Biochemistry, Biology (BCH, BIO)

Majors and Minor in Biochemistry, Biology

Department of Biochemistry and Cell Biology, Ecology and Evolution, Neurobiology and Behavior; College of Arts and Sciences

UNDERGRADUATE BIOLOGY WEB ADDRESS: http://www.bio.sunysb.edu

Minors of particular interest to students majoring in Biology or Biochemistry: Biomaterials (BES), Bioengineering (BNG), Environmental Studies (ENS), Health and Wellness (LHW), Philosophy (PHI), Science and Engineering (LSE)

Department of Biochemistry and Cell Biology

CHAIRPERSON: William J. Lennarz
DIRECTOR OF UNDERGRADUATE STUDIES: Harvard Lyman

Faculty

Paul M. Bingham, Associate Professor, Ph.D., Harvard University: Novel approaches to cancer chemotherapy; the biological basis of human origins, evolution, and history.

Deborah Brown, Professor, Ph.D., Stanford University: Structure and function of membrane microdomains and caveolae.

David Bynum, Professor, Ph.D., Dartmouth College: Cell Motility. Recipient of the State University Chancellor’s Award for Excellence in Teaching, 1988; recipient of the President’s Award for Excellence in Teaching, 1988; recipient of the National Science Foundation/Presidential Award for Science, Mathematics and Engineering Mentoring, 2002.

Vitaly Citovsky, Professor, Ph.D., Hebrew University: Nuclear Targeting and intercellular communication in plants.

Neta Dean, Associate Professor, Ph.D., University of California, Los Angeles: Role of glycans in genetic disorders and fungal pathogenesis.

Dale G. Deutsch, Professor, Ph.D., Purdue University: Molecular and cell biology of endo-cannabinoid action.

Hao-Peng Duffy, Research Associate Professor, Ph.D., SUNY Stony Brok/Cold Spring Harbor Laboratory: Cancer research.

Markus Eilers, Research Assistant Professor, Ph.D., Universität Dortmund/Max Planck Institute for Molecular Physiology: Structure and function of G-protein coupled receptors.

J. Peter Gergen, Professor, Ph.D., Brandeis University: Drosophila developmental genetics and the mechanisms of translational regulation.

Petra Haenzelmann, Research Assistant Professor, Ph.D., University of Bayreuth: Functional and structural studies of proteins involved in molybdenum.

Robert Haltiwanger, Professor, Ph.D., Duke University: Role of glycosylation in signal transduction events.

Bernadette Holdener, Associate Professor, Ph.D., University of Illinois-Chicago: Protein folding and trafficking in mouse development and signal transduction.

Nancy Hollingsworth, Associate Professor, Ph.D., University of Washington, Seattle: Analysis of meiotic chromosome recombination, synopsis, and segregation in yeast.

Viktor Hornak, Research Assistant Professor, Ph.D., Slovak Technical University: Computational techniques for gaining insights into function and dynamics of biological macromolecules.

Jen-Chih Hsieh, Assistant Professor, Ph.D., Duke University: Wnt signaling by the Frizzled protein.

A. Wall Karzai, Assistant Professor, Ph.D., Johns Hopkins University: A system for protein trafficking, directed deregulation, and ribosome rescue.

William Lennarz, Distinguished Professor, Ph.D., University of Illinois: The biosynthesis and degradation of glycoproteins in yeast and animal cells.

Chang-Jun Liu, Adjunct Assistant Professor, Ph.D., Shanghai Institute of Plant Physiology: Biosynthesis of plant natural products and structure-function relationship of key enzymes in natural product biosynthetic pathways.

Erwin London, Professor, Ph.D., Cornell University: Membrane biochemistry and biophysics.

Harvard Lyman, Associate Professor, Ph.D., Brandeis University: Photoregulation of chloroplast development and replication; redox regulation of phototaxis. Recipient of the State University Chancellor’s Award for Excellence in Teaching, 1991 and the President’s Award for Excellence in Teaching, 1991. Director of Undergraduate Studies, Department of Biochemistry and Cell Biology.

Kenneth B. Marcu, Professor, Ph.D., Stony Brook University: Cellular gene expression programming in innate and adaptive immune responses and cancer. Foreign Scholar of the Institute of Advanced Studies of the University of Bologna, Italy.

Aaron Neiman, Associate Professor, Ph.D., University of California, San Francisco: Vesicle trafficking and intracellular signaling in yeast.

Nisson Schechter, Professor, Ph.D., Western Michigan University: Molecular basis of nerve growth and regeneration.

C. Hermann Schindelin, Associate Professor, Ph.D., Free Universität Berlin: Structure and function of proteins involved in ubiquitin-dependent protein degradation and neuroreceptor anchoring.

Jakob Schmidt, Professor, Ph.D., University of California, Riverside, MD, University of Munich: Neurochemistry.

Richard Setlow, Adjunct Professor, Ph.D., Yale University: DNA repair; biological effects of ultraviolet and ionizing radiation.

John Shanklin, Adjunct Professor, Ph.D., University of Wisconsin-Madison: Structure and function of fatty acid desaturase.

Sanford Simon, Professor, Ph.D., Rockefeller University: Biochemistry and cell biology of inflammatory cells and their proteinases; development of natural and synthetic proteinase inhibitors.

Steven O. Smith, Professor, Ph.D., University of California, Berkeley: Membrane protein structure and function.

James V. Staros, Professor and Dean, College of Arts and Sciences, Ph.D. Yale: Molecular mechanisms of transmembrane signaling by the ErbB family of tyrosine kinases.

Rolf Sternglanz, Distinguished Professor, Ph.D., Harvard University: Chromatin structure and function.

F. William Studier, Adjunct Professor, Ph.D., California Institute of Technology: Genetics and physiology of bacterial viruses.

Gerald H. Thomsen, Associate Professor, Ph.D., Rockefeller University: Molecular embryology, morphogenesis, growth factor signaling and ubiquitin pathways.

Zuzana Zachar, Research Assistant Professor, Ph.D., Stony Brook University: Director MAT Biology; Cancer chemotherapy drug discovery.

Department of Ecology and Evolution

CHAIRPERSON: Charles H. Janson
DIRECTOR OF UNDERGRADUATE STUDIES: Michael A. Bell

Faculty

Michael A. Bell, Professor, Ph.D., University of California, Los Angeles: Evolutionary biology; ichthyology; paleobiology and geographic variation.

Daniel E. Dykhuizen, Professor, Ph.D., University of Chicago: Population genetics and molecular evolution, especially of bacteria.

Walter F. Eanes, Professor, Ph.D., Stony Brook University: Population and biochemical genetics of Drosophila; molecular evolution.

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Department of Neurobiology and Behavior

CHAIRPERSON: Lorne M. Mendell
DIRECTOR OF UNDERGRADUATE STUDIES: John B. Cabot

Faculty

Paul R. Adams, Professor, Ph.D., London University: Synaptic plasticity and network models.

Paul Brehm, Professor, Ph.D., University of California, Los Angeles: Cellular neurobiology; synaptic transmission.

John B. Cabot, Professor, Ph.D., University of Virginia: Autonomic system.


L. Craig Evinger, Professor, Ph.D., University of Washington: Integrative neuroscience.

Simon Haglepoua, Professor, Ph.D., Stony Brook University: Molecular neurobiology.

Maurice Kernan, Associate Professor, Ph.D., University of Wisconsin-Madison: Molecular neurobiology.

Mary Kritzer, Associate Professor, Ph.D., Yale University: Neurobiology of cognition.

Joel M. Levine, Professor, Ph.D., Washington University: Developmental neurobiology, nerve regeneration.

Gail Mandel, Distinguished Professor, Ph.D., University of California, Los Angeles: Molecular neurobiology.

Gary G. Matthews, Professor, Ph.D., University of Pennsylvania: Cellular neurobiology; synaptic transmission.

David McKinnon, Professor, Ph.D., Australian National University: Molecular biology of ion channels.

Lorne M. Mendell, Distinguished Professor, Ph.D., Massachusetts Institute of Technology: Modifiability of spinal synapses.

Howard Sirotkin, Assistant Professor, Ph.D., Albert Einstein College of Medicine: Vertebrate development and genetics.

Lonnie Wollmuth, Associate Professor, Ph.D., University of Washington, Seattle: Psychology and biophysics.

Stephen Yazulla, Professor, Ph.D., University of Delaware: Physiology.

Affiliated Faculty

Marian Evinger, Pediatrics
Stuart S. McLaughlin, Physiology and Biophysics

Teaching Assistants (all areas)

Estimated number: 65

Courses in Biology

See the Course Descriptions listing in this Bulletin for complete information.

BIO 101-E Human Biology
BIO 103-E Introduction to Biotechnology
BIO 104 How Science Works
BIO 111-E The Aquatic World
BIO 113-E General Ecology
BIO 115-E Evolution and Society
BIO 150-E The Living World
BIO 201-E Fundamentals of Biology: Organisms to Ecosystems
BIO 202-E Fundamentals of Biology: Molecular and Cellular Biology
BIO 203-E Fundamentals of Biology: Cellular and Organ Physiology
BIO 208-H Cell, Brain, Mind
BIO 310 Cell Biology
BIO 311 Techniques in Molecular and Cellular Biology
BIO 312 Bioinformatics and Computational Biology
BIO 315 Microbiology
BIO 316 Molecular Immunology
BIO 317 Principles of Cellular Signaling
BIO 318-H Bioethics and Policy
BIO 320 General Genetics
BIO 325 Animal Development
BIO 327 Developmental Genetics Laboratory
BIO 328 Mammalian Physiology
BIO 334 Principles of Neurobiology
BIO 335 Animal Physiology Laboratory
BIO 338 From Synapse to Circuit: Selforganization of the Brain
BIO 339 Molecular Development of the Nervous System
BIO 340 Zoology
BIO 341 Plant Diversity
BIO 349 Invertebrate Zoology
BIO 344 Chordate Zoology
BIO 346 Aquatic Arthropods and Vertebrates
BIO 348 Diversity and Evolution of Reptiles and Amphibians
BIO 350-H Darwinian Medicine
BIO 351-H Ecology
BIO 352 Ecology Laboratory
BIO 353 Marine Ecology
BIO 354 Evolution
The Biochemistry Program

The Biochemistry Undergraduate Major Program provides a challenging and exciting introduction to the chemical basis of biological phenomena. The major is designed to prepare students who intend to pursue graduate study, attend health-related professional schools, pursue secondary school teaching careers, and fill entry-level positions in private, state, and federal laboratories or in pharmaceutical and biotechnical industries. The undergraduate curriculum provides a fundamental background in biology, chemistry, genetics, cell biology, and biochemistry, with courses in mathematics and physics necessary for advanced understanding of this broad field. Students may not declare a double major among biochemistry, biology, and pharmacology majors.

Requirements for the Major in Biochemistry (BCH)

All courses offered for the major must be taken for a letter grade. A minimum grade of C must be obtained in all courses in requirements A, B, and C below.

Completion of the major requires approximately 68-72 credits.

A. Courses in Related Fields

1. CHE 131, 132 General Chemistry or CHE 141, 142 Honors Chemistry
B. Core Courses in Biology

1. BIO 150 The Living World
   (See Note)
2. BIO 201 Fundamentals of Biology: Organisms to Ecosystems
3. BIO 202 Fundamentals of Biology: Molecular and Cellular Biology
4. BIO 203 Fundamentals of Biology: Cellular and Organ Physiology

Note: Students with documented high school AP Biology scores of 4 or 5 receive a waiver for BIO 150. Other students with approved backgrounds in biology may request a waiver of BIO 150 from the Department of Biochemistry.

C. Advanced Courses in Biology

1. BIO 320 General Genetics
2. BIO 310 Cell Biology
3. BIO 361, 362 Biochemistry I, II
   (See Note 1)
4. One of the following laboratories:
   BIO 365 Biochemistry Laboratory
   (fall only)
   BIO 311 Techniques in Molecular and Cellular Biology
5. Two additional courses, totaling at least five credits, chosen after consultation with an advisor from the following list. It is highly recommended that students take more than the suggested minimum number of electives. (See Note 2)

Honors Program in Biochemistry

Graduation with Honors in Biochemistry requires the following:

1. A cumulative g.p.a. of at least 3.50 in all courses required for the major.
2. Presentation of an acceptable thesis based on laboratory research project. Students interested in graduation with Honors must contact the Biochemistry Honors Coordinator for more detailed information no later than the second week of classes during their last semester.

Bachelor of Science Degree in Biochemistry / Master of Science Degree in Chemistry Program

A student interested in this research intensive graduate program, intended to prepare students for professional employment in the chemical or pharmaceutical industries, may apply for admission at the end of the junior year. The program leads to a Bachelor of Science Degree in Biochemistry at the end of the fourth year, followed by a Master of Science in Chemistry at the end of the fifth year. During the senior year the student is expected to take two 500-level CHE courses and begin research. In the fifth year, the student works full-time on research, earning 24 credits in CHE 599.

The two 500-level CHE courses taken during the senior year may be counted toward the two electives required by the Biochemistry major.
Biology is the study of organisms, including the molecular and cellular basis of life, development of the individual and its genetic basis, maintenance of the individual, and interaction of organisms with their biotic and physical environment.

The Biology major introduces students to the concepts and methodologies associated with the multiple levels of biological complexity. Following BIO 150 The Living World, an introduction to the research tools, models, and concepts of modern biology, students explore the Fundamentals of Biology (BIO 201-203), a thorough introduction to organisms, ecosystems, cellular and molecular biology, and physiology. These courses also provide a solid background for students interested in the health professions. Students go on to advanced laboratory work and have the opportunity to specialize in any of several areas, including: developmental genetics, ecology and evolution, environmental biology, and neuroscience. Students may also elect the General Biology specialization. Students may design their own curriculum, in consultation with an advisor, within the context of these specializations, based on individual interest. The Biology major requires a strong foundation in mathematics, chemistry, and physics.

Majors are encouraged to explore research opportunities in biology, typically beginning in their second or third year. Most positions for biologists require graduate training. Most students majoring in biology prepare for professional study in the biological or health sciences. Some prepare for secondary school teaching, and others for technical positions in industry, including biotechnology, government agencies, and research institutes.

Students should contact the Undergraduate Biology Office for information and brochures related to the Biology major and minor, and for the forms mentioned in requirements and some course descriptions. The office receives completed forms and petitions concerning the Biology major and minor and all requests for evaluations of transferred biology courses. The office also coordinates advising and processes graduation clearances for major and minor requirements. Students may not declare a double major among biology, biochemistry, and pharmacology.

Requirements for the Major in Biology (BIO)

Students must complete a minimum of 32 credits in Requirements A and C on page 126. (See Note 1). All courses used to satisfy requirements A and C must be passed with a letter grade of C or higher. At least one semester of each of the following two-semester sequences must be passed with a letter grade of C or higher: calculus, general chemistry lecture, organic chemistry lecture, and physics lecture. Courses taken under the Pass/No Credit option may not be used to satisfy major requirements.

Completion of the major requires approximately 65-67 credits.

A. Biology Core

1. BIO 150 The Living World (See Note 1)
2. BIO 201, 202, 203 Fundamentals of Biology (See Note 2)

B. Courses Required in Related Fields

1. MAT 125, 126 Calculus A, B or MAT 131, 132 Calculus I, II or MAT 141, 142 Calculus I, II: Honors or level 8 or 9 on the Mathematics Placement Examination.
2. CHE 131, 132 General Chemistry and CHE 133, 134 General Chemistry Laboratory

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Advanced Laboratory Courses:

Area I  BIO 311, 365
Area II  BIO 327
Area III BIO 335
Area IV BIO 340, 341, 343, 344, 346, 380
Area V  BIO 352, 356, 367, MAR 301, 303, 305, 320
Area VI BIO 312

1. General Biology Specialization

a. Advanced Lecture Courses: At least one lecture course in four of the five areas above. Students in the Biology Secondary Teacher Education Program must take a course in each of the five areas.

b. Advanced Laboratory Courses: Two advanced laboratory courses chosen from any two of the six areas above.

c. Study in Depth: A second lecture course in one of the five areas of inquiry or any 400-level BIO course for majors or SCI 454 (for students enrolled in the Biology Secondary Teacher Education Program).

d. Biology Electives: Additional advanced biology lecture, laboratory, and independent research courses, as needed, for a minimum of 32 credits in Requirements A and C. (See Note 3)

e. Breadth Requirement

i. Two advanced biology lecture or lecture/laboratory courses chosen from any area excluding Area V, Ecology and Evolution above.

ii. One advanced biology laboratory (or lecture with laboratory) course chosen from any area excluding Area V, Ecology and Evolution above.

e. Biology Electives

Additional advanced biology lecture, laboratory, and independent research courses, as needed, for a minimum of 32 credits in Requirements A and C. (See Note 3)

2. Ecology and Evolution Specialization

a. BIO 351 Ecology
b. BIO 354 Evolution
c. Area Lecture/Laboratory Requirement: Students must choose one course from i. Lecture/Laboratory Courses or one course each from ii. Lecture Courses and iii. Laboratory Courses below.

i. Lecture/Laboratory Courses
   - BIO 340 Zoology
   - BIO 341 Plant Diversity
   - BIO 343 Invertebrate Zoology
   - BIO 344 Chordate Zoology
   - BIO 346 Aquatic Arthropods and Vertebrates
   - BIO 380 Entomology
ii. Lecture Courses

3. Environmental Biology Specialization

a. BIO 351 Ecology
b. Area Lecture/Laboratory Requirement: Two courses chosen from the lists below. In choosing courses, students must include at least one course with laboratory. Students may take no more than one course from i. Organisms, and no more than one course from iii. The Environment.

i. Organisms
   - BIO 340 Zoology (with lab)
   - BIO 341 Plant Diversity (with lab)
BIO 343 Invertebrate Zoology (with lab)
BIO 344 Chordate Zoology (with lab)
BIO 346 Aquatic Arthropods and Vertebrates (with lab)
BIO 348 Diversity and Evolution of Reptiles
BIO 380 Entomology (with lab)
MAR 366 Plankton Ecology
MAR 371 Marine Birds and Sea Turtles

ii. Ecology
BIO 352 Ecology Lab
BIO 353 Marine Ecology
BIO 359 Behavioral Ecology
BIO 367 Molecular Diversity Laboratory
BIO 385 Plant Ecology
BIO 386 Ecosystem Ecology in a Changing World
MAR 303 Long Island Marine Habitats (with lab)

iii. The Environment
ATM 305 Global Atmospheric Change
ATM 397 Air Pollution and its Control
MAR 318 Engineering Geology and Coastal Processes
MAR 333 Coastal Oceanography

b. Breadth Requirement
Three advanced biology lecture courses from outside the Environmental Biology specialization, chosen in consultation with the undergraduate biology advisor. At least one of the courses must include a laboratory component.

c. Biology Electives
Additional advanced biology lecture, laboratory, and independent research courses, as needed, for a minimum of 32 credits in Requirements A and C.
(See Note 3)

4. Neuroscience Specialization

a. Area Lecture/Laboratory Requirement:
   i. BIO 334 Principles of Neurobiology
   ii. BIO 328 Mammalian Physiology
   iii. BIO 335 Animal Physiology Laboratory

   iv. One of the following:
       BIO 317 Principles of Cellular Signaling
       BIO 338 Self Organization of the Brain
       BIO 339 Molecular Development of the Nervous System
       BCP 401 Principles of Pharmacology

b. Breadth Requirement
   i. Two advanced biology lecture courses chosen from any area excluding Area III, Neurobiology and Physiology.
   ii. One advanced biology laboratory (or lecture with laboratory) course chosen from any area excluding Area III, Neurobiology and Physiology.

c. Biology Electives
Additional advanced biology lecture, laboratory, and independent research courses, as needed, for a minimum of 32 credits in Requirements A and C.
(See Note 3)

5. Developmental Genetics Specialization

a. Area Lecture/Laboratory Requirement:
   i. BIO 320 General Genetics
   ii. BIO 325 Animal Development
   iii. BIO 327 Developmental Genetics Laboratory
   iv. BIO 310 Cell Biology or BIO 339 Molecular Development of the Nervous System

b. Breadth Requirement
   i. Two advanced biology lecture courses from outside the Developmental Genetics specialization, chosen in consultation with the undergraduate biology advisor.
   ii. One advanced biology laboratory (or lecture with laboratory) from outside the Developmental Genetics specialization, chosen in consultation with the undergraduate biology advisor.

c. Biology Electives
Additional advanced biology lecture, laboratory, and independent research courses, as needed, for a minimum of 32 credits in Requirements A and C.
(See Note 3)

D. Upper-Division Writing Requirement
The advanced writing component of the major in Biology requires approval by the writing committee of either:

a. A term paper written for an upper-division course in biological sciences at Stony Brook (including readings and research), or

b. two laboratory reports from a single upper-division course in biological sciences at Stony Brook.

A list of currently participating courses is available in the Undergraduate Biology Office. Students who wish to use material from a participating course should obtain the necessary form and present it to the course director prior to submission of the material. The course director will provide a special evaluation of the writing (in addition to a grade), and send the completed form to the Biology Writing Committee (through the Undergraduate Biology Office). Materials from other biology courses may be used if they include a suitable writing component. They must be submitted to the writing committee, together with the form signed by the instructor.

Students are urged to submit appropriate materials in their junior year, or by the end of their next-to-last term, in order to allow for evaluation and possible remedial effort. Later submissions are considered, but may delay graduation. If material is rejected, the student is urged to attend the Writing Center (or to take an appropriate course) before resubmitting the paper or material from another biology course.

Notes:

1. All students with documented high school AP biology scores of 3 or higher receive a waiver of BIO 150 The Living World.

2. Requests for waivers of major requirements must be approved by the Undergraduate Biology Studies Committee. Biology majors must meet the major requirements of the bulletin of their latest matriculation date.

3. Up to six credits of electives may be chosen from a list of courses offered outside the department; see the Undergraduate Biology Office for the current list.

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Application of Transfer Credits to Biology Requirements

Biology courses taken elsewhere apply to major requirements only if authorized by the biology transfer evaluator or if listed as equivalent to a Stony Brook course in Stony Brook Transfer Guides. Transfer students must take at least 15 of the 32 credits in Requirements A and C at Stony Brook in courses for majors at the 200 level or higher. At least 12 of the 15 credits must be in BIO-designator courses. At least two of the advanced laboratory experiences, including one area laboratory, must be taken at Stony Brook. Transfer students may meet Section B requirements with transferred courses, if the courses are approved as being equivalent (even if the number of credits is different).

Biology Secondary Teacher Education Program

See the Education and Teacher Certification entry in the alphabetical listings of Approved Majors, Minors, and Programs.

Honors Programs in Biology and in Biology and Society

Graduation with departmental honors in Biology or in Biology and Society requires both of the following:

1. A cumulative grade point average of 3.50 or higher in all courses for the major.
2. Presentation of an honors thesis based on a research project (see list of approved research and internship courses for each specialization below) written in the form of a paper for a scientific journal.

A student interested in becoming a candidate for honors should submit an outline of the proposed thesis research project to the director of undergraduate biology as early as possible but no later than the second week of classes in the last semester. The director of undergraduate biology and the research sponsor appoint a thesis committee consisting of the research sponsor and two additional faculty members, one of them from a different department than that of the research sponsor. The student must present a copy of the finished thesis to each member of the thesis committee and the director of undergraduate biology at least 28 days before the date of graduation.

Approved Research and Internship Courses

1. General Biology Specialization
   BIO 484, 486, 489 Independent Research
   BIO 488 Internship
2. Bioengineering Specialization
   BIO 488 Internship
   BME 499 Research in Bioengineering
3. Developmental Genetics Specialization
   BIO 487 Independent Research
   BIO 488 Internship
4. Ecology and Evolution Specialization
   BIO 489 Research in Ecology and Evolution
   BIO 488 Internship
5. Environmental Biology Specialization
   One of the following:
   ATM 487, BIO 489, MAR 487 Independent Research
   BIO 488, MAR 488 Internship
6. Neuroscience Specialization
   BIO 486 Research in Neurobiology and Physiology
   BIO 488 Internship

Requirements for the Minor in Biology (BIO)

Only students with majors other than Biology, Biochemistry, or Pharmacology may elect the Biology minor. All courses for the minor must be taken for a letter grade. (See Note 1) All credits for the minor, except for those in Requirement A, must be in BIO major courses taken at Stony Brook. Requests for waivers of minor requirements must be approved by the Undergraduate Biology Studies Committee.

Completion of the minor requires at least 20 credits in those biology courses designed for the Biology major, including:

A. Two of the following courses:
   BIO 201 Fundamentals of Biology: Organisms to Ecosystems
   BIO 202 Fundamentals of Biology: Cell and Molecular Biology
   BIO 203 Fundamentals of Biology: Cellular and Organ Physiology
B. Nine credits at the 300 level
C. A lecture course in at least two of the five areas of inquiry (I-V) listed under the biology major.

Note:

1. All 20 credits of biology courses intended for the biology minor must be passed with a grade of C or higher, including 9 credits at the 300 level. A grade of Satisfactory in readings, internship, and research courses applies to the quality requirements within credit limitations noted below:

Up to two credits of biology independent research (BIO 484, 486, 487, 489) and one credit of tutorial readings (BIO 444, 446, 447, 449) may be applied toward the minor. The list of substitute electives for the major does not apply to the minor.