury to the brain, such as Alzheimer's disease, Parkinson's disease and stroke. Three lectures and one three-hour laboratory each week. Lab Fee $470. Prerequisites: BIO 370 or BIO 340 or BIO 310 or BIO 375 or permission of the instructor. (Fall)
Lemons/*Four credits*

BIO 430 COMPARATIVE PHYSIOLOGY
This course combines a brief review of fundamental principles of animal physiology with an in-depth discussion of how these principles are modified and shaped by environmental and ecological pressures. The functional significance of physiological adaptation to an animal's environment is emphasized by describing various mechanisms of regulation of physiological variables (temperature, metabolism, oxygen consumption, water retention, circadian rhythms) in extremely different environmental conditions. Three lectures and one three-hour laboratory each week. Prerequisite: BIO 370 or permission of instructor. Lab fee: $470. (Fall, alternate years)
Cromarty/*Four credits*

BIO 440 BIOTECHNOLOGY IN THEORY AND PRACTICE
This course integrates the disciplines of cellular biology, molecular biology, and protein chemistry through a series of related experiments. The course will expose students to: 1) recent journal articles within the scientific literature; 2) selected methods, techniques, and instruments used in biotechnology; and 3) strategies that can be employed to solve interesting biological problems. The laboratory experience will introduce the student to DNA amplification by the polymerase chain reaction; oligonucleotide-directed site specific mutagenesis; gel electrophoresis; isolation of protein, DNA and RNA; gene cloning; DNA sequencing; cell culture; gene expression in mammalian cell lines; and Southern hybridization analysis. Class meets six hours per week for lecture, laboratory, and discussion. Lab Fee: $470. Prerequisites: CHE 202 and BIO 340. (Spring)
Theroux/*Four credits*

BIO 480 SEMINAR IN LIFE SCIENCES
An overview of a defined scientific topic (such as the process of cell division) will be presented, and then recently published articles on this topic will be discussed in detail. As part of the course requirements, each student will be asked to present one or more assigned journal articles to the class. The course is designed to increase the student's knowledge of an active area of scientific inquiry and to enhance the student's reading, data analysis, and oral presentation skills. Prerequisites: Seniors or second semester juniors who have completed BIO 160 and five additional biology and chemistry courses, and permission of instructor.
Staff/*Three credits*

BIO 490–491 INDEPENDENT STUDY
Directed study or experimental research. Prerequisites: Six courses in Biology and consent of instructor. The student is expected to have a cumulative G.P.A. of 3.0 to enroll. (Offered by arrangement only.)
Staff/*Three credit*s

BIO 540 FOUNDATIONS IN BIOTECHNOLOGY
Provides an interdisciplinary, state-of-the-art introduction to biotechnology. Covers the molecular foundations of biotechnology, molecular microbiology, receptor pharmacology, drug development processes, biotech process development and scale-up, drug approval and regulatory affairs, genomics, microarray analysis, proteomics, computational biology, molecular modeling, analytical biotechnology, and bioterrorism and biotechnology. This course is offered at Northeastern University as BIOT 5120. Prerequisites: BIO 210, BIO 340.
Northeastern University/*Three credits*

BIO 541 CELL CULTURE PROCESSES FOR BIOPHARMACEUTICAL PRODUCTION

Covers the principles and concepts involved in the development of mammalian and other types of cell culture processes for the manufacturing of biopharmaceutical products such as monoclonal antibodies and recombinant proteins. Topics include protein expression and clone generation, batch and perfusion processes and media development, bioreactor operations and scale-up, and innovations in cell culture processes. Regulatory concepts include quality assurance in a cGMP environment. This course is offered at Northeastern University as BIOT 5631. Prerequisite: BIO 340.
Northeastern University/*Three credits*

BIO 542 THE BIOTECHNOLOGY ENTERPRISE

Exposes students to the business of biotech from scientific discovery startup through its product launch and subsequent organizational and scientific pipeline growth. Topics include scientific discovery, biotech-related funding and organizational structures, regulatory and clinical trial considerations, biotech alliances, patient access, ethics and compliance, and commercialization and growth while meeting unmet patient or consumer needs in this highly regulated industry. Although the focus is on the highest regulated standards in biopharma, the course also touches upon various aspects of other biotechnology domains. This course is offered at Northeastern University as BIOT 5219.
Northeastern University/*Two credits*

BIO 543 BASIC BIOTECHNOLOGY LAB SKILLS

Introduces selected key skills and techniques central to life sciences research. Combines hands-on training in basic laboratory skills with lecture and live demonstration. Laboratory exercises highlight the importance of precision/accuracy in dispensation of liquids and in the preparation of solutions and standards, documentation and record keeping, and maintaining a safe and sterile work environment while performing scientific research. This course is offered at Northeastern University as BIOT 5145.
Northeastern University/*One credit*

BIO 544 PROTEIN CHEMISTRY

Describes proteins (what they are, where they come from, and how they work) in the context of analytical analysis and molecular medicine. Discusses the chemical properties of proteins, protein synthesis, and the genetic origins of globular proteins in solution, membrane proteins, and fibrous proteins. Covers the physical intra- and intermolecular interactions that proteins undergo along with descriptions of protein conformation and methods of structural determination. Explores protein folding as well as protein degradation and enzymatic activity. Highlights protein purification and biophysical characterization in relation to protein analysis, drug design, and optimization. This course is offered at Northeastern University as CHEM 5620. Prerequisite: CHE 414.
Northeastern University/*Three credits*

BIO 545 MOLECULAR CELL BIOLOGY FOR BIOTECHNOLOGY

Integrates biochemistry and molecular biology in the cellular context. Includes the organization and replication of genomes, principles and methods for genetic manipulation, the regulation of gene expression, and the structure and function of organelles. Emphasizes protein synthesis, including translation, post-translational modifications, and translocations of proteins within the cells and secretion. This course is offered at Northeastern University as BIOL 6299. Prerequisite: BIO 340.
Northeastern University/*Three credits*

BIO 546 EXPERIMENTAL DESIGN AND BIOSTATISTICS

Explores the principles of experimental design and statistical analysis. Emphasizes research in the molecular and biological sciences and biotechnology. Topics include probability theory, sampling hypothesis formulation and testing, and parametric and nonparametric statistical methods. This course is offered at Northeastern University as BIOT 6214. Prerequisite: ECO 115.
Northeastern University/*Two credits*

BIO 547 BIOINFORMATICS PROGRAMMING

Focuses on the fundamental programming skills required in the bioinformatics industry. Focuses on Python and R as the main programming language used. Topics include string operations, file manipulation, regular expressions, object-oriented programming, data structures, testing, program design, and implementation. Includes substantial out-of-classroom assignments. This course is offered at Northeastern University as BINF 6200. Prerequisite: BIO 548 Bioinformatics Computational Methods. Northeastern BINF 6308, may be taken concurrently.

Northeastern University/*Four credits*

BIO 548 BIOINFORMATICS COMPUTATIONAL METHODS 1

Offers the first semester of a two-semester sequence on the use of computers in bioinformatics research. Offers students an opportunity to work with current methods and computational algorithms used in contemporary sequence analysis. Teaches practical skills necessary to manage and mine the vast biological information being generated and housed in public databases. Emphasizes the use of Python as the primary computer language and requires students to learn and understand basic computer logic and syntax, including an introduction to scalars, arrays, hashes, decision statements, loops, subroutines, references, and regular expressions. A focus on fundamental skills, including the command line interface found in the Linux operating system, is designed to prepare students for second-semester applications. This course is offered at Northeastern University as BINF 6308. Prerequisites: BIO 260 Bioinformatics and CSC 120 Statistics Programming.
Northeastern University/*Four credits*

BIO 549 BIOINFORMATICS COMPUTATIONAL METHODS 2

Designed to build upon the core topics covered in BINF 6308, i.e., use of the computer as a tool for bioinformatics research. Builds upon the Python language fundamentals covered during the first semester but requires students to apply these fundamentals to a semester-long project. The project includes protein family analysis, multiple sequence analysis, phylogeny, and protein structure analysis. Additionally, students have an opportunity to learn to build, load, connect, and query custom MySQL databases, and parse command line flags. This course is offered at Northeastern University as BINF 6309. Prerequisite: BIO 548 Bioinformatics Computational Methods 1 (Northeastern BINF 6308).
Northeastern University/*Four Credits*

BIO 550 STATISTICS FOR BIOINFORMATICS

Introduces the concepts of probability and statistics used in bioinformatics applications, particularly the analysis of microarray data. Uses statistical computation using the open-source R program. Topics include maximum likelihood; Monte Carlo simulations; false discovery rate adjustment; nonparametric methods, including bootstrap and permutation tests; correlation, regression, ANOVA, and generalized linear models; preprocessing of microarray data and gene filtering; visualization of multivariate data; and machine-learning techniques, such as clustering, principal components analysis, support vector machine, neural networks, and regression tree. This course is offered at Northeastern University as MATH 7340. Prerequisite: ECO 115 Statistics with Excel and BIO 260 Bioinformatics.
Northeastern University/*Four credits*

CHEMISTRY (CHE)

CHE 102 CHEMISTRY FUNDAMENTALS FOR HEALTH SCIENCE

This course aims to prepare students who have not completed general and organic chemistry for upper-level biology courses, especially BIO 370 General Physiology. Topics covered include atoms and molecules, properties and concentration of solutions, acids and bases, thermodynamics, kinetics, and basic organic chemistry with an emphasis on biological and healthcare-related examples. (Spring)
Staff/*One credit*

CHE 105 EVERYDAY CHEMISTRY

This course is designed for non-majors to better understand the chemistry that they interact with in their everyday lives. Even though chemistry has a constant and ubiquitous impact on our lives, most people are unaware of the science behind the products that they use every day. Emphasis will be on the connection between fundamental chemical properties and concepts and the student's everyday lives. Topics will be organized around the chemistry seen in different household areas such as the kitchen, bathroom, laundry room, and garage. Two or three integrated lecture-laboratory sessions per week. Lab fee: $235. This course fulfills the Foundations Program requirement for a natural science. (Spring)
Staff/*Three credits*

CHE 131–132 GENERAL CHEMISTRY I AND II

Fundamental principles of chemistry. Topics covered in CHE 131 include: matter and measurement, atomic and electronic structure, stoichiometry, gases, bonding, and solutions. In CHE 132: chemical equilibria (gases, solubility), acids and bases, electrochemistry, thermochemistry, nuclear and coordination chemistry. Emphasis is placed on problem solving. Laboratory work includes Qualitative Analysis. CHE 131 is a prerequisite for CHE 132. Intended science majors should take this series in their first year. Lab Fee: $470 each semester. These courses fulfill the Foundations Program requirement for a natural science. (Part I, Fall; Part II, Spring) Pre-requisite: MAT 114 is a prerequisite for CHE 132.

Knurr, Marcotte, Niece, Tuttle /*Four credits each semester*

CHE 201–202 ORGANIC CHEMISTRY I AND II

The chemistry of organic compounds (the compounds of carbon) is studied. The topics include covalent bonding, molecular structure, and resonance; constitutional, geometric, and optical isomerism; the reactions of organic compounds through their functional groups; the nucleophilic, electrophilic, and free radical reaction mechanisms; and spectroscopy. These theoretical and practical principles are applied to the solution of such organic chemical problems as structure determination, chemical synthesis of desired molecules, the effect of structure on properties, and the biological roles of organic molecules. This full-year course meets the needs of students who expect to pursue graduate studies in natural sciences and also of those who plan to enter professional schools. Prerequisite: CHE 131–132. Lab Fee: $470 each semester. (Part I Fall; Part II Spring)

Colby Davie, Dix/*Four credits each semester*

CHE 275 SPECIAL TOPICS IN CHEMISTRY

This special topics course will explore an area of chemistry using the literature, and if appropriate, a cross-disciplinary approach. The course will allow the students and faculty an opportunity to investigate areas of chemistry that are not part of the regular curriculum.

Staff/*Three credits*

CHE 291 INTERNSHIP IN CHEMISTRY

Directed study within an internship program. The student will be expected to keep a journal detailing the internship. The student will also be expected to write a paper (usually approximately 10 pages in length) summarizing an area related to the internship experience. An evaluation by the on-site supervisor will be considered when determining the grade. The student will be required to have a cumulative G.P.A. of 3.0 to enroll.

CHE 311–312 PHYSICAL CHEMISTRY I AND II

An intensive study of the structure and interconversions of matter in its several states. Intra- and inter-molecular forces, thermodynamics, equilibria, electrochemistry, kinetics, and statistical and quantum mechanics are considered. Prerequisites: CHE 201–202, PHY 201–202 (may be concurrent with permission of instructor), MAT 117–118 or MAT 131–132 or permission of the instructor. Lab Fee: $470 per semester. (Part I Fall; Part II Spring)

Knurr/*Four credits each semester*

CHE 315 ANALYTICAL CHEMISTRY

A study of the major methods of chemical analysis, including statistics in evaluating the error associated with measurements, the systematic treatment of acid-base equilibria, introductory electrochemistry and spectrophotometry, and the theory of separations (chromatography). Three lectures and one three-hour laboratory per week. Prerequisite: CHE 201–202. Lab Fee: $470. (Fall, odd-numbered years)

Niece/*Four credits*

CHE 316 INORGANIC CHEMISTRY

A study of the structure and properties of the elements and their compounds. Topics covered are atomic structure, periodic relationships, molecular bonding, acid-base systems, and coordination compounds. Laboratory work focuses on the interaction between experiment and theory in understanding and predicting chemical phenomena. Three lectures and one laboratory period per week. Prerequisite: CHE 201–202. Lab fee: $470. (Fall, even-numbered years)

Niece/*Four credits*

CHE 318 ENVIRONMENTAL CHEMISTRY

A specialized knowledge of chemistry is needed in order to identify, understand, and solve environmental problems. This course will be an in depth study of the chemistry of environmental issues and pollutants. Students will learn the mechanisms of important chemical reactions, as well as relevant analytical techniques related to environmental chemistry. In the lab, students will combine field work, analytical chemistry, and remediation techniques during their investigation of environmental problems. Prerequisites: CHE 131–132, CHE 201. Lab Fee: $470. (Spring, odd-numbered years)

Tuttle/*Four credits*

CHE 414 BIOCHEMISTRY

The major classes of biochemicals, carbohydrates, proteins, lipids, and nucleic acids are studied with particular attention to the relationship between their chemical structures and biological functions. Specific topics include (but are not limited to) biocatalysis, receptors, membrane structure, metabolism, biosynthesis, and energy production. Prerequisite: CHE 201–202 and BIO 160. Lab Fee: $470. (Fall, Spring)

Marcotte, Schandel/*Four credits*

CHE 416 MOLECULAR STRUCTURE AND CHARACTERIZATION

A detailed study of current chemical bonding theories and characterization techniques. Topics covered include molecular symmetry, molecular orbital theory, and computer molecular modeling. Molecular characterization with electronic, vibrational, and nuclear magnetic resonance spectroscopies is addressed. Laboratory work includes molecular modeling, NMR, UV/Visible, and IR Spectroscopy. Three lectures and one laboratory period per week. Prerequisites: CHE 312 (can be concurrent with instructor's permission, CHE 316. Lab Fee: $470 (Spring, odd-numbered years)

Niece/*Four credits*

CHE 450 INSTRUMENTAL CHEMISTRY

The study of the theory of instrumental methods of analysis and their application in the laboratory. Topics include computers in data collection and management, UV-vis, IR, AA, fluorimetry, and electrochemical methods. In addition, NMR and mass spectrometry are covered in the lecture. Two lectures and one laboratory period per week. Prerequisite: CHE 202 or permission. Lab Fee: $470. (Spring, even-numbered years)

Niece/*Four credits*

CHE 460 MEDICINAL CHEMISTRY

Natural and synthetic medicines are investigated with attention to their fate in a living organism: absorption, distribution, and elimination; dose-response and time-response relationships of drugs; and the relationship between chemical structure and biological activity. The biochemistry of several diseases (probably including AIDS) will be examined to learn different ways that chemicals can be used to interfere with the course of a disease. Prerequisite: CHE 201–202 and BIO 160. (Spring, even-numbered years)

Dix/*Three credits*

CHE 470 ADVANCED ORGANIC CHEMISTRY

An advanced course surveying modern organic chemistry. Topics include synthetic methods, mechanistic analysis, isotope effects, pericyclic and photochemical reactions, and electron transfer. Several case studies will be used to illustrate these topics. Three lectures per week. Prerequisites: CHE 201–202 and CHE 311 or CHE 313. (Spring, odd-numbered years)

Colby Davie/*Three credits*

CHE 480 SEMINAR IN CHEMISTRY

The student researches specified areas of Chemistry under the guidance of faculty members for oral presentation and defense before the class. Written papers are submitted for final review. Offered upon sufficient demand. Prerequisites: six courses in Physics and Chemistry.

Staff/*Three credits*

CHE 491–492 INDEPENDENT STUDY

Directed study and research in some aspect of chemistry. Open to students who have a minimum GPA of 3.0 and at least six courses in chemistry or other science. Offered by arrangement with a faculty member. (Fall, Spring)

Staff/*Three credits each semester*

ENVIRONMENTAL SCIENCE (ENV)

ENV 150 INTRODUCTION TO ENVIRONMENTAL SCIENCE

The interdisciplinary nature of environmental science will be stressed by covering the chemical, biological, and social aspects of environmental issues and problems in a case study approach. Exercises integrated into the course will expose the students to data analysis and field work associated with applied environmental work. Two or three integrated lecture-laboratory sessions per week. Lab fee: $235. Required for all Environmental Science majors. This course fulfills the Foundations Program requirement for a natural science. (Fall)

Staff/*Three credits*

ENV 260 WATER RESOURCES PLANNING AND MANAGEMENT

This is an interdisciplinary introduction to our most precious resources. Water has shaped our bodies, our planet, our history, our culture. How we manage it will shape our future. Because of increasing demand, waste, and pollution, we are depleting—and risk destroying—the limited supply of usable fresh water. This course will look at water through scientific, historical, and cultural viewpoints and survey contemporary water problems in all their dimensions—political, economic, and technological.

Marine Studies Consortium/*Three credits*

ENV 275 SPECIAL TOPICS IN ENVIRONMENTAL SCIENCE

This special topics course will explore an area of environmental science using the literature, and if appropriate, a cross-disciplinary approach. The course will allow the students and faculty an opportunity to investigate areas of environmental science that are not part of the regular curriculum.

Staff/*Three credits*

ENV 280 COASTAL ZONE MANAGEMENT

This course will introduce students to the coastal environment and its resources and uses; coastal zone issues resulting primarily from human activities; the framework established by the Federal Coastal Zone Management Act for collaborative planning and regulation of the U.S. coastal zone; the roles played by the federal, state, and local governments, advocacy groups, and private property owners; the design and achievements of these programs; and international applications of coastal management. Guest speakers and case studies (e.g., Boston Harbor project, nonpoint source plans, Cape Cod Commission) will be used to illustrate themes and the intricacies of public policy development.

Marine Studies Consortium/*Three credits*

ENV 291 INTERNSHIP IN ENVIRONMENTAL SCIENCE

Directed study within an internship program. The student will be expected to keep a journal detailing the internship. The student will also be expected to write a paper (usually approximately 10 pages in length) summarizing an area related to the internship experience. An evaluation by the on-site supervisor will be considered when determining the grade. The student is required to have a cumulative G.P.A. of 3.0 to enroll.

ENV 350 WETLANDS

Wetlands play a vital role in the hydrology and ecology of global landscapes. This course will consider several topics: the function of inland and coastal marshes, swamps, and bogs in water and nutrient cycles; the influence of wetlands on biodiversity, from microbes to vertebrates; the biological links between wetlands and human activities, such as agriculture, coastal development, and fisheries; and the legal framework for the protection and restoration of endangered wetlands. Prerequisites: CHE 132 and two Biology courses at the 200 level or higher. (Fall)

Marine Studies Consortium/*Three credits*

ENV 480 ENVIRONMENTAL SCIENCE SEMINAR

An in-depth study of a current topic in environmental science. This course will emphasize review and analysis of primary literature. Students will be expected to give oral presentations as part of the course requirements. Some example topics are global availability of drinking water in the 21st century, eutrophication, and environmental pollution control. Classes will meet for three hours weekly. Prerequisites: Permission of instructor or six courses in environmental science or other science. (Spring, even-numbered years)

Tuttle/*Three credits*

ENV 491–492 INDEPENDENT STUDY

Directed study or experimental research on some aspect of environmental science. Prerequisites: The student is expected to have a cumulative GPA of 3.0 and six courses in environmental science or other science. Offered by arrangement. (Fall, Spring)

Staff/*Three credits*

PHYSICS (PHY)

PHY 112 ASTRONOMY

Discover the many methods we have to observe our universe, virtually visit new planets, chat about the lives and times of the stars, and unravel the truths we can verify about the structure of our universe. This course will mix observational activities, discussion and debate, lecture, and mini experiments covering topics in astronomy. No prerequisite. Lab Fee: $235. This course fulfills the Foundations Program requirement for a natural science. (Spring)

Staff/*Three credits*

PHY 201 GENERAL PHYSICS I

This course explores mechanics and heat. Three lectures and one laboratory period. Prerequisite: MAT 114 or Calculus (may be concurrent). Lab Fee: $470 per semester. This course fulfills the Foundations Program requirement for a natural science. (Fall)

Georgiev, Herd/*Four credits*

PHY 202 GENERAL PHYSICS II

This course explores sound, electricity, magnetism, and light. Three lectures and one laboratory period. Prerequisite: PHY 201 and MAT 114 Elementary Functions or MAT117 Calculus I (may be concurrent). Lab Fee: $470 per semester. This course fulfills the Foundations Program requirement for a natural science. (Spring)

Georgiev, Herd/*Four credits*

PHY 213 INTRODUCTION TO ENGINEERING PROBLEM SOLVING

This introductory course is designed to acquaint students with the variety of engineering disciplines, as well as provide students with the basics of the engineering mindset. The ability to develop and resolve solutions to applied problems is a necessary skill for a multitude of disciplines. The structure of the course emphasizes group projects and the use of computers to create models to solve problems. Prerequisite: MAT 117/131 and MAT 118/132 (can be taken concurrently). (Spring)

Staff/*Three credits.*

PHY 301 MECHANICS I: STATICS

The goal will be to endow students with a fundamental understanding of the engineering mechanics of static objects and fluids. Students will emerge proficient in problem solving, application of physical mechanical principles and critical thinking skills. This will be the first course in a year-long sequence on engineering mechanics. Topics to be covered include: Vector Algebra/Calculus, Vector forces and moments in 2-D and 3-D systems, Equivalent systems of forces, Equilibrium of rigid bodies, Centroids, centers of gravity, and distributed forces, Trusses, frames, machines: two-force and multi-force members, Beams: internal forces, shear and bending moment diagrams, Dry friction, Wedges and screws, Moments of inertia, Fluid Statics, Virtual work mechanics essentials. Prerequisites: MAT 118 or MAT 132 and PHY 202. (Fall, odd-numbered years)

Staff/Three credits

PHY 302 MECHANICS II: DYNAMICS

This course is a 3 credits course, the second in a year-long sequence on engineering mechanics, the first being statics, a required sequence for most engineering tracks. Students will explore the fundamentals of physical-mechanical principles and apply them to the dynamics of objects and fluids. Topics to be covered include: friction forces and spring forces, power, work, and energy, momenta, impulses, and collisions, dynamics of systems of particles, kinetics of a rigid body, fluids. This course is only offered in the spring, every other year. There is no lab requirement for this course. Prerequisites: MAT 118 or MAT 132 and PHY 202. (Spring, even-numbered years)

Staff/*Three credits*

PHY 480 SEMINAR IN PHYSICS

The student researches specified areas of physics under the guidance of faculty members for oral presentation and defense before the class. Written papers are submitted for final review. Offered upon sufficient demand. Prerequisites: Six courses in physics and chemistry. (Spring)

Staff/*Three credits*

PHY 491–492 INDEPENDENT STUDY

Directed study in an area of Physics. The course is open to students who have completed a minimum of six science courses and have a cumulative GPA of 3.0 or higher. Offered by arrangement. (Fall, Spring)

Staff/*Three credits*