BIOLOGICAL SCIENCES

The biology major provides a unified curriculum for undergraduates enrolled in either the College of Agriculture and Life Sciences or the College of Arts and Sciences. Courses in biological sciences are integral to many disciplines and are basic requirements in many schools and colleges at Cornell.

Graduate study in the biological sciences is administered by more than 15 specialized fields within the Graduate School, as described in the Fields of Study catalog at www.gradschool.cornell.edu/?p=38.

ORGANIZATION

Many different departments participate in the biology major.

Student services are provided by the Office of Undergraduate Biology (OUB), www.biology.cornell.edu. Located in Stimson Hall, the professional and student advisors provide academic and career advising, as well as help undergraduates find research opportunities on campus. Advisors in the OUB also follow the progress of biology majors and work closely with faculty advisors. Additional services and resources of the Biology Center include tutoring, lecture tapes, examination files, and extensive information on summer research opportunities and graduate programs. The center has comfortable areas for studying and relaxing.

The Shoals Marine Laboratory, a cooperative venture with the University of New Hampshire, is located on Appledore Island in the Gulf of Maine. Its base office in Stimson Hall provides academic advising for students interested in the marine sciences and administers the SEA Semester program for Cornell students pursuing studies at Woods Hole, Mass., or aboard the schooner *Robert C. Seamans* or brigantine *Corwith Cramer*.

DISTRIBUTION REQUIREMENT

In the College of Agriculture and Life Sciences, the Physical and Life Sciences distribution requirement is a minimum of 18 credits, including at least 6 credits of introductory biology satisfied by BIO G 109–110, 105–106, or 101 and 103 plus 102 and 104, or 107–108.

For Students in the College of Arts and Sciences, all biology ("BIO") courses can be used toward fulfillment of the biological sciences distribution requirement. Please see the Arts and Sciences "Distribution Requirements" section of this catalog for further details. The following courses are especially suitable for the distribution requirement because they have no prerequisite: BIO G 101-104, 105-106, 107-108, 109-110, 170; BIOAP 212; BIOEE 154, 207, 275; BIOGD 184; BIOMI 192; BIONB 111; BIOPL 240, 241.

In the College of Human Ecology, the natural sciences distribution requirement is for at least 6 credits selected from BIO G 109–110, 101 and 103 plus 102 and 104, 105–106 or 107–108 or from specified courses in chemistry or physics.

Switching between BIO G 109–110 and either BIO G 101–104 or 105–106 at midyear may not be possible because of variation in presentation of topics. Students must receive permission of the instructor to switch sequences. Taking sequences in reverse order is strongly discouraged in BIO G 101–104 but allowed in BIO G 105–106.

USE OF ANIMALS IN THE BIOLOGICAL SCIENCES CURRICULUM: CORNELL UNIVERSITY

Students wishing to enroll in biology ("BIO") courses should know and understand the following criteria relative to the use of animals in the teaching program, as passed by the faculty of the Division of Biological Sciences in 1988, and reaffirmed in 1997:

1. "Live animals will be used for teaching in certain courses in the biological sciences. Some animals will require humane euthanasia after they have been used for teaching.
2. Courses bearing the "BIO" description conform to the rules for the care of such animals as outlined in *Guiding Principles in the Care and Use of Animals* (as approved by the Council of the American Physiological Society), the Guide for the Care and Use of Laboratory Animals (DHEW publication 86–23, revised 1996; see p. 7, *Courses of Study*), the Animal Welfare Act, and the New York State Public Health Law. Within these regulations, and in keeping with the principle of Academic Freedom of the Faculty, the use of animals to aid in teaching any biological sciences discipline is at the discretion of the professor in charge.
3. Each course, as well as research projects, in which animals are used receives a formal review annually by the Cornell University Institutional Animal Care and Use Committee (IACUC).
4. Any concerns regarding the use of live animals in teaching should be addressed first to the faculty member responsible for that course. He or she is required to be in compliance with all applicable regulations and guidelines. Alternatively, students may choose to address their concerns to the director of the Cornell Center for Research Animal Resources, Dr. Michele Bailey, at 253–3520. The director may initiate discussion with the faculty member responsible for a particular course without involving the student if he or she would prefer to remain anonymous.
5. Enrollees in those courses in the biological sciences in which animal use is a component may, at the professor's discretion, be asked to sign copies of this statement (USE OF ANIMALS . . .) at the first meeting of the course."

ADVANCED PLACEMENT

For information on credit for advanced placement in biological sciences, see www.biology.cornell.edu/advising/ap.html.

THE MAJOR

The major of biological sciences is available to students enrolled in either the College of Agriculture and Life Sciences or the College of Arts and Sciences. The undergraduate program is coordinated for students in both colleges by the Office of Undergraduate Biology. By completion of the sophomore year, all students who intend to major in biological sciences must declare the major and a program of study through the Office of Undergraduate Biology, in 216 Stimson Hall.

Whenever possible, students should include the introductory biology, chemistry, and mathematics sequences in their freshman schedule and complete the organic chemistry lecture course in their sophomore year. Biology majors should regularly monitor their progress in the major, and should assess as realistically as possible the likelihood of achieving at a level that is consistent with their academic and personal goals. Weak performance in core courses, particularly after the freshman year, may indicate a need to reevaluate aptitude and genuine interest in the major. Students with questions, particularly with concerns about their ability to complete the major, are encouraged to consult with their biology advisor and to take advantage of the advising and counseling resources of the Office of Undergraduate Biology as well as those of the university and their college.

The requirements for the biological sciences major are listed below. Requirements 1–9 must be taken for a letter grade. Courses taken for the program of study should be taken for a letter grade unless the course is offered for S-U grades only or if the student's advisor grants permission.

1. **Introductory biology for majors** (one year): BIO G 101 and 103 plus 102 and 104, or 105–106. BIO G 107–108, offered during the eight-week Cornell summer session for 8 credits, also satisfies the introductory biology requirement for majors.
2. **General chemistry**: CHEM 207–208 or 215. Students who, via advanced placement, take only CHEM 208 or only 215 should be aware that some professional and graduate schools require 8 credits of general chemistry.

These students may wish to take both CHEM 215 and 208 or 215 and 216. Students may wish to consult with their faculty advisor or advisors in the Office of Undergraduate Biology for further clarification.

3. **College mathematics** (one year): one semester of calculus (MATH 106, 111, 191, or their equivalent) plus one semester selected from the following:
   a. a second semester of calculus (MATH 112, 192, or their equivalents).
   b. a course in finite mathematics (MATH 105).
   c. a course in statistics (BTRY 301, MATH 171, AEM 210, ILR 212, PSYCH 350, PAM 210, ECON 319, ECON 321, SOC 301).
4. **Organic chemistry**: CHEM 257 and 251, or 357–358 and 251, or 357–358 and 301, or 359–360 and 251, or 359–360 and 301.
5. **Physics:** PHYS 101–102, 207–208,* or 112–213.* Those who take PHYS 112–213 are advised to complete PHYS 214 as well.
6. **Genetics:** BIOGD 281.
7. **Biochemistry:** BIOBM 330, or 331 and 332, or 333.
8. **Evolutionary biology:** BIOEE 278 or BIOPL 448. Note: BIOPL 241 Botany is a prerequisite course to BIOPL 448.
9. **A program of study** selected from the outline below.

Although not required for the biological sciences major, a course in statistics is recommended for all biology students. Students should consult their faculty advisors when choosing appropriate courses in statistics.

Note: Core courses cannot count toward the program of study requirements.

Programs of Study and Requirements

As noted in the list of requirements above, students accepted into the biological sciences major must choose a program of study. Whereas the core requirements of the biology curriculum provide the common foundation deemed essential for all biology majors, the role of the program of study is to provide either a concentration in a particular area of biology or, in the case of the general biology program of study, a survey of biology that is broad but not superficial. The program of study requirement can be met by taking 13 to 15 credit hours of courses chosen by the student in consultation with his or her biology advisor. Programs of study for particular subject areas are designed by faculty members specializing in the subject. Typically, the program of study consists of one or more courses that provide foundation in the subject and a list of optional courses from that area or related areas, many of which are at an advanced level (300 or higher). Because biology is an experimental science, most programs of study require one or more laboratory courses. The laboratory requirement in some programs of study can be met by participation in the independent research course (BIO G 499). The possible programs of study and their requirements are listed below:

1. ***Animal Physiology:*** BIOAP 311 Introductory Animal Physiology, BIOAP 316 Cellular Physiology, plus a minimum of 7 credit hours selected from the following lecture and laboratory courses, of which at least 4 credit hours must be a laboratory course.
   a. Lecture courses: BEE 454 Physiological Engineering; AN SC 300 Animal Reproduction and Development; AN SC 410 Nutritional Physiology and Metabolism; AN SC 427 Fundamentals of Endocrinology; BIO G 305 Basic Immunology; BIOAP 214 Biological Basis of Sex Differences; BIOAP 458 Mammalian Physiology; BIOAP 475 Mechanisms Underlying Mammalian Developmental Defects; BIOAP 489 Mammalian Embryology; BIOBM 407 Nature of Sensing and Response: Signal Transduction in Biological Systems; BIOBM 437 Eukaryotic Cell Proliferation; BIOGD 385 Developmental Biology; BIOGD 400 A Genomics Approach to Studying Life; BIOGD 401 Genomic Analysis; BIOGD 483 Molecular Aspects of Development; BIOGD 610 Genomes as Chromosomes; BIOGD 612 Overview of Model Genetic Organisms; BIONB 322 Hormones and Behavior; BIONB 325 Neurodiseases-Molecular Aspects; BIONB 326 The Visual System; BIONB 492 Sensory Function; NS 331 Physiological and Biochemical Bases of Human Nutrition.
   b. Laboratory courses: BEE 454 Physiological Engineering; AN SC 301 Animal Reproduction and Development; BIO G 401 Introduction to Scanning Microscopy; BIO G 403 Transmission Electron Microscopy for Biologists; BIOAP 413 Histology: The Biology of the Tissues; BIOAP 319 Animal Physiology Laboratory; BIOAP 416 Cellular Physiology and Genomics Laboratory; BIOBM 440 Laboratory in Biochemistry and Molecular Biology; BIONB 491 Principles of Neurophysiology.
2. ***Biochemistry:*** BIOBM 440 Laboratory in Biochemistry and Molecular Biology; physical chemistry (CHEM 287–288 or 389–390 or 389–288); 6 credits of organic chemistry (CHEM 357–358 or CHEM 359–360); plus one of the following two alternatives. Students wanting to maximize their background in chemistry should take CHEM 300 Quantitative Chemistry and CHEM 301 Honors Experimental Chemistry I. Students wanting to gain further depth in biochemistry and related disciplines should take BIOBM 432 Survey of Cell Biology and either CHEM 300 Quantitative Chemistry or CHEM 252 Elementary Experimental Organic Chemistry. Students choosing the first alternative are encouraged to take BIOBM 432.

Notes:

- CHEM 288 is designed for biologists. Five hours of biochemistry are recommended (331 and 332, or 330 and 334 or 333 and 334). Students interested in graduate work in biochemistry should take PHYS 207–208 and should consider taking CHEM 389–390 and its prerequisites. They should be sure to complete CHEM 207–208 or 215–216 during their freshman year.
- Biology majors in the College of Agriculture and Life Sciences who select the biochemistry program are allowed to take up to 61 credit hours in the endowed colleges because of the high number of required endowed courses for this program of study.

3. ***Computational Biology***: Computation has become essential to biological research. Genomic databases, protein databanks, MRI images of the human brain, and remote sensing data on landscapes contain unprecedented amounts of detailed information that are transforming almost all of biology.

   Problems investigated by computational biologists include topics as diverse as the genetics of disease susceptibility; comparing entire genomes to reveal the evolutionary history of life; predicting the structure, motions, and interactions of proteins; designing new therapeutic drugs; modeling the complex signaling mechanisms within cells; predicting how ecosystems will respond to climate change; and designing recovery plans for endangered species. The computational biologist must have skills in mathematics, statistics, and the physical sciences as well as in biology. A key goal in training is to develop the ability to relate biological processes to computational models. Cornell faculty work primarily in four subareas of computational biology: biomolecular structure, bioinformatics and data mining, ecology and evolutionary biology, and statistical and computational methods for modeling biological systems. Specific topics of study include DNA databases, protein structure and function, computational neuroscience, biomechanics, population genetics, and management of natural and agricultural systems.

   Beyond core skills in mathematics, physical sciences, and biology, the computational biology program of study requires additional course work in mathematics and computer programming, a "bridging" course aimed at connecting biology to computation, and an advanced course where the theoretical/computational component of one aspect of biology is studied. Students should enroll in the more rigorous courses in the physical and mathematical sciences and may wish to take additional courses in these areas.

   Computational biology has applications as broad as biology itself. The problems of interest and the tools available to study them are constantly evolving, so students are encouraged to gain fundamental skills that will serve them throughout their careers. There is great, and increasing, demand for research scientists and technical personnel who can bring mathematical and computational skills to the study of biological problems. The program is also an excellent preparation for graduate study in any area of biology or computational biology.

Required Courses for Program of Study in Computational Biology

a. One course in computer programming (CS 100 Introduction to Computer Programming or BEE 151 Introduction to Computing)

b. One additional course in mathematics (MATH 221 Linear Algebra and Calculus; or MATH 231 Linear Algebra; or MATH 294 Engineering Mathematics II; or MATH 420 Differential Equations and Dynamical Systems; or BTRY 408 Theory of Probability; or BTRY 421 Matrix Computation)

c. A bridging course, i.e., a course in mathematical modeling applied to biology (BIOEE 362 Dynamic Models in Biology; BIOEE 460 Theoretical Ecology; CS 321/BIOBM 321, Numerical Methods in Computational Molecular Biology; BTRY 382 Introduction to Statistical Genomics and Bioinformatics, BTRY 494 Quantitative Genetics, or CS 428 Introduction to Computational Biophysics)

d. One course from the following list of advanced courses:

AN SC 420 Quantitative Animal Genetics; BIOBM 631 Protein Structure and Function; BIOGD 481 Population Genetics; BIOGD 484 Molecular Evolution; BIOGD 487 Human Genomics; BIOEE 460 Theoretical Ecology; BIONB 330 Introduction to Computational Neuroscience; BIONB 422 Modeling Behavioral Evolution; BIOPL 440 Phylogenetic Systematics; BTRY 408 Theory of Probability; BTRY 482/682 Statistical Genomics; BTRY 494 Quantitative Genetics; BTRY 652 Computationally Intensive Statistical Inference; CIS 409 Data Structures and Algorithms for Computational Science; CS 211 Computers and Programming; CS 426 Introduction to Computational Biology; CS 626 Computational Molecular Biology; CS 627 Computational Biology: The Machine Learning Approach; MATH 420 Differential Equations and Dynamical Systems; NTRES 310 Applied Population Ecology; NTRES 411 Quantitative Ecology of Fisheries; NTRES 412 Wildlife Population Analysis: Techniques and Models; NTRES 670 Spatial Statistics; OR&IE 360 Engineering Probability and Statistics II; OR&IE 361 Introductory Engineering Stochastic Processes

Notes

- It is strongly recommended that students complete the Core physics requirement using the PHYS 207–208 option.
- It is strongly recommended that students complete the Core organic chemistry requirement using the CHEM 257/251 option and that the time saved be used to take either CS 211 or a second mathematics course from the list above
- MATH 221 Linear Algebra and Calculus, MATH 231 Linear Algebra, MATH 294 Engineering Mathematics II, or BTRY 421 Matrix Computation is recommended for bridging course CS 321/BIOBM 321. MATH 221 Linear Algebra and Calculus, MATH 231 Linear Algebra, or MATH 420 Differential Equations and Dynamical Systems is recommended for bridging course BIOEE 460.
- Courses may not be used to simultaneously satisfy two different requirements. For example, BTRY 408 can be used to satisfy either requirement (2) or requirement (4), but not both.
- Students who use BTRY 408 to fulfill the additional mathematics requirement should not use OR&IE 360 Engineering Probability and Statistics II to fulfill the requirement for an advanced course.
- Biology majors in the College of Agriculture and Life Sciences who select this program of study are allowed to take up to 61 credit hours in the endowed colleges due to the high number of required endowed courses for this program of study.

4. ***Ecology and Evolutionary Biology***: BIOEE 261 Ecology and the Environment. *Effective fall semester 2005*, new students must also complete 10 credits from the following lists: (a) Principles, (b) Organisms, and (c) Ecological and Evolutionary Processes. One course must be chosen from list (a) and a second either from list (b) *or* (c). The remaining credits can be satisfied with courses from all three lists. Students are encouraged to take at least one course from each list.

a. Principles: BIOEE 453 Speciation; BIOEE 458 Community Ecology; BIOEE 460 Theoretical Ecology; BIOEE 464 Macroevolution; BIOEE 480/ ENTOM 470 Ecological Genetics; BIOEE 478 Ecosystem Biology; NTRES 310 Applied Population Ecology.

b. Organisms: BIOEE 274 The Vertebrates: Structure, Function, and Evolution; BIOEE 373 Biodiversity and Biology of the Marine Invertebrates or BIOSM 376 Marine Invertebrate Zoology; BIOEE 450 and 451 Mammalogy, lec and lab; BIOEE 470 and 472 Herpetology lec and lab; BIOEE 475 Ornithology; BIOEE 476 Biology of Fishes; ENTOM 212 Insect Biology; BIOPL 241 Introductory Botany; BIOPL 448 Plant Evolution and the Fossil Record; PL PA 309 Fungi; BIOSM 449 Seaweeds, Plankton, and Seagrass.

c. Ecological and Evolutionary Processes: BIOEE 263 Field Ecology; BIOEE 265 Tropical Field Ecology and Behavior; NS/ANTHR 275 Human Biology and Evolution; BIOEE/BIONB/ENTOM 369 Chemical Ecology; BIOEE/EAS 350 Dynamics of Marine Ecosystems; BIOEE/MATH 362 Dynamic Models in Biology; BIOEE 446 Plant Behavior—Induced Plant Responses to Biotic Stresses; BIOEE/ENTOM 455 Insect Ecology; BIOEE/NTRES 456 Stream Ecology; BIOEE 457 and 459 Limnology: Ecology of Lakes, lec and lab; BIOEE/EAS 462 Marine Ecology; BIOEE 466 and 468 Physiological Plant Ecology, lec and lab; BIOEE/HORT 473 Ecology of Agricultural Systems; NTRES 420 Forest Ecology; BIOSM 413 Research in Marine Biology; NTRES 422 and 423 Wetland Ecology and Management, lec and lab; BIOMI 418 Microbial Ecology; CSS/HORT 466 Soil Ecology; BIOPL/ENTOM 440 Phylogenetic Systematics; BIOPL 447 Molecular Systematics; BIOPL/ENTOM 453 Principles and Practice of Historical Biogeography; BIOEE/EAS 479 Paleobiology; BIOGD 484 Molecular Evolution.

Note: Students also are encouraged to gain experience in some aspect of field biology through course work at a biological field station and can apply up to 6 credits in the place of courses from lists (b) or (c). For example, students may apply 6 credits from the following courses taken at the Shoals Marine Laboratory (BIOSM): BIOSM 308 Marine Microbial Ecology; BIOSM 309 Climates and Ecosystems; BIOSM 310 Marine Symbiosis; BIOSM 374 Field Ornithology; BIOSM 377 Diversity of Fishes; BIOSM 477 Marine Vertebrates; and BIOSM courses in lists b and c. The Ecology and Evolutionary Biology program offers a specialization in Marine Biology and Oceanography (for a description, see "Courses in Marine Science"). The Organization for Tropical Studies (OTS) offers an Undergraduate Semester Abroad Program, featuring two courses (Fundamentals in Tropical Biology and Field Research in Tropical Biology) that can count as two 3-credit courses toward the concentration. Six credits can be applied from the 15-week fall "Semester in Environmental Science" program offered by the Woods Hole Marine Biological Laboratory.

5. ***General Biology:*** The program of study in general biology requires a minimum of 13 credit hours in addition to courses counted toward requirements 1–9 on pages 155–156. These 13 credits must include:

a. One course from each of three different programs of study in biology. Only those courses specifically listed as fulfilling a program of study requirement are acceptable without permission of advisor.

b. A course with a laboratory.

c. A minimum of two upper-level (300 and above) courses of 2 or more credits each.

100-level courses are not acceptable for meeting any of these requirements. BIO G 498 may not be used to fulfill the requirements of this program of study. BIO G 499 (minimum of 2 credits, but no more than 3 credits) may count as one of the upper-level courses, and may count as the laboratory course with approval of the advisor, but it cannot count as a course representing a program of study.

Note: It is possible to use a single course to fulfill more than one requirement. For example, BIOAP 413 Histology could count in all three areas: as a course in the Animal Physiology program of study, as an upper-level course, and as a course with a lab.

6. ***Genetics and Development:*** A minimum of 13 credits, usually chosen from the following courses: BIOGD 385 Developmental Biology; BIOGD 400 A Genomics Approach to Studying Life; BIOGD 401 Genomics Analysis; BIOGD 450 Vertebrate Development; BIOGD 480 Seminar in Developmental Biology; BIOGD 481 Population Genetics; BIOGD 482 Human Genetics and Society; BIOGD 483 Advanced Developmental Biology; BIOGD 484 Molecular Evolution; BIOGD 486 Advanced Eukaryotic Genetics; BIOGD 487 Human Genomics; BIOGD 489 Mammalian Embryology; BIOGD 490 Manipulating the Mouse Genome; BIOGD 610–624 Genomics Modules; BIOGD 640 Stem Cell Biology; BIOGD 682 Fertilization and the Early Embryo; BIOGD 684 Advanced Topics in Population Genetics; BIOGD 687 Developmental Genetics; BIOGD 689 Cellular Basis of Development; BIOMI 420 Microbial Genomics; BIOMI 485 Bacterial Genetics; ENTOM 400 Insect Development; BIOAP 475 Mechanisms Underlying Mammalian Developmental Defects; BIONB 493 Developmental Neurobiology; BIONB 495 Molecular and Genetic Approaches to Neuroscience; BIOBM 437 Cell Proliferation and Senescence; BIOBM 439 Molecular Basis of Human Disease; NS 608 Epigenetics; BIOBM 633 Biosynthesis of Macromolecules; BIOBM 639 The Nucleus; BIOEE 453 Speciation; PL BR 403 Genetic Improvement of Crop Plants; PL BR 606 Advanced Plant Genetics; BIOPL 343 Molecular Biology and Genetic Engineering of Plants; BIOPL 482 Plant Molecular Biology II; BIOPL 483 Plant Molecular Biology I; BIOPL 641 Laboratory in Plant Molecular Biology.

   Up to 3 credits for this program of study may be chosen from other biological sciences courses, including BIO G 499 Independent Undergraduate Research in Biology, with approval from the faculty advisor.

7. ***Insect Biology:*** ENTOM 212 Insect Biology plus a minimum of three additional courses totaling at least 9 credits selected from the following two groups. At least one of the three additional courses must be selected from group a.

   Group a: ENTOM 322 Insect Morphology; ENTOM 331 Insect Phylogeny and Evolution; ENTOM 333 Larval Insect Biology; ENTOM 400 Insect Development; ENTOM 455 Insect Ecology; ENTOM 483 Insect Physiology

   Group b: ENTOM 315 Spider Biology; ENTOM 325 Insect Behavior; ENTOM 344 Insect Conservation Biology; ENTOM 352 Medical and Veterinary Entomology; ENTOM 369 Chemical Ecology; ENTOM 370 Pesticides, Environment, and Human Health; ENTOM 394 Circadian Rhythms; ENTOM 443 Entomology and Pathology of Trees and Shrubs; ENTOM 444 Integrated Pest Management; ENTOM 452 Herbivores and Plants; ENTOM 453 Principles and Practice of Historical Biogeography; ENTOM 456 Stream Ecology; ENTOM 463 Invertebrate Pathology; ENTOM 470 Ecological Genetics; ENTOM 477 Biological Control; ENTOM 490 Insect Toxicology

8. ***Microbiology:*** Students in the Microbiology program of study must complete BIOMI 290 General Microbiology, Lec; BIOMI 291 General Microbiology, Lab. At least 8 additional credits are required, which must include at least one of the following courses: BIOMI 414 Bacterial Diversity; BIOMI 416 Bacterial Physiology; BIOMI 418 Microbial Ecology; BIOMI 485 Bacterial Genetics.

   Additional approved courses are included in the list below. Students are invited to complete their requirements in one of three areas of interest (these are only recommended areas of interest; students can design their own course list as long as they meet the requirements described above): (a) Prokaryotic Biology, (b) Molecular Microbiology and Biotechnology, and (c) Pathogenic Microbiology. Courses acceptable to the program of study that cover topics related to a particular area of interest are:

   Prokaryotic Biology: BIOMI 391 Advanced Microbiology Laboratory; BIOMI 414 Bacterial Diversity; BIOMI 416 Bacterial Physiology; and BIOMI 418 Microbial Ecology.

   Molecular Microbiology and Biotechnology: BIOMI 391 Advanced Microbiology Laboratory; BIOMI 416 Bacterial Physiology; BIOMI 420 Microbial Genomics; BIOMI 485 Bacterial Genetics; and BIOMI 394 Applied and Food Microbiology.

   Pathogenic Microbiology: BIOMI 404 Pathogenic Bacteriology and Mycology; BIOMI 409 Viruses and Disease; BIOMI 417 Medical Parasitology; and BIOMI 485 Bacterial Genetics.

9. ***Molecular and Cell Biology:*** CHEM 357–358 or 359–360; BIOBM 432 Survey of Cell Biology; BIOBM 440 Laboratory in Biochemistry and Molecular Biology, or BIONB 430 Experimental Molecular Neurobiology; and at least 7 additional credits of courses that have a cell biological or molecular biological orientation. The 7 additional hours should include at least two courses from the following list: BIOAP 416 Cellular Physiology and Genomics Laboratory; BIOBM 401 Genomic Analysis; BIOBM 434 Applications of Molecular Biology; BIOBM 435–436 Undergraduate Seminar in Biochemistry; BIOBM 437 Regulation of Cell Proliferation, Senescence, and Death; BIOBM 439 Molecular Basis of Human Disease; BIO G 305 Immunology; BIOGD 385 Developmental Biology; BIOGD 400 A Genomics Approach to Studying Life; BIOGD 461 Development and Evolution; BIOGD 484 Molecular Evolution; BIOGD 486 Advanced Eukaryotic Genetics; BIOGD 487 Human Genomics; BIOGD 490 Manipulating The Mouse Genome; BIOMI 409 Principles of Virology; BIOMI 420 Microbial Genomics; BIOMI 485 Bacterial Genetics; BIONB 425 Molecular Neurophysiology; BIONB 495 Molecular and Genetic Approaches to Neurosciences; BIOPL 343 Molecular Biology and Genetic Engineering of Plants; BIOPL 347 Laboratory in Molecular Biology and Genetic Engineering of Plants; BIOPL 444 Plant Cell Biology. Students graduating in spring 2008 or earlier may include BIOMI 290 General Microbiology, Lec, and BIONB 222 Neurobiology and Behavior II: Introduction to Neurobiology. Graduate-level courses such as BIOBM 631 Protein Structure and Function; BIOBM 633 Biosynthesis of Macromolecules; BIOBM 636 Functional Organization of Eukaryotic Cells; and BIOBM 639 The Nucleus are also acceptable by permission of advisor. Five hours of biochemistry are recommended (BIOBM 331 and 332, or 330 and 334, or 333 and 334). CHEM 207–208 or 215–216 should be completed in the freshman year.

10. ***Neurobiology and Behavior:*** The two-semester introductory course sequence Neurobiology and Behavior I and II (BIONB 221 and 222) with discussion section (4 credits per semester) and 7 additional credits. The 7 additional credits must include at least one advanced course from the BIONB offerings. "Topics" courses (BIONB 420s and 720s), independent study (BIO G 499), BIONB 321, and PSYCH 423 may be used as supplemental credits but **do not** qualify as advanced courses.

Note: Students who declare the program of study in Neurobiology and Behavior after taking BIONB 221 or 222 for only 3 credits must still take the 1-credit discussion section in BIONB 221 and 222. To arrange this, the student should consult the professors in charge of the two courses.

11. ***Nutrition:*** NS 331 Physiological and Biochemical Bases of Human Nutrition (4 credits) and at least 9 credits of additional course work in the biological aspects of nutrition, such as NS 122 Nutrition and the Life Cycle; NS 315 Obesity and the Regulation of Body Weight; NS 332 Methods in Nutritional Sciences; NS 341 Human Anatomy and Physiology; NS 347 Human Growth and Development; NS 361 Biology of Normal and Abnormal Behavior; NS 421 Nutrition and Exercise; NS 441 Nutrition and Disease; NS 452 Epidemiology and Dietary Markers of Chronic Disease; NS 603 (alternate years) Mineral Nutrition: Metabolic, Health, and Environmental Aspects; NS 614 Topics in Maternal and Child Nutrition; NS 631 Micronutrients: Function, Homeostasis, and Metabolism; and NS 632 Regulation of Macronutrient Metabolism. Some courses require NS 115 Nutrition, Health, and Society, which may be used as part of the additional 9 credits.

Note: For students in the College of Agriculture and Life Sciences, credits in NS courses count toward the required 55 CALS credits. For students in the College of Arts and Sciences, NS credits will count toward the 100 hours required in A&S if those credits fulfill major requirements.

12. ***Plant Biology:*** Students choose one area of study from the following two options:

    Option (a) Botany: Students are required to take BIOPL 241 Introductory Botany. Students should then choose, with the aid of their faculty advisor, a minimum of three of the following courses, for a total of at least 10 additional credits, to round out their botanical training: BIOPL 242 and 244 Plant Function and Growth, Lec and Lab; BIOPL 243 Taxonomy of Cultivated Plants; BIOPL 245 Plant

Biology; BIOPL 247 Ethnobiology; BIOPL 248 Taxonomy of Vascular Plants; BIOPL 340 Methods in Biological and Biochemical Prospecting; BIOPL 342 and 344 Plant Physiology, Lec and Lab; BIOPL 343 and 347 Molecular Biology and Genetic Engineering of Plants, Lec and Lab; BIOPL 345 Plant Anatomy; BIOPL 348 The Healing Forest; BIOPL 359 Biology of Grasses; BIOPL 380 Strategies and Methods in Drug Discovery; BIOPL 404 Crop Evolution, Domestication, and Diversity; BIOPL 422 Plant Development; BIOPL 440 Phylogenetic Systematics; BIOPL 442 Current Topics in Ethnobiology; BIOPL 444 Plant Cell Biology; BIOPL 447 Molecular Systematics; BIOPL 448 Plant Evolution and the Fossil Record; BIOPL 449 Green Signals and Triggers—The Plant Hormones; BIOPL 452/454 Systematics of Tropical Plants and Field Lab; BIOPL 453 Principles and Practice of Historical Biogeography; BIOPL 462 Plant Biochemistry; BIOEE 452 Herbivores and Plants; BIOEE 463 and 465 Plant Ecology and Population Biology, Lec and Lab; or BIOEE 466 and 468 Physiological Plant Ecology, Lec and Lab.

Option (b) Plant Biotechnology: Students are required to take BIOPL 343 and 347 Molecular Biology and Genetic Engineering of Plants, Lec and Lab. Students choose, in consultation with their faculty advisor, a minimum of 10 additional credits from the following list: BIOPL 241 Introductory Botany; BIOPL 242 and 244 Plant Function and Growth, Lec and Lab; BIOPL 342 and 344 Plant Physiology, Lec and Lab; BIOPL 422 Plant Development; BIOPL 444 Plant Cell Biology; BIOPL 462 Plant Biochemistry; BIOPL 482, 483 Plant Molecular Biology I and II modules; PL BR 401 Plant Cell and Tissue Culture; or PL BR 402 Plant Tissue Culture Laboratory.

13. ***Systematics and Biotic Diversity:*** A minimum of 13 credits from the following two groups, including at least 7 credits from group a and three from group b and at least two laboratory courses (marked with *). BIO G 499, Independent Undergraduate Research in Biology, with approval of the advisor, can be used in fulfillment of up to 4 credits in group (a), and can count as one laboratory course if it has a laboratory component of 2 or more credits.

    a. *BIOEE 264 Tropical Field Ornithology; *BIOEE 274 The Vertebrates: Structure, Function, and Evolution; BIOEE 371 Human Paleontology; *BIOEE 373 Biology of the Marine Invertebrates; BIOEE 405 Biology of the Neotropics; BIOEE 470 Herpetology, Lec; *BIOEE 471 Mammalogy; *BIOEE 472 Herpetology, Lab; *BIOEE 475 Ornithology; *BIOEE 476 Biology of Fishes; BIOEE 477 Marine Invertebrates Seminar; BIOMI 290 General Microbiology, Lec; *BIOMI 291 General Microbiology, Lab; BIOMI 414 Prokaryotic Diversity, Lec; *BIOPL 241 Introductory Botany; *BIOPL 243 Taxonomy of Cultivated Plants; *BIOPL 245 Plant Biology; BIOPL 247 Ethnobiology; *BIOPL 248 Taxonomy of Vascular Plants; BIOPL 348 The Healing Forest; BIOPL 359 Biology of Grasses; BIOPL 452 Systematics of Tropical Plants; *BIOPL 454 Systematics of Tropical Plants: Field Laboratory; *ENTOM 212 Insect Biology; ENTOM 215 Spider Biology: Life on a Silken Thread; ENTOM 315 Spider Biology; *ENTOM 322 Comparative Insect Morphology; *ENTOM 331 Introductory Insect Systematics; *ENTOM 333 Maggots, Grubs, and Cutworms: Larval Insect Biology; *ENTOM 631 Systematics of the Coleoptera; PL PA 309 Introductory Mycology; *PL PA 319 Field Mycology.

    b. BIOEE 453 Speciation; BIOEE 464 Macroevolution; BIOEE 479 Paleobiology; *BIOPL 440 Phylogenetic Systematics; BIOPL 442 Current Topics in Ethnobiology BIOPL 447 Molecular Systematics; *BIOPL 448 Plant Evolution and the Fossil Record; *BIOPL 453 Principles and Practices of Historical Biogeography.

The Minor in Biological Sciences

The minor in biological sciences has been designed to provide students with a broad background in biology while allowing them some flexibility to choose courses of interest. Students must have completed one full year of introductory biology (or its equivalent) to declare the minor. Students will complete 12 to 15 credits by taking either all three biology core course requirements (listed below) or two biology core course requirements and 5 or more biology credits from the lists of approved program of study courses (found in *Courses of Study*) or from the following list of courses:

AN SC 300, 301, 410, 420, 427

BEE 454

BTRY 382, 482/682

CS 426, 626, 627

CSS 421

EAS 350, 479

ENTOM 212, 213, 215, 315, 322, 325, 331, 333, 344, 352, 369, 370, 394, 400, 443, 444, 452, 453, 455, 456, 463, 470, 471, 477, 483, 490, 631

NS 222, 315, 331, 332, 341, 347, 361, 421, 431, 441, 452, 455, 475, 602, 603, 614

NTRES 305, 310, 411, 412, 418, 419, 608, 670

PL BR 401, 402, 403, 606

PL PA 309, 319

Biology core courses

1. Biochemistry: BIOBM 330, 333, or 331-332; one year of general chemistry and organic chemistry lecture (CHEM 257 or 357-358) are prerequisites
2. Evolutionary biology: BIOEE 278 or BIOPL 448
3. Genetics: BIOGD 281

Notes:

- BIO G 499 Independent Research may not be used to fulfill any requirement for the minor. No course substitutions are allowed. With the exception of transfer and study abroad students, no biology courses taken at other institutions will count toward the minor.
- External transfer students must complete the core biology courses at Cornell. Students who are fulfilling the minor requirements under Option 2 must complete a minimum of one program of study course of at least 3 credits at Cornell.
- All courses for the minor must be taken for a letter grade unless a course is offered S-U only.
- Applications for the minor are located in 216 Stimson Hall. See Bonnie Comella or Wendy Aquadro for academic advising and for certifying completion of the minor.

Independent Research and Honors Program

Biology majors are encouraged to consider participating in individual research under the direction of a Cornell faculty member. Students interested in beginning research should contact faculty members who have compatible research interests. Information about faculty research interests and undergraduate research opportunities is available in the Office of Undergraduate Biology, 216 Stimson Hall, and at www.biology.cornell.edu.

Faculty members may consider the student's previous academic accomplishments, interests and career goals, and the availability of space and equipment when agreeing to supervise a student in their laboratory. Students conducting research for the first time must enroll in BIO G 299, an S-U course designed to introduce students to research. After the first semester, students enroll in BIO G 499. Registration for both of these classes is done in the Office of Undergraduate Biology in 216 Stimson Hall. Students may work with faculty in any department on campus as long as the research topic is biological. Students may not earn credit for research done off campus, unless supervised by a Cornell faculty member. Up to 3 credits of research may be used to complete the program of studies in general biology, genetics and development, systematic and biotic diversity, as well as 4 credits in neurobiology and behavior.

The honors program in biological sciences is designed to offer advanced training in life science research through the performance of an original research project under the direct guidance of a member of the Cornell faculty. Biology majors planning on graduating with honors must apply to the Biology Honors Program in the spring of their junior year. Applications and information are available in the Office of Undergraduate Biology, 216 Stimson Hall, or at www.biology.cornell.edu/research/honors.html. To qualify for the program, students must have been accepted into the biological sciences major, have completed at least 30 credits at Cornell, and have a cumulative Cornell grade point average (GPA) of at least 3.0. In addition, students must have at least a 3.0 cumulative Cornell GPA in all biology, chemistry, mathematics, and physics courses. (Grades earned in courses in other departments that are used to fulfill biology major requirements are included in this computation.) In addition, candidates must find a Cornell faculty member to supervise their research. An honors candidate usually enrolls for credit in BIO G 499 Undergraduate Research in Biology under the direction of the faculty member acting as honors supervisor, although the honors program does not require enrollment for credit. Students accepted into the honors program are required to participate in honors research seminars during their senior year; submit an acceptable honors thesis;

complete all major requirements; and maintain a 3.00 Cornell cumulative and science GPA through graduation. Recommendation to the faculty that a candidate graduate with honors and at what level of honors is the responsibility of the Honors Program Committee. The student's final GPA and quality of his or her thesis are factors in determining the level of honors recommended.

Students interested in the honors program are strongly encouraged to begin their research projects in their junior year and to consider spending the following summer at Cornell engaged in full-time research on their honors project. Students interested in staying for the summer also are encouraged to apply to the Cornell Hughes Scholars Program.

Biology majors who are considering study abroad and graduating with honors are encouraged to meet with their academic and research advisor during their sophomore year to carefully plan their academic schedule to meet the requirements of the honors program.

Application forms, requirements, deadline dates for the honors program and the Hughes Scholars Program, and information pertaining to faculty research may be obtained at the Office of Undergraduate Biology, 216 Stimson Hall, and at www.biology.cornell.edu.

CURRICULUM COMMITTEE

Many decisions pertaining to the curriculum and to the programs of study are made by the Biology Curriculum Committee, which meets monthly during the academic year. The committee consists of faculty and elected student members and welcomes advice and suggestions from all interested parties.

ADVISING

Students in need of academic advice are encouraged to consult their advisors or see an academic advisor in the Office of Undergraduate Biology, 216 Stimson Hall.

Students interested in marine biology should visit the Shoals Marine Laboratory Office, G14 Stimson Hall.

Students interested in the multidisciplinary program biology and society should see "Special Programs and Interdisciplinary Studies" in the "College of Arts and Sciences" section of this catalog.

TRANSFERRING CREDIT

Biology majors are required to complete all three biology core courses (biochemistry, evolution, and genetics) at Cornell.

External transfer students are limited to transferring one core biology course and one course of up to 3 credits toward their program of study. See the Office of Undergraduate Biology for approval procedures.

Students who matriculated to Cornell as freshmen and Study Abroad students may transfer program of study courses at the discretion of their advisor. Study Abroad students must obtain approval from the Office of Undergraduate Biology, Director of Advising, to transfer biology core courses. Online course credit is not acceptable to transfer for any biology course.

GENERAL COURSES (BIO G)

Three introductory biology course sequences are taught during the academic year: BIO G 101–104, 105–106, and 109–110; and one during the eight-week summer session: BIO G 107–108. BIO G 101–104, 105–106, and 107–108 are intended for biological sciences majors and other students needing 8 credits from an introductory sequence for majors (e.g., students in a premedical curriculum). Any of these sequences meet the prerequisite for upper-level courses listing "one year of introductory biology for majors" as a prerequisite. BIO G 109–110 is a course sequence intended for nonmajors and meets the prerequisite for many, but not all, upper-level courses listing "one year of introductory biology" as a prerequisite. Students can earn a maximum of 8 credits in introductory biology (including advanced placement credits).

BIO G 101–102(1101–1102) Biological Sciences, Lectures

101, fall; 102, spring. 2 credits each semester. Corequisite: BIO G 103 (fall) or 104 (spring). Prerequisite: for 102, passing grade (D or better) in 101 or permission of instructor. May not be taken for credit after BIO G 105–106 or 109–110. S-U or letter grades by permission of instructor. First lec of fall semester, F Aug. 24. No admittance after second week of classes. Evening prelims: fall, Sept. 20 and Oct. 30; spring, Feb. 21 and Apr. 1. Fall, staff; spring, staff.

Designed for students who intend to specialize in biological sciences. The fall semester covers the chemical and cellular basis of life, energy transformations, physiology, neurobiology, and behavior. The spring semester covers genetics, development, evolution, and ecology. Each topic is considered in terms of modern evolutionary theory, and discussions of plant and animal systems are integrated.

BIO G 103–104(1103–1104) Biological Sciences, Laboratory

103, fall; 104, spring. 2 credits each semester. Corequisite: BIO G 101 (fall) or 102 (spring). Prerequisite: for 104, passing grade (D or better) in 103 or permission of instructor. Students registered for lab courses who are more than 10 minutes late for first meeting of lab forfeit registration in that course; no admittance after second week of classes. S-U or letter grades by permission of instructor. K.-c. Chen.

Designed to provide lab experience with major biological phenomena to support an understanding of the important concepts, principles, and theories of modern biology. A second objective is to help students gain expertise in the methods used by biologists to construct new knowledge. Students are exposed to basic concepts, research methods, including laboratory and data transformation techniques, and instrumentation in the major areas of biology. First-semester topics include biochemistry, physiology, plant biology, and behavior. In the second semester, laboratory experience is provided in genetics, biotechnology, invertebrate diversity, plant and animal development, and ecology. During the first semester, students dissect a doubly pithed frog (pithing is done by the staff). Students dissect several invertebrates during the second semester. For those students who object to animal dissection, alternative materials are available for study. However, testing involves identification of important structures in real organisms.

BIO G 105–106(1105–1106) Introductory Biology

105, fall; 106, spring. 4 credits each semester; 2 credits by permission of instructor. Limited to 200 students. Taking 105–106 in sequence preferred but not required. May not be taken for credit after BIO G 101–104 or 109–110. No admittance after first week of classes. First lec of fall semester R Aug. 23, 9:05; additional study and lab. D. Campbell.

Designed primarily for biology majors, preprofessionals, and other students who desire a challenging, broad introduction to fundamental concepts of biology. Cell biology, physiology, anatomy, and biochemistry are strongly emphasized in the fall semester. The spring semester covers genetics, development, ecology, evolution, behavior, and the diversity of organisms. Students who plan to concentrate in anatomy and physiology should consider taking this course because of the strong emphasis on organismal biology. Because some testing involves the use of predissected specimens, students who object to dissections should take BIO G 101–104. The course uses an autotutorial format and offers considerable flexibility in scheduling. Completion of the course requires mastery of a group of core units. Testing on these units is primarily by oral examination. Students who elect to take the course must be able to meet deadlines. Four formal laboratory sessions are offered each semester; additional laboratory work is included in the core units. Evaluation is based on written reports on experimental work, practical exams, and a comprehensive final exam. Web site: instruct1.cit.cornell.edu/courses/biog105.

BIO G 107–108(1107–1108) General Biology

Summer, 8-week session; 107, weeks 1–4; 108, weeks 5–8. 4 credits each. 107–108 fulfills introductory biology requirement for majors and forms suitable introductory biology course sequence for students intending to go to medical school. Prerequisite: one year of college or permission of instructor; for BIO G 108, a grade of D or better in the prerequisite courses (BIO G 101, 103, 105, or 107). Fee for weeks 1–4: $25; for weeks 5–8, $25. Staff.

Designed for students who plan further study in biology. 107 covers biological metabolism, first at the molecular level and then progressively to the organ system level. The laboratory work involves an introduction to some major techniques, vertebrate dissection, and a survey of plant organization. 108 seeks to integrate the topics of genetics, developmental biology, population biology, and ecology in a general consideration of biological evolution. The laboratory work is a continuation of the material covered in 107 and involves more techniques, a survey of animal organization, and the design and performance of a field study. For those students who object to animal dissection, alternative materials are available for study. However, testing involves identification of important structures in real organisms.

BIO G 109–110(1109–1110) Biological Principles
109, fall; 110, spring. 3 credits each semester includes lecture and lab. Limited to 600 students. Nonmajors survey course, not appropriate for major in biological science or premed requirement. Both BIO G 109 and 110, taken in either order, are required to fulfill distribution requirement in CALS and Human Ecology. Either course fulfills Arts and Sciences distribution requirement. Students with transfer credit must consult with course instructors for appropriate course placement. Due to overlap in content, BIO G 109 may not be taken after BIO G 102 or 106, or equivalent, and BIO G 110 may not be taken after BIO G 101, 105, or equivalent. Note: This course may not satisfy prerequisite for upper-level courses in biology. Letter grades only. Prelims: fall (in class), Sept. 21 and Oct. 31; spring (evening), Feb. 21 and Apr. 3. H. Greene, R. Wayne, E. Balko, and staff.
Offers a comprehensive knowledge of biology as part of a general education. Broad goals of the course encompass an understanding of the potential benefits and limitations of science, the complexity and workings of the natural world, and the internal machinery of how our bodies and those of other animals and plants work. Fall: biological diversity, genetics, evolution, ecology, behavior, and conservation biology; Spring: human physiology, plant development, genetic engineering, infectious diseases, and human health. Laboratory sessions (6 labs per semester) are used for problem-solving experiments, demonstrations, discussions, and dissections (preserved vertebrate, invertebrate, and plant materials); for those students who object to dissection, alternative materials are available for study without grade penalty. Testing on dissection labs involves identification of important structures in real organisms.

BIO G 112(1120) Issues in Social Biology: from Diet to Diseases, DNA to Deforestation
Spring. 3 credits. S-U or letter grades. P. J. Davies.
An analysis of current issues of biological relevance and the biological science behind these issues. Topics will include issues such as food and nutrition, antioxidants, organic produce, disease prevention, athletic enhancers, genetic testing, cancer, stem cells and animal cloning, genetically modified crops, bacteria and antibiotics, viruses, risk, statistics and epidemiology, photosynthesis and global warming, extinction and overpopulation, invasive species, resource over-utilization. The topics will vary according to current issues.

BIO G 125(1250) Biology Seminar
Fall and spring. 1 credit. Prerequisite: first-year standing or permission of instructor. S-U grades only. Staff.
A first-year seminar designed for students with Biology AP credit or a strong interest in research. Students will interact with faculty while learning to read and evaluate scientific publications on current biological topics. Multiple topics and sections will be offered each semester.

BIO G 170(1700) Evolution of the Earth and Life (also EAS 102[1102])
Spring. 3 credits. S-U or letter grades. J. L. Cisne.
For description, see EAS 170.

BIO G 200(2000) Special Studies in Biology
Fall, spring, or summer. 1–3 credits. Prerequisite: written permission from Office of Undergraduate Biology. Students must register in 216 Stimson Hall. S-U or letter grades by permission of instructor. Staff.
Registration device for students who want to take only a portion of a regular biological sciences course—for example, only the lectures or only the laboratory in a course that includes both. Only students who have already had training equivalent to the portion of the regular course that is to be omitted may register in this manner. This course may not be substituted for 100-level courses and may not be used to fulfil college distribution requirements except by permission from the Office of Undergraduate Biology.

BIO G 299(2990) Introduction to Research Methods in Biology
Fall, spring, or summer. Variable credit; max. 3 suggested. S-U grades only. Recommended for freshmen and sophomores. Students must register for credit in Office of Undergraduate Biology, 216 Stimson Hall. Applications available in OUB and at www.bio.cornell.edu. **Add deadline is three days before university deadline.** Any Cornell faculty member whose research field is biological in nature may serve as a supervisor for this course. Non-Cornell supervisors not acceptable.
Intended for students who are new to undergraduate research. Students enrolled in BIO G 299 may be reading scientific literature, learning research techniques, or assisting with ongoing research. The faculty supervisor determines the work goals and the form of the final report.

BIO G 305(3050) Basic Immunology Lectures (also VETMI 315[3150])
Fall. 3 credits. Highly recommended: basic courses in microbiology, biochemistry, and genetics. S-U or letter grades. Lec. J. A. Marsh.
For description, see VETMI 315.

BIO G 400(4000) Undergraduate Seminar in Biology
Fall or spring. Variable credit; 1–3 assigned for individual seminar offerings; may be repeated for credit. S-U or letter grades. Staff.
Specialized seminars on topics of interest to undergraduates presented by biology faculty including visiting faculty.

[BIO G 401(4010) Introduction to Scanning Electron Microscopy]

[BIO G 403(4030) Transmission Electron Microscopy for Biologists
Fall. 1, 3, or 4 credits (4 credits if student takes both sections). Limited to 8 students; minimum of 4. Prerequisites: BIOAP 313, BIOPL 345 or 443. S-U or letter grades. Two sec: 01, 1 credit, weeks 1–4; 02, 3 credits, weeks 5–12. Students may register for one or both sec. Fee may be charged. Lec, lab. Next offered 2008–2009. Staff.
Section 01 covers the principles and use of the transmission electron microscope (TEM), with emphasis on proper operation of the instrument and interpretation of images obtained. Negatively stained materials are used for viewing with the transmission electron microscope. Section 02 covers the principles and techniques of preparing biological material for transmission electron microscopy. Using animal, plant, and microbe materials, this section studies chemical fixtures, cryofixations, ultrathin sectioning, immunogold localization, quantitative microscopy, and metal shadowing techniques. Students have two additional weeks to complete laboratory assignments at the end of each section.]

BIO G 404(4040) Planning for Graduate Study in Biology
Fall. 1 credit. S-U grades only. L. E. Southard.
For students who plan to pursue a graduate degree leading to a research career. Selected topics include information on academic and industrial research careers, selecting appropriate graduate programs, and options for funding. Features faculty, graduate student, and outside speakers. Students write and receive feedback on personal statements.

BIO G 408(4080) Presentation Skills for Biologists
Spring. 1 credit. S-U grades only. Prerequisite: research experience. Priority given to students accepted into Biology Honors Program. L. Southard and G. Hess.
Covers oral and written communication skills used in presenting research to other scientists. Topics include organization and writing of scientific papers, presentation tips for research seminars, and preparation of visual aids using Microsoft Power Point. All students present a 10-minute seminar on their research and evaluate other presentations.

BIO G 410(4100) Teaching High School Biology
Fall. 3 credits. Prerequisite: one year introductory biology; permission of instructor. S-U or letter grades. Offered alternate years. L. Southard.
Gives students the opportunity to experience teaching high school science. Students select an important biological concept, then develop inquiry-based teaching plans appropriate for high school students. The first part of the course consists of lectures, discussion, and laboratory experiments, which familiarize the students with the scientific content. Students then work in teams with high school teachers to develop their curriculum. The final part of the course includes practice presentations and teaching at regional high schools.

BIO G 431(4310) Frontiers in Biophysics
Fall, full day of lec, S, Sept. 15, 9 A.M.–4 P.M., Racker Room, Biotechnology Bldg. 0.5 credit. S-U grades only. G. Feigenson and staff.
Overview of current research in biophysics at Cornell by faculty from different departments across the university. Designed for undergraduates considering a career in biophysics and for graduate students interested in biophysics research opportunities at Cornell.

BIO G 450(4500) Light and Video Microscopy for Biologists
Fall. 3 credits. Limited to 12 students. Prerequisites: one year introductory biology and permission of instructor. Lec, lab. R. O. Wayne.
Students learn the relationship between reality and the image using philosophy, mathematics, and physical theory. Next they apply these tools theoretically and in practice to understand and become experts at image formation and analysis using brightfield, darkfield, phase-contract, fluorescence, polarization, interference, differential interference and modulation contrast microscopes. They build

upon our knowledge and experience to understand how analog image processors and digital image processors can influence, enhance and analyze the images gathered by the microscope. Last they learn about many other kinds of microscopes, including confocal, near field, x-ray, acoustic, nuclear magnetic resonance, infrared, centrifuge, atomic force, and scanning tunneling microscopes.

BIO G 498(4980) Teaching Experience
Fall or spring. 1–4 credits. Limited enrollment. Prerequisites: previous enrollment in course to be taught or equivalent. Note: Arts students may not count this course toward graduation but may, upon petition (one time only) to their class dean, carry fewer than 12 *other* credits and remain in good standing. This would affect Dean's List eligibility but not eligibility for graduating with distinction. S-U or letter grades by permission of instructor. Staff.
Designed to give qualified undergraduate students teaching experience through actual involvement in planning and assisting in biology courses. This experience may include supervised participation in a discussion group, assisting in a biology laboratory, assisting in field biology, or tutoring.

BIO G 499(4990) Independent Undergraduate Research in Biology
Fall, spring, or summer. Variable credit. S-U or letter grades. Note: Arts students may not register for more than 6 credits per semester with one supervisor or 8 credits per semester with more than one supervisor. Students in CALS may use up to 15 credits of independent study (BIO G 499, 498) toward graduation. Up to 3 credits of research may be used to complete programs of study in General Biology, Genetics and Development, and Systematics and Biotic Diversity, and 4 credits of research in Neurobiology and Behavior. Prerequisite: one semester of BIO G 299 or equivalent or permission of instructor and Office of Undergraduate Biology.
For students with previous undergraduate experience conducting biological research at Cornell. Students enrolled for this credit should be doing independent work on their own project. Registration forms are available in OUB and on the web at www.bio.cornell.edu. **Add deadline is three days before university deadline.** Each student must submit proposed research project description during course registration. Any Cornell faculty member whose research field is biological in nature may serve as supervisor for this course. Non-Cornell supervisors not acceptable.

BIO G 600(6000) Graduate Seminar in Biology
Fall or spring. Variable credit (1–3 credits assigned for individual seminar offerings). May be repeated for credit. S-U or letter grades. Staff.
Specialized seminars on topics of interest to graduate students presented by biology faculty including visiting faculty.

BIO G 663(6630) Nanobiotechnology (also A&EP 663[6630])
Fall. 3 credits. Letter grades only. H. Hoch.
For description, see A&EP 663.

BIO G 705(7050) Advanced Immunology Lectures (also VETMI 705[7050])
Spring. 3 credits. Prerequisite: basic immunology course or permission of instructor. Offered alternate even years. Lec. Coordinator: J. A. Marsh.
For description, see VETMI 705.

[BIO G 706(7060) Immunology of Infectious Diseases (also VETMI 719[7190])
Spring. 2 credits. Prerequisite: basic immunology course or permission of instructor. S-U or letter grades. Offered odd alternate years; next offered 2008–2009. Coordinator: E. Denkers.
For description, see VETMI 719.]

ANIMAL PHYSIOLOGY (BIOAP)

[BIOAP 214(2140) Biological Basis of Sex Differences (also B&SOC 214(2141), FGSS 214[2140])
Fall. 3 credits. Prerequisite: one year introductory biology. S-U or letter grades. Offered alternate years; next offered 2008–2009. J. E. Fortune.
Examines the structural and functional differences between the sexes. Emphasizes mechanisms of mammalian reproduction. Current evidence on the effects of gender on nonreproductive aspects of life is discussed. Provides students with a basic knowledge of reproductive endocrinology and with a basis for objective evaluation of sex differences in relation to contemporary life.]

BIOAP 311(3110) Introductory Animal Physiology, Lectures (also VTBMS 346[3460])
Fall. 3 credits. Prerequisites: one year college biology, chemistry, and mathematics. Recommended: previous or concurrent physics course. S-U or letter grades by permission of instructor. Evening prelims. E. R. Loew.
General course in animal physiology emphasizing principles of operation, regulation, and integration common to a broad range of living systems from the cellular to the organismal level. Structure/function relationships are stressed along with underlying physico-chemical mechanisms.

BIOAP 312(3120) Farm Animal Behavior (also AN SC 305[3050])
Spring. 2 credits. Prerequisites: one year introductory biology, and introductory animal physiology (AN SC 100 and 150 or equivalent is sufficient or BIOAP 311). Recommended: at least one animal production course or equivalent experience. S-U or letter grades. P. Perry and K. A. Houpt.
For description, see AN SC 305.

BIOAP 316(3160) Cellular Physiology
Spring. 3 credits. Pre- or corequisite: BIOBM 330 or 331 and 332 or 333. Evening prelims. A. Quaroni.
Comprehensive course covering the general characteristics of eukaryotic cells; the structure, composition, and function of subcellular organelles; and the major signal transduction pathways regulating a variety of physiological cell activities. Among the main subjects covered are absorption and transport processes, mechanism of action of signaling molecules (hormones), the cell cycle and regulation of cell proliferation, cell-cell communication, extracellular matrix, and carcinogenesis.

BIOAP 319(3190) Animal Physiology Experimentation
Fall. 4 credits. Limited to 40 students per lab sec. Pre- or corequisite: BIOAP 311 or permission of instructor. For pre-med, pre-vet juniors and seniors and graduate students interested in biomedical science. E. R. Loew, N. A. Lorr, and staff.
Student-conducted in vitro and in vivo experiments designed to illustrate basic physiological processes, physiological research techniques, instrumentation, experimental design, and interpretation of results. Techniques include anesthesia, surgical procedures, dissection, and real-time computer recording and analysis. Experiments with isolated living tissues or live anesthetized animals examine properties of membranes and epithelia, blood, nerves, skeletal and smooth muscle; cardiovascular, respiratory, renal, and reproductive function and their regulation by the nervous and endocrine systems.

BIOAP 413(4130) Histology: The Biology of the Tissues
Spring. 4 credits. Prerequisite: one year introductory biology. Recommended: BIOBM 330 or 331, or equivalents. S-U or letter grades. S. Suarez and L. Mizer.
Provides students with a basis for understanding the microscopic, fine-structural, and functional organization of vertebrates (primarily mammals), as well as methods of analytic morphology at the cell and tissue levels. Emphasizes dynamic interrelations of structure, composition, and function in cells and tissues.

BIOAP 416(4160) Cell Physiology and Genomics Laboratory
Spring. 4 credits. Limited to 24 students. For pre-med, pre-vet, juniors, seniors, and graduate students interested in biomedical science. Pre- or corequisite: BIOAP 316 or BIOBM 432 or permission of instructor. N. A. Lorr, H.–H. Chuang, and staff.
A laboratory course introducing modern methods and instrumentation in cell physiology and genomics. Students learn: (1) cell culture and imaging by fluorescent microscopy; (2) isolation and manipulation of RNA and DNA, in vitro transcription; (3) transformation, transfection, and microinjection; (4) protein electrophoresis, western blotting, and immunocytochemistry; (5) electrophysiology using Xenopus oocyte expression system and Ussing chambers; and (6) analysis of gene expression using RT–PCR, real time PCR, and microarray analysis. Students will conclude the course with an experiment of their own design.

BIOAP 425(4250) Gamete Physiology and Fertilization (also AN SC 425[4250])
Fall. 2 credits. Prerequisite: AN SC 300 or equivalent. Offered alternate years. Lec. J. E. Parks.
For description, see AN SC 425.

BIOAP 427(4270) Fundamentals of Endocrinology (also AN SC 427[4270])
Fall. 3 credits. Prerequisite: animal or human physiology course or permission of instructor. Lec. P. A. Johnson.
For description, see AN SC 427.

BIOAP 458(4580) Mammalian Physiology
Spring. 3 credits. Auditors allowed. Prerequisite: BIOAP 311 or equivalent. Recommended for biological sciences majors, pre-med and pre-vet students, and beginning graduate students in physiology, nutrition, and animal science. Evening prelims. K. W. Beyenbach.
The course offers a treatment of selected topics in vertebrate and human physiology that emphasizes concepts and a working knowledge of physiology. The first course half surveys biological design and the functional strategies of multicellular animals. Topics include mammalian fluid compartments, homeostasis, and membrane and epithelial transport. The second half examines the mechanism and the regulation of cardiovascular, gastrointestinal, and renal systems. Course concluding lectures aim to illustrate the integration of systems in the regulation of acid/base balance. Clinical examples of dysfunction will underscore the role of normal function, and some diseases will be traced to the deepest roots of their molecular etiology. Weekly problem sets count 50 percent of the final grade.

BIOAP 475(4750) Mechanisms Underlying Mammalian Developmental Defects (also NS 475[4750])
Spring. 3 credits. Prerequisites: BIOBM 330, 331–332, or 333 (may be taken concurrently). Offered alternate years. D. Noden and P. Stover.
Focuses on the causes of developmental defects and how genetic changes or teratogenic insults disrupt developmental regulatory and metabolic pathways.

BIOAP 489(4890) Mammalian Embryology (also BIOGD 489[4890])
Spring. 3 credits. Prerequisite: introductory biology. Offered alternate years. D. M. Noden.
Examines the early formation of the mammalian body and placenta, emphasizing comparative aspects, and morphogenesis and histogenesis of each organ system.

[BIOAP 619(6190) Lipids (also NS 602[6020])
Fall. 2 credits. Next offered 2008–2009. A. Bensadoun.
For description, see NS 602.]

BIOAP 710–718(7100–7180) Special Topics in Physiology
Fall or spring. 1 or 2 credits per topic; may be repeated for credit. Enrollment in each topic may be limited. S-U or letter grades by permission of instructor.
Lectures, laboratories, discussions, and seminars on specialized topics.

BIOAP 711(7110) Readings in Applied Animal Behavior
Fall. 1 credit. Prerequisite: BIOAP 311 or equivalent. Offered alternate years. Lec. K. A. Houpt.

BIOAP 714(7140) Cardiac Electrophysiology
Fall. 1 credit. S-U grades only. Offered alternate years. R. Gilmour.
Survey of cardiac potentials, passive membrane properties, ion channels, and cardiac arrhythmias. Emphasizes nonlinear dynamic aspects of cardiac electrophysiology and cardiac arrhythmias.

BIOAP 715(7150) Stress Physiology: To Be Discussed as Part of Animal Welfare
Fall. 1 credit. Prerequisite: BIOAP 311 or equivalent. Offered alternate years. K. A. Houpt.
Emphasizes physiological assessment of stress.

BIOAP 720(7200) Animal Physiology and Anatomy Seminar
Spring and fall. 1 credit each semester. Prerequisite: admission to graduate field of physiology. M. Roberson.
Designed to train graduate students in the field of physiology to become professional scientists. Students are required to give a seminar on their research. Advice and feedback are provided. Throughout the semester, advice is provided on subjects such as preparation of manuscripts, seminars, and grant proposals.

BIOAP 757(7570) Current Concepts in Reproductive Biology
Fall. 3 credits. Limited to 20 students. Prerequisites: undergraduate degree in biology and strong interest in reproductive biology. S-U or letter grades. Offered alternate years. J. E. Fortune, P. A. Johnson, and staff.
Team-taught survey course in reproductive physiology/endocrinology. Lectures by a number of reproductive biologists on various aspects of male reproductive function (endocrine regulation, testis function, spermatogenesis, sperm physiology/function); female reproductive function (endocrinology, ovarian development and function, oocyte physiology/function); fertilization and gamete transport; pregnancy; parturition; lactation; aging; reproductive technology. Student participation in the form of discussions and/or presentations.

Related Courses in Other Departments

Advanced Work in Animal Parasitology (VETMI 737)

Animal Reproduction and Development (AN SC 300)

Comparative Insect Morphology (ENTOM 322)

Developmental Biology (BIOGD 385)

Fundamentals of Endocrinology (AN SC 427)

Research in Marine Biology (BIOSM 413)

Sensory Function (BIONB 492)

Teaching Experience (BIO G 498)

Undergraduate Research in Biology (BIO G 499)

BIOCHEMISTRY, MOLECULAR AND CELL BIOLOGY (BIOBM)

BIOBM 132(1320) Orientation Lectures in Molecular Biology and Genetics (also BIOGD 132[1320])
Spring, weeks 1–3. 0 credits. Primarily for freshmen, sophomores, and transfer students. S-U grades only. Lec. Staff.
Six professors discuss their research and promising new areas for research in the future.

BIOBM 330–332(3300–3320) Principles of Biochemistry
Introductory biochemistry is offered in three formats: individualized instruction (330) and lectures (331 and 332) during the academic year, and lectures (333) during the summer. *Individualized instruction is offered to a maximum of 250 students each semester. Lectures are given fall semester (331), spring semester (332), and summer (333).*

BIOBM 330(3300) Principles of Biochemistry, Individualized Instruction
Fall or spring. 4 credits. Prerequisites: one year introductory biology and one year general chemistry and CHEM 257 or 357–358 (CHEM 358 may be taken concurrently) or equivalent, or permission of instructor. Recommended: concurrent registration in BIOBM 334. May not be taken for credit after BIOBM 331, 332, or 333. S-U or letter grades. Evening prelims: fall, Sept. 27 and Oct. 30; spring, Feb. 21 and Apr. 1. J. E. Blankenship, P. C. Hinkle, and staff.
Fourteen units that cover protein structure and function, enzymes, basic metabolic pathways, DNA, RNA, protein synthesis, and an introduction to gene cloning. No formal lectures, autotutorial format.

BIOBM 331(3310) Principles of Biochemistry: Proteins and Metabolism
Fall. 3 credits. Prerequisites: one year introductory biology, one year general chemistry, and CHEM 257 or 357–358 (CHEM 257 or 357 should not be taken concurrently) or equivalent, or permission of instructor. May not be taken for credit after BIOBM 330 or 333. S-U grades by permission of instructor. Lec; evening prelim Oct. 18. G. W. Feigenson.
The chemical reactions important to biology, and the enzymes that catalyze these reactions, are discussed in an integrated format. Topics include protein folding, enzyme catalysis, bioenergetics, and key reactions of synthesis and catabolism.

BIOBM 332(3320) Principles of Biochemistry: Molecular Biology
Spring. 2 credits. Prerequisites: one year introductory biology and previous or concurrent registration in organic chemistry, or permission of instructor. May not be taken for credit after BIOBM 330 or 333. S-U or letter grades by permission of instructor. Lec. B. K. Tye.
Comprehensive course in molecular biology that covers the structure and properties of DNA, DNA replication and repair, synthesis and processing of RNA and proteins, the regulation of gene expression, and the principles and applications of recombinant DNA technologies, genomics, and proteomics.

BIOBM 333(3330) Principles of Biochemistry: Proteins, Metabolism, and Molecular Biology
Summer, eight-week session. 4 credits. Prerequisites: one year introductory biology, one year general chemistry, and CHEM 257, or 357–358, or equivalents, or permission of instructor. May not be taken for credit after BIOBM 330, 331, or 332. H. Nivison.
Topics include the structure and function of proteins, enzyme catalysis, metabolism, and the replication and expression of genes.

BIOBM 334(3340) Computer Graphics and Molecular Biology
Fall or spring. 1 credit. Prerequisite: BIOBM 333 or 331–332 (BIOBM 332 may be taken concurrently) *or* Corequisite: BIOBM 330. J. E. Blankenship, P. C. Hinkle, and staff.
Visualization of complex biomolecules using Silicon Graphics computers. Group presentations on current topics in molecular biology.

BIOBM 432(4320) Survey of Cell Biology
Spring. 3 credits. Prerequisite: BIOBM 330, 333, or 331, and previous or concurrent registration in 332, or equivalent. Recommended: BIOGD 281. Lec. Evening prelims Mar. 4 and Apr. 17. V. M. Vogt.
Survey of a wide array of topics focusing on the general properties of eukaryotic cells. Topics include methods used for studying cells, the structure and function of the major cellular organelles, and analyses of cellular processes such as mitosis, endocytosis, cell motility, secretion, cell-to-cell communication, gene expression, and oncogenesis. Some of the material is covered in greater depth in BIOBM 437, BIOGD 483, and BIOBM 632, 636, and 639.

[BIOBM 434(4340) Applications of Molecular Biology to Medicine, Agriculture, and Industry
Fall. 3 credits. Prerequisites: BIOBM 330 or 333 or 331/332. Recommended: BIOBM 432. S-U or letter grades. Lec. Next offered 2008–2009. S. Ely.
Lecture topics emphasize transgenic animal and plant systems that constitute marketed or near-market applications such as production of pharmaceuticals in milk, edible and nucleic acid vaccines, gene therapy, and high-tech agricultural products. Additional non-transgenic topics will include cancer treatments and relevant aspects of the human genome projects. An overview of human immunology and its relationship to drug development will be provided. Students will also explore relevant scientific literature.]

BIOBM 435–436(4350–4360) Undergraduate Biochemistry Seminar
1 credit; may be repeated. Prerequisites: upperclass standing; BIOBM 330, 333, or 331–332, or written permission of instructor. S-U grades only. D. Wilson.
Selected papers from the literature on a given topic are evaluated critically during 12 one-hour meetings.

BIOBM 437(4370) Regulation of Cell Proliferation, Senescence, and Death (also BIOGD/TOX 437[4370])
Spring. Variable credit; students may take lec for 2 credits or lec and disc for 3 credits. Limited to about 20 students per disc; priority given to graduate students. Prerequisite: BIO G 101–102 or 105–106 and BIOBM 330 or 331/332. Recommended: BIOGD 281 and BIOBM 432. S-U or letter grades. S. Lee.
Covers a wide spectrum of issues related to cell proliferation in eukaryotes. Lectures include various aspects of the regulation of cell division cycle and signal transduction pathways, with additional topics on oncogenesis, cell aging, and cell death. The facts as well as concepts and logics behind findings are presented in the lectures. Research articles are analyzed and discussed in depth during discussion section.

BIOBM 438(4380) The RNA World
Spring. 3 credits. Prerequisites: BIOBM 330 or 331/332 or 333, or permission of instructor. A. Ke.
Part of the excitement about "the RNA world" stems from the recognition that RNA is ancient and that the evolution of life as we know it depended upon RNA evolving both informational and catalytic capabilities. This course explores these ideas but more generally provides a comprehensive introduction to RNA biology. Many of the most interesting topics in the RNA biology, such as the mechanism of the RNA interference and its widespread applications, will be covered in detail. Other topics require consideration of essential RNA-protein complexes such as ribosomes, spliceosomes, telomerase, and Signal recognition particles. Classical experiments as well as up-to-date research are covered in this course. A portion of each class is devoted to discussion and questions.

BIOBM 439(4390) Molecular Basis of Human Disease (also BIOGD 439[4390])
Fall. 3 credits. Prerequisites: biochemistry and molecular biology (e.g., BIOBM 330, 331–332, or 333) and genetics (e.g., BIOGD 281) or permission of instructor. Recommended: cell biology (e.g., BIOBM 432 or BIOAP 316) and physiology (e.g., BIOAP 311 or 458). S-U or letter grades. Lec. W. L. Kraus.
This course examines how changes in the normal expression, structure, and activity of gene products caused by genetic mutations, epigenetic phenomena, and environmental agents lead to human diseases. The material focuses on how these changes lead to alterations in normal cellular processes, as well as the resulting physiological consequences. Topics are selected from hormone insensitivity syndromes, inborn errors of metabolism, gene fusions resulting in hybrid proteins, gene amplification, gene inactivation, disruption of signaling pathways, disruption of metabolic pathways, and the molecular actions of infectious agents and environmental toxins. Examples of diseases are selected to emphasize various aspects of genetics, molecular biology, cell biology, physiology, immunology, and endocrinology that have been presented in other courses. In addition, the methods used to identify the underlying biochemical and genetic basis of the diseases, as well as possible pharmaceutical and genetic therapies for treating the diseases, are presented. A portion of the lecture periods will be devoted to discussion and practice questions.

BIOBM 440(4400) Laboratory in Biochemistry and Molecular Biology
Fall, spring, or summer (three-week session). 4 credits. Limited enrollment. Priority given to undergraduate biology majors in Biochemistry or Molecular and Cell Biology programs of study and to graduate students with minor in field of biochemistry. Prerequisites: BIOBM 330 or 333 or 331–332 (at least one of 331–332 completed but one may be taken concurrently). S. Ely and H. Nivison.
Experiments related to molecular biology (includes PCR, DNA cloning, hybridization analysis, restriction mapping, and DNA sequence analysis), protein purification and analysis (salt fractionation, ion exchange chromatography, affinity chromatography, SDS-PAGE, and immunoblotting), and determination of enzyme kinetic parameters.

[BIOBM 443(4430) Experimental Molecular Neurobiology (also BIONB 430[4300])
Spring. 4 credits. Limited to 12 students. Letter grades only. Disc, lab. Offered alternate years; next offered 2008–2009. D. L. Deitcher.
For description, see BIONB 430.]

[BIOBM 450(4500) Principles of Chemical Biology (also CHEM 450[4500])
Fall. 3 credits. Prerequisites: CHEM 357–358 or 359–360 or equivalent. Next offered 2008–2009. T. P. Begley.
For description, see CHEM 450.]

[BIOBM 483(Sec 04)[4530] Molecular Aspects of Plant Development I (also BIOPL 483.4)
Fall. 1 credit. 12 lec TBA. Next offered 2008–2009. J. B. Nasrallah.
For description, see BIOPL 483.4].

BIOBM 485(4850) Bacterial Genetics (also BIOMI/BIOGD 485[4850])
Fall. 2 credits. Prerequisite: BIOGD 281. Recommended: BIOMI 290 and BIOBM 330 or 331 and 332 or 333. Lec. J. E. Peters.
For description, see BIOMI 485.

BIOBM 631(6310) Protein Structure, Dynamics, and Function
Fall. 3 credits. Prerequisites: BIOBM 330 or 333 or 331–332 and organic chemistry. Recommended: physical chemistry course. S-U or letter grades. Lec. L. Nicholson.
Presentations on the basic principles of protein structure, dynamics, and function. Specific topics include protein folding, stability, dynamics, evolution, folded conformations, structure prediction, molecular recognition, and basic enzyme kinetics.

BIOBM 633(6330) Biosynthesis of Macromolecules
Fall. 2 credits. Prerequisite: BIOBM 330 or 333 or 331–332. Recommended: BIOGD 281. Lec. J. W. Roberts and D. B. Wilson.
Synthesis of DNA, RNA, and proteins, and regulation of gene expression.

BIOBM 636(6360) Functional Organization of Eukaryotic Cells
Spring. 3 credits. Prerequisites: BIOBM 330 or 333 or 331–332, and 432, or equivalents. Lec. W. J. Brown.
Aims to provide an integrated view of eukaryotic cell organization as elucidated using biochemical molecular, genetic, and cell biological approaches. Major topics include the cytoskeleton, membrane traffic, and cell polarity. Together with BIOBM 437, 632, and 639 this course provides broad coverage of the cell biology subject area.

BIOBM 638(6380) Macromolecular Interactions and Cell Function
Spring. 2 credits. Prerequisite: BIOBM 330 or 333 or 331–332. Recommended: BIOBM 631 or 633. S-U or letter grades. Lec. J. Fu.
Lectures focusing on the principles of protein-protein and protein-nucleic acid interactions that underlie cellular processes such as signal transduction, intracellular traffic, gene regulation, and cell development. The emphasis throughout is on the structural basis of these processes as related to cell function. Some specific topics are signal amplification, nuclear import and export, transcription by RNA polymerases, RNA processing and export, and translation of mRNAs.

[BIOBM 639(6390) The Nucleus
Spring. 2 credits. Prerequisite: BIOBM 330 or 333 or 331–332, or equivalent. Recommended: BIOGD 281. Lec. Next offered 2008–2009. J. T. Lis.
Lectures on topics of eukaryotic genome organization, chromatin structure, regulation of gene expression, RNA processing, the structure and movement of chromosomes, and nuclear export and import. Covers the structure and function of the nucleus at the molecular and cell biological levels and, together with BIOBM 437, 632 and 636, provides broad coverage of the cell biology subject area.]

BIOBM 641(6410) Laboratory in Plant Molecular Biology (also BIOPL 641[6410])
Fall. 4 credits. Prerequisites: BIOGD 281 or equivalent, BIOBM 330 or 331 or equivalent, and permission of instructor. S-U grades by permission of instructor. Lab. M. R. Hanson and K. Van Wijk.
For description, see BIOPL 641.

BIOBM 730(7300) Protein NMR Spectroscopy (also VETMM 707[7070])
Spring. 2 credits. Prerequisites: CHEM 389 and 390, or 287 and 288, or permission of instructor. S-U or letter grades. Offered alternate years. Lec. L. K. Nicholson and R. E. Oswald.
Students acquire the tools necessary for understanding multidimensional NMR of proteins. NMR fundamentals and schemes for magnetization transfer, water suppression, decoupling, and others are presented.

BIOBM 732–737(7320–7370) Current Topics in Biochemistry
Fall or spring. 0.5 or 1 credit for each topic; may be repeated for credit. Prerequisite: BIOBM 330 or 333 or 331–332 or equivalent. S-U grades only.
Lectures and seminars on specialized topics. Topics for fall and spring to be announced in the course and time roster published at the beginning of each semester or the department mini-courses web site, www.mbg.cornell.edu/cals/mbg/about/courses/mini-courses.cfm.

BIOBM 738(7380) Macromolecular Crystallography (also CHEM 788[7880])
Fall. 3 credits. Prerequisite: permission of instructor. Lec. S. E. Ealick.
For description, see CHEM 788.

BIOBM 751(7510) Ethical Issues and Professional Responsibilities
Spring. 1 credit. Prerequisite: graduate students beyond first year. S-U grades only. Organizational meeting first W of semester. Sem. P. Hinkle.
Ethical issues in research and the professional responsibilities of scientists are discussed based on readings and occasional lectures. The topics are intended to cover the requirements for ethical training of graduate students on training grants and follow the recommendations of the Office of Research Integrity.

BIOBM 830(8300) Biochemistry Seminar
Fall or spring. 0 credits. Prerequisite: graduate students in Biochemistry, Molecular, and Cell Biology. Lec open to everyone. V. Vogt.
Lectures on current research in biochemistry, presented by distinguished visitors and staff members.

BIOBM 831(8310) Advanced Biochemical Methods I
Fall. 6 credits. Requirement for, and limited to, first-year graduate students in field of biochemistry, molecular, and cell biology. S-U grades only. Lab and disc. Organizational meeting first F of semester 10:10. T. C. Huffaker.
The first half of this course comprises an intensive laboratory covering fundamental aspects of modern molecular biology and cell biology. The second half comprises research in the laboratory of a professor chosen by the student (see BIOBM 832). Students must enroll separately for each half.

BIOBM 832(8320) Advanced Biochemical Methods II
Spring. 6 credits. Requirement for, and limited to, first-year graduate students in field of biochemistry, molecular, and cell biology. S-U grades only. Lab. V. Vogt.
Research in the laboratories of two different professors chosen by the student. Arrangements are made jointly between the director of graduate studies and the research advisor.

BIOBM 833(8330) Research Seminar in Biochemistry
Fall or spring. 1 credit each semester; may be repeated for credit. Requirement for, and limited to, second-, third-, and fourth-year graduate students majoring in field of biochemistry, molecular and cell biology. S-U grades only. W. L. Kraus and V. M. Vogt.
Each student presents one seminar per year on his or her thesis research and then meets with instructors and thesis committee members for evaluation.

BIOBM 836(8360) Methods and Logic in Biochemistry, Molecular and Cell Biology, Part I
Spring. 1 credit. Prerequisite: first-year graduate students majoring in field of biochemistry, molecular, and cell biology. S-U grades only. Sem and disc. G. P. Hess.
Seminar with critical discussion by students of original research papers selected by faculty members of the field of biochemistry, molecular and cell biology.

BIOBM 838(8380) Methods and Logic in Biochemistry, Molecular and Cell Biology, Part II
Spring. 2 credits. Prerequisite: second-year graduate students majoring in field of biochemistry, molecular and cell biology or field of genetics and development. S-U grades only. D. Shalloway.
Interactive seminar to develop the general skills needed to support a career in scientific research: experimental design, writing scientific papers and grants, oral presentation, basic statistical and computational methods, and managing a research laboratory. Exercises focus on the preparation of a mock research grant proposal.

Related Courses in Other Departments

Lipids (BIOAP 619, NS 602)

Molecular Techniques for Animal Biologists (AN SC 650)

Teaching Experience (BIO G 498)

Undergraduate Research in Biology (BIO G 499)

ECOLOGY AND EVOLUTIONARY BIOLOGY (BIOEE)

BIOEE 154(1540) Introductory Oceanography, Lectures (also EAS 154[1540])
Fall. 3 credits; optional 1-credit laboratory offered as BIOEE/EAS 155. S-U or letter grades. B. C. Monger.
For description, see EAS 154.

BIOEE 155(1550) Introductory Oceanography, Laboratory (also EAS 155[1550])
Fall. 1 credit. Corequisite: BIOEE/EAS 154. S-U or letter grades. B. C. Monger.
For description, see EAS 155.

BIOEE 207(2070) Evolution (also HIST 287[2870], S&TS 287[2871])
Fall or summer (six-week session). 3 credits. Intended for students with no background in college biology. May not be taken for credit after BIOEE 278. Does not meet evolutionary biology requirement for biological sciences major. S-U or letter grades. W. B. Provine.
Evolution is the central concept in biology. This course examines evolution in historical and cultural contexts. This course aims to understand the major issues in the history and current status of evolutionary biology and explore the implications of evolution for culture. Issues range from controversies over mechanisms of evolution in natural populations to the conflict between creationists and evolutionists.

BIOEE 261(2610) Ecology and the Environment
Fall or summer (three-week session). 4 credits. Prerequisite: one year introductory biology. S-U or letter grades. Fall: B. F. Chabot, A. A. Dhondt, and staff. Summer: one weekend field trip. A. T. Vawter.
Fall: Explores interactions between the environment and organisms in the context of individuals, populations, communities, and ecosystems. Emphasizes basic ecological principles and processes intrinsic to understanding the world around us and in more advanced studies in the environmental sciences, including management-oriented disciplines. Major topics include adaptive strategies of organisms, population dynamics, species interactions, community structure and ecosystem function, biodiversity, biogeochemistry, productivity, human influences on ecosystems, and sustainable practices.

Summer: Introduction to principles of ecology, concerning the interactions between organisms and their environment. Deals with both terrestrial and aquatic ecology, drawing examples from both plant and animal studies. Phenomena that occur at the individual, population, community, and ecosystem levels of organization are examined through classroom lectures and discussion and through a series of lab and field experiences in natural habitats around Ithaca and in the Adirondack Forest Preserve. Ecological principles are applied extensively to current environmental problems and issues.

BIOEE 263(2630) Field Ecology
Fall. 3 credits. Pre- or corequisite: BIOEE 261. Letter grades only. One weekend field trip. A. Kessler.

Field exercises designed to give students direct experience with fieldwork, with emphasis on developing observational skills, journal keeping, and a landscape perspective. Topics include plant succession, niche relationships of insects, influence of herbivores and competition on plant performance, decomposition of soil litter, foraging behavior, census methods, and use of scientific collections.

BIOEE 264(2640) Tropical Field Ornithology
Winter, Jan. 3–17, 2008, two-week, full-time course. 3 credits. Limited to 12 students; minimum of 8. Prerequisite: permission of instructor. Intended for students with limited or no bird knowledge. S-U or letter grades. Daily fieldwork, disc, reading, and individual project. Cost of tuition covers airfare, food, and lodging. A. A. Dhondt.
Provides students with the opportunity to study birds intensively in a neotropical environment. Students learn observational and field techniques, participate in group research projects and in daily seminars. The group is housed in the Biodiversity Center at Punta Cana. One or two field trips are taken to national parks in the Dominican Republic.

BIOEE 265(2650) Tropical Field Ecology and Behavior
Winter, field course based in Kenya, Africa. 4 credits. Limited to 15 students. Prerequisites: one introductory biology course and permission of instructors. Letter grades only. I. J. Lovette and D. Rubenstein.
Gives students a broad hands-on understanding of tropical biology, ecology, and behavioral ecology. Students gain experience with experimental design and data collection, field methods, basic statistics, interpretation and evaluation of primary scientific literature, and scientific paper writing. Most in-country costs (e.g., ground transportation, room, board) are covered by course tuition, but students pay separately for their international airfare and there may also be a small supplementary laboratory fee.

BIOEE 267(2670) Introduction to Conservation Biology
Fall. 3 credits. Intended for both science and nonscience majors. May not be taken for credit after NTRES 410. Completion of BIOEE 267 not required for NTRES 410. S-U or letter grades. One Sat. a.m. field trip. Offered alternate years. J. W. Fitzpatrick.
Broad exploration of biological concepts and practices related to conserving the earth's biodiversity; integrates ecological, evolutionary, behavioral, and genetic principles important for understanding conservation issues of the 21st century. Topics include species and ecosystem diversity, values of biodiversity, causes of extinction, risks facing small populations, simulation modeling, design of nature preserves, the Endangered Species Act, species recovery, ecosystem restoration and management, and past and future human impacts on the planet.

BIOEE 274(2740) The Vertebrates: Structure, Function, and Evolution
Spring. 4 credits. Prerequisite: one year introductory biology. Fee: $25. S-U or letter grades. B. A. McGuire.
Introductory course in vertebrate organismal biology that explores the structure and function of vertebrates with an emphasis on trends in vertebrate evolution. Lectures cover topics such as the origin and evolution of various vertebrate groups, sensory systems, thermoregulation, life history, locomotion, feeding, size, and scaling. Laboratories include dissections of preserved vertebrate animals and noninvasive live animal demonstrations.

BIOEE 278(2780) Evolutionary Biology
Fall or spring. 3 or 4 credits; 4-credit option involves writing component and two disc per week; 4-credit option limited to 20 students per sec each semester. (Students may not preregister for 4-credit option; interested students complete application form on first day of class.) Limited to 300 students. Prerequisite: one year introductory biology or permission of instructor; first-semester freshmen by permission of instructor. S-U or letter grades. One all-day Sat. field trip. Evening prelims: spring, Feb. 28 and Apr. 1. Fall, M. A. Geber; spring, K. R. Zamudio.
Considers explanations for patterns of diversity and for the apparent good fit of organisms to the environment. Topics include the genetic and developmental basis of evolutionary change, processes at the population level, the theory of evolution by natural selection, levels of selection, concepts of fitness and adaptation, modes of speciation, long-term trends in evolution, rates of evolution, and extinction. Students taking the 4-credit option read additional materials from the primary literature and write a series of essays in place of the regular prelims.

BIOEE 350(3500) Dynamics of Marine Ecosystems (also EAS 350[3500])
Fall. 3 credits. Limited to 25 students. Prerequisites: one year of calculus and semester of oceanography (i.e., BIOEE/EAS 154), or permission of instructor. S-U or letter grades. Offered alternate years. C. H. Greene and R. W. Howarth.
For description, see EAS 350.

BIOEE 351(3510) Marine Ecosystems Field Course (also EAS 351[3510])
Spring, full-time, three-week course. 4 credits. Limited to 25 students. Prerequisites: enrollment in Cornell Abroad Earth and Environmental Sciences Semester in Hawaii; one semester of calculus and two semesters of biology or permission of instructor. Letter grades only. C. H. Greene, C. D. Harvell, and B. C. Monger.
For description, see EAS 351.

BIOEE 362(3620) Dynamic Models in Biology (also MATH 362[3620])
Spring. 4 credits. Prerequisites: two semesters introductory biology (BIO G 101–102, 105–106, 107–108, 109–110 or equivalent) and completion of mathematics requirements for Biological Sciences major or equivalent. S-U or letter grades. Offered alternate years. S. P. Ellner and J. M. Guckenheimer.
Introductory survey of the development, computer implementation, and applications of dynamic models in biology and ecology. Case-study format covering a broad range of current application areas such as regulatory networks, neurobiology, cardiology, infectious disease management, and conservation of endangered species. Students also learn how to construct and study biological systems models on the computer using a scripting and graphics environment.

BIOEE 363(3630) Field Methods in Ornithological Research
Summer (eight-week session). 5 credits. Limited to 15 students. Prerequisites: introductory biology or equivalent, interest and ability to spend all day in the field under variable weather conditions, including intense sun and periods of rain, and permission of instructor. S-U or letter grades. D. W. Winkler and staff.
Detailed, hands-on experience with the methods commonly used in ornithological field research, focusing on different methodologies used to obtain data on organismal structure and function, life history characteristics, and behavior. While being immersed in an ongoing, intensive research program in the Ithaca area, students learn about the types of evolutionary and ecological questions that can be addressed through use of different research methodologies, experimental design, and basic statistical analysis techniques.

BIOEE 369(3690) Chemical Ecology (also BIONB/ENTOM 369[3690])
Spring. 3 credits. Prerequisites: one semester of introductory biology for majors or nonmajors and one semester of introductory chemistry for majors or nonmajors or equivalents, or permission of instructor. S-U or letter grades. A. Kessler, A. Agrawal, G. Jander, and J. S. Thaler.
Why are chilies so spicy? This course examines the chemical basis of interactions between species and is intended for students with a basic knowledge of chemistry and biology. Focuses on the ecology and chemistry of plants, animals, and microbes. Stresses chemical signals used in diverse ecosystems, using Darwinian natural selection as a framework. Topics include: plant defenses, microbial warfare, communication in marine organisms, and human pheromones.

BIOEE 371(3710) Human Paleontology (also ANTHR 371[3710])
Fall. 4 credits. Limited to 18 students. Prerequisite: one year introductory biology or ANTHR 101 or permission of instructor. Letter grades only. Occasional field trips. K. A. R. Kennedy.
Broad survey of the fossil evidence for human evolution with special attention to skeletal and dental anatomy, geological contexts, paleoecology, dating methods, archaeological associations, and current theories of human origins and physical diversity.

BIOEE 373(3730) Biodiversity and Biology of the Marine Invertebrates
Fall (but course must be taken previous summer at Shoals Marine Laboratory [SML]), three-week, full-time course. 5 credits (students enroll for credit during fall semester). Limited to 24 students. Prerequisites: one year introductory biology for majors; permission of faculty because off campus. Letter grades only. Daily and evening lec, lab, and fieldwork. Total cost for room, board, and overhead at SML: $1,200. Offered alternate years. C. D. Harvell.
Introduction to the biology and evolution of the major invertebrate phyla, concentrating on marine representatives. In addition to the evolution of form and function, lectures cover aspects of ecology, behavior, physiology, chemical ecology, and natural history of invertebrates. SML exposes students to a wealth of marine and terrestrial invertebrates in their natural habitats. Regular field

excursions allow an excellent opportunity to study freshly collected and in situ representatives of most of the major phyla.

[BIOEE 405(4050) Biology of the Neotropics
Spring. 2 credits. Limited to 18 students. Prerequisite: BIOEE 261 or permission of instructor. S-U or letter grades. Next offered 2008–2009. A. S. Flecker.]

[BIOEE 446(4460) Plant Behavior—Induced Plant Responses to Biotic Stresses
Spring. 3 credits. Limited to 12 students. Prerequisite: BIOEE 261 or permission of instructor. S-U or letter grades. Next offered 2008–2009. A. Kessler.]

[BIOEE 450(4500) Mammalogy, Lectures
Spring. 3 credits. Recommended: BIOEE 274. Letter grades; S-U grades by permission only. Offered alternate years; next offered 2008–2009. B. A. McGuire.]

[BIOEE 451(4510) Mammalogy, Laboratory
Spring. 1 credit. Limited to 16 students. Pre- or corequisite: BIOEE 450. Letter grades; S-U grades by permission only. Fee: $15. Travel to Cornell University Museum of Vertebrates (CUMV) at the Laboratory of Ornithology is necessary. One all-day field trip may be scheduled. Offered alternate years; next offered 2008–2009. B. A. McGuire.]

[BIOEE 453(4530) Speciation
Spring. 4 credits. Limited to 40 students. Prerequisites: BIOEE 278 and BIOGD 281 or equivalents, or permission of instructor. S-U or letter grades. Offered alternate years; next offered 2008–2009. R. G. Harrison.]

[BIOEE 455(4550) Insect Ecology (also ENTOM 455[4550])
Fall. 4 credits. Recommended: ENTOM 212 or BIOEE 261 or permission of instructor. S-U or letter grades. Offered alternate years; next offered 2008–2009. J. S. Thaler.]

BIOEE 456(4560) Stream Ecology (also NTRES 456[4560])
Fall. 4 credits. Limited to 40 students. Prerequisite: BIOEE 261 or permission of instructor. S-U or letter grades. Field project with lab papers. One Sat. field trip. Offered alternate years. A. S. Flecker and C. E. Kraft.
For description, see NTRES 456.

BIOEE 457(4570) Limnology: Ecology of Lakes, Lectures
Spring. 3 credits. Prerequisite: BIOEE 261 or written permission of instructor. Recommended: introductory chemistry. Letter grades; S-U grades by permission only. Offered alternate years. N. G. Hairston, Jr.
Limnology is the study of fresh waters and other inland, nonmarine environments. This course focuses on lakes and ponds, which are discussed as distinct aquatic environments with clear terrestrial boundaries, and within which ecological interactions are especially evident. In lakes, interactions between organisms are often strong and adaptations easily recognized. Physical and chemical properties of the environment impact organisms in important ways and organisms, likewise, influence physics and chemistry. As a result, lakes provide excellent systems for understanding the links between physical (thermal and mixing), chemical (dissolved elements and compounds), and organismal dynamics. Lakes are exciting environments for study in their own right and for gaining perspective on ecological and evolutionary processes in general.

BIOEE 458(4580) Community Ecology
Spring. 4 credits. Prerequisites: BIOEE 261, 278, or permission of instructor. S-U or letter grades. Offered alternate years. M. A. Geber and A. Agrawal.
Intersection between ecology and evolution of species interactions. Covers historical and current views on community structure and diversity. Topics include impacts of species interactions on ecology and evolution of community players, multispecies webs and natural selection in complex communities. Approach is empirical and methodological.

BIOEE 459(4590) Limnology: Ecology of Lakes, Laboratory
Spring. 2 credits. Pre- or corequisite: BIOEE 457. Letter grades; S-U grades by permission only. One weekend field trip. Fee for food on field trip: $15. Offered alternate years. N. G. Hairston, Jr. and staff.
Laboratories and field trips devoted to studies of the biological, chemical, and physical properties of lakes and other freshwater environments. Exercises focus on understanding the freshwater environment, on experimentation, and on understanding ecological processes within lakes. Optional vertebrate dissection (fish) during one laboratory exercise and during a portion of the weekend field trip.

[BIOEE 460(4600) Theoretical Ecology
Spring. 4 credits. Limited enrollment. Prerequisites: completion of Biological Sciences mathematics requirement or equivalent, and either one additional semester of mathematics, statistics, or modeling (e.g., BEE 260/453/475, NTRES 310/411, BIONB 422) or permission of instructor. S-U or letter grades. Offered alternate years; next offered 2008–2009. S. P. Ellner.]

[BIOEE 462(4620) Marine Ecology (also EAS 462[4620])
Fall. 3 credits. Limited to 75 students. Prerequisite: BIOEE 261. Letter grades; S-U grades by permission only. Offered alternate years; next offered 2008–2009. C. D. Harvell and C. H. Greene.]

BIOEE 464(4640) Macroevolution
Spring. 4 credits. Limited to 35 students. Prerequisite: BIOEE 278 or permission of instructor. Interested graduate students strongly encouraged to preregister. Letter grades; S-U grades by permission only. Offered alternate years. A. R. McCune.
Advanced course in evolutionary biology centered on large-scale features of evolution. Areas of emphasis include phylogeny reconstruction, patterns and processes of speciation, the origin of evolutionary novelty, causes of major evolutionary transitions, and patterns of diversification and extinction in the fossil record. Discussion of these problems involves data and approaches from genetics, morphology, systematics, paleobiology, development, and ecology.

[BIOEE 466(4660) Physiological Plant Ecology, Lectures
Spring. 3 credits. Limited to 30 students. Prerequisite: BIOEE 261 or introductory plant physiology. Letter grades; S-U grades by permission only. Offered alternate years; next offered 2008–2009. J. P. Sparks.]

BIOEE 467(4670) Seminar in the History of Biology (also HIST 415[4150], B&SOC/S&TS 447[4471])
Fall or summer (six-week session). 4 credits. Limited to 18 students. S-U or letter grades. W. B. Provine and G. Gorman.
Specific topics change each year. Topic for fall 2007: Evolution and religion. How can evolutionists prepare for teaching biological evolution in a nation where the great majority of people either disbelieve in evolution or believe that purposive causes direct evolution?

[BIOEE 468(4680) Physiological Plant Ecology, Laboratory
Spring. 2 credits. Limited to 15 students. Pre- or corequisite: BIOEE 466. Letter grades only. Offered alternate years; next offered 2008–2009. J. P. Sparks.]

[BIOEE 469(4690) Food, Agriculture, and Society (also B&SOC/S&TS 469[4691])
Spring. 3 credits. Limited to 20 students. Prerequisite: introductory ecology course or permission of instructor. S-U or letter grades. Next offered 2008–2009. A. G. Power.]

[BIOEE 470(4700) Herpetology, Lectures
Spring. 2 credits. Limited to 50 students. Recommended: BIOEE 274 and concurrent enrollment in BIOEE 472. Letter grades; S-U grades by permission only. Offered alternate years; next offered 2008–2009. H. W. Greene.]

[BIOEE 472(4720) Herpetology, Laboratory
Spring. 2 credits. Limited to 35 students. Pre- or corequisite: BIOEE 470. Letter grades; S-U grades by permission only. Fee: $30. Occasional field trips and special projects. Offered alternate years; next offered 2008–2009. H. W. Greene.]

[BIOEE 473(4730) Ecology of Agricultural Systems (also HORT 473[4730])
Fall. 3 credits. Limited to 45 students. Prerequisite: BIOEE 261 or permission of instructor. S-U or letter grades. During first six weeks of class, Thurs. meetings may run later because of field trips. Next offered 2008–2009. L. E. Drinkwater and A. G. Power.]

BIOEE 475(4750) Ornithology
Spring. 4 credits. Limited to 35 students. Prerequisite: permission of instructor by preregistering in E141 Corson Hall. Recommended: BIOEE 274. Letter grades; S-U grades by permission only. Carpooling to Lab of Ornithology necessary. Fee: $15. Occasional field trips and special projects. Offered alternate years. D. W. Winkler.
Lectures cover various aspects of the biology of birds, including anatomy, physiology, systematics, evolution, behavior, ecology, and biogeography. Laboratory includes dissection of dead material, studies of skeletons and plumages, and specimen identification of avian families of the world and species of New York.

[BIOEE 476(4760) Biology of Fishes
Fall. 4 credits. Limited to 24 students. Recommended: BIOEE 274 or equivalent experience in vertebrate zoology. Letter grades; S-U grades by permission only. Small lab fee may be required. Two field trips. Offered alternate years; next offered 2008–2009. A. R. McCune.]

BIOEE 477(4770) Marine Invertebrates Seminar
Fall. 1 credit. Prerequisite: BIOEE 373 or permission of instructor. S-U grades only. Offered alternate years. C. D. Harvell and J. G. Morin.
Discussions and directed readings center on current research themes in invertebrate biology. Designed as an on-campus companion course to the field-based BIOEE 373 Biology of the Marine Invertebrates. Students write individual research essays based on projects done in the field.

[BIOEE 478(4780) Ecosystem Biology
Spring. 4 credits. Prerequisite: BIOEE 261 or equivalent. S-U or letter grades. Offered alternate years; next offered 2008–2009. C. L. Goodale and R. W. Howarth.]

BIOEE 479(4790) Paleobiology (also EAS 479[4790])
Spring. 4 credits. Prerequisites: one year introductory biology for majors and either BIOEE 274, 373, or permission of instructor. S-U or letter grades. Offered alternate years. W. D. Allmon.
For description, see EAS 479.

BIOEE 480(4800) Ecological Genetics (also ENTOM 470[4700])
Spring. 3 credits. Prerequisite: BIOEE 278 or permission of instructor. S-U or letter grades. B. P. Lazzaro.
For description, see ENTOM 470.

BIOEE 490(4900) Topics in Marine Biology
Spring. 2 credits; may be repeated for credit. Limited to 15 students. Prerequisite: permission of instructor. Primarily for undergraduates. S-U or letter grades. Offered alternate years. J. G. Morin and M. J. Shulman.
Seminar courses on selected topics in marine biology; may include laboratory or field trips. Topics and time of organizational meeting are shown in departmental course offerings listed on the web site.

BIOEE 660(6600) Field Studies in Ecology and Evolutionary Biology
Fall or spring. Variable credit. Prerequisites: BIOEE 261, taxon-oriented course, and permission of instructor. Letter grades; S-U grades by permission only. Lec and field trips TBA. Estimated costs: TBA. Staff.
Provides students with opportunities to learn field techniques and new biota by participating in an intensive series of field exercises. Extended field trips may be scheduled during fall break, intersession, or spring break. The regions visited, trip objectives, and other details are announced by the various instructors at an organizational meeting held at the beginning of the semester. Meetings on campus are devoted to orientation and reports on completed projects.

[Sec 01 Tropical Field Ecology
Spring. 2 credits. Prerequisite: for undergraduates, experience or course work with terrestrial, marine, or freshwater organisms. Extended field trip over winter break. Letter grades only. Fee to cover transportation and housing: TBA. Offered alternate years; next offered 2008–2009. C. D. Harvell, J. P. Sparks, and N. G. Hairston, Jr.]

Sec 02 Graduate Field Course in Ecology
Spring. 3 credits. Prerequisite: graduate standing. Letter grades only. Fee charged to help cover food and lodging for trip to Florida. Offered alternate years. J. P. Sparks.
Designed to give graduate students experience in defining questions and designing field investigations. The course is based at the Archbold Biological Station in central Florida over spring break and during the following week. The class visits several ecosystems including sand pine scrub, cattle ranches, cypress swamps, and the everglades.

BIOEE 661(6610) Environmental Policy (also ALS 661[6610], B&SOC 461[4611])
Fall and spring. 3 credits each semester; students must register for 6 credits each semester since R grade given at end of fall semester. Limited to 12 students. Prerequisite: permission of instructor. Letter grades only. D. Pimentel.
Focuses on complex environmental issues. Ten to 12 students, representing several disciplines, investigate significant environmental problems. The research team spends two semesters preparing a scientific report for publication in *Science* or *BioScience*. Thus far, every study has been published.

BIOEE 668(6680) Principles of Biogeochemistry
Spring. 4 credits. Limited to 20 students. Prerequisite: solid background in ecology, environmental chemistry, or related environmental science; for undergraduates, permission of instructor. S-U or letter grades. Offered alternate years. R. W. Howarth and C. L. Goodale.
Lectures cover the biotic controls on the chemistry of the environment and the chemical control of ecosystem function. Emphasis is on cycles of major elements and minor elements globally and in selected ecosystems, stressing the coupling of element cycles. A comparative approach is used to illustrate similarities and differences in element cycling among ecosystems. Analysis of both theoretical and applied issues, including global atmospheric changes and factors controlling the acidification of lakes and soils.

[BIOEE 671(6710) Palaeoanthropology of South Asia (also ANTHR 671[6371], ASIAN 671[6671])
Fall. 3 credits. Limited to 15 students. Letter grades only. Next offered 2008–2009. K. A. R. Kennedy.]

[BIOEE 673(6730) Human Evolution: Concepts, History, and Theory (also ANTHR 673[6373])
Spring. 3 credits. Prerequisite: one year introductory biology or ANTHR 101 or permission of instructor. Letter grades only. Next offered 2008–2009. K. A. R. Kennedy.]

[BIOEE 675(6750) Current Topics in Plant Molecular Ecology
Fall. 1 credit; may be repeated for credit. Limited to 20 students. Prerequisite: graduate standing or permission of instructor. S-U or letter grades. Offered alternate years; next offered 2008–2009. A. Kessler.]

BIOEE 750–760(7590–7600) Special Topics in Evolution and Ecology
Fall or spring. 1–3 credits; may be repeated for credit. Limited enrollment. Letter grades; S-U grades by permission only. Staff.
Independent or group-intensive study of special topics of current interest. Content varies each semester.

BIOEE 761(7610) Microsatellite DNA: Techniques
Fall. 1 credit; may be repeated for credit. Limited to 12 students. Prerequisite: permission of instructor. Primarily for graduate students; undergraduates admitted only under exceptional circumstances. E-mail S. M. Bogdanowicz (smb31) by end of Aug. if interested. S-U grades only. Fee: TBA. R. G. Harrison and S. M. Bogdanowicz.
Construct and screen genomic DNA libraries for microsatellite loci. Lectures and group discussions regarding microsatellite isolation, characterization, and evolution. Informal presentations of student research projects.

BIOEE 764(7640) Plant-Insect Interactions Seminar
Fall or spring. 1 credit; may be repeated for credit. Prerequisite: for undergraduates, permission of instructor. S-U grades only. A. Agrawal, J. S. Thaler, and A. Kessler.
Group-intensive study of current research in plant-insect interactions. Topics vary from semester to semester, but include: chemical defense, coevolution, insect community structure, population regulation, biocontrol, tritrophic interactions, and mutualism.

BIOEE 767(7670) Current Topics in Ecology and Evolutionary Biology
Fall. 4 credits. Prerequisite: for undergraduates, permission of instructor. S-U grades only. P. P. Feeny.
Critical evaluation and discussion of theory and research in ecology and evolutionary biology. Lectures by faculty and student-led discussions of topics in areas of current importance.

BIOEE 770–775(7700–7705) Workshop in Biogeochemistry
Fall or spring. 1–3 credits; may be repeated for credit. Limited to 15 students. Prerequisite: BIOEE 668. S-U grades only. Staff.
Workshop-forum in which graduate students interact with invited world leaders in biogeochemistry. Workshop topics change each semester. A one-week workshop is preceded by seven one-hour preparatory discussions of readings.

BIOEE 780(7800) Graduate Seminar in Ornithology (also NTRES 780[7800])
Fall or spring. 1 credit; may be repeated for credit. Prerequisite: for undergraduates, permission of instructor. S-U grades only. I. J. Lovette, A. A. Dhondt, D. W. Winkler, and J. L. Dickinson.
Group intensive study of current research in ornithology. Topics vary from semester to semester.

BIOEE 899(8990) M.S. Thesis Research
Fall or spring. 1–15 credits. Prerequisite: admission to field of ecology and evolutionary biology. S-U or letter grades. E&EB field faculty.
Thesis research conducted by an M.S. student in the field of ecology and evolutionary biology with advice and consultation of a major professor who is a member of the field.

BIOEE 999(9990) Ph.D. Dissertation Research
Fall or spring. 1–15 credits. Prerequisite: admission to field of ecology and evolutionary biology as Ph.D. student. S-U or letter grades. E&EB field faculty.
Dissertation research conducted by a Ph.D. student in the field of ecology and evolutionary biology with advice and consultation of a major professor who is a member of the field.

Related Courses in Other Departments

Evolutionary Theory and Human Behavior (ANTHR 375/675)

Ethics and the Environment (B&SOC/S&TS 206, PHIL 246)

Physical Hydrology for Ecosystems (BEE 371)

Evolution of the Earth and Life (BIO G 170, EAS 102)

General Microbiology, Lectures (BIOMI 290)

Prokaryotic Diversity (BIOMI 414)

Microbial Ecology (BIOMI 418)

Neurobiology and Behavior I: Introduction to Behavior (BIONB 221)

Methods in Animal Behavior (BIONB 323)

Ecology of Animal Behavior (BIONB/BIOSM 329)

Modeling Behavioral Evolution (BIONB 422)

Animal Communication (BIONB 426)

Animal Social Behavior (BIONB 427)

Introductory Botany (BIOPL 241)

Taxonomy of Vascular Plants (BIOPL 248)

Phylogenetic Systematics (BIOPL/ENTOM 440)

Molecular Systematics (BIOPL 447)

Plant Evolution and the Fossil Record (BIOPL 448)

Principles and Practice of Historical Biogeography (BIOPL/ENTOM 453)

Field Ornithology (BIOSM 374)

Field Marine Biology and Ecology (FMBE) (BIOSM 375)

Seaweeds, Plankton, and Seagrass: The Ecology and Systematics of Marine Plants (BIOSM 449)

Biological Statistics I (BTRY/STBTRY 301, NTRES 313)

Statistical Genomics (BTRY/STBTRY 482)

Soil Science (CSS 260)

Geographic Information Systems (CSS 420)

Practicum in Forest Farming as an Agroforestry System (CSS/HORT/NTRES 426)

Soil Ecology (CSS/HORT 466)

Introductory Geological Sciences (EAS 101)

Evolution of the Earth System (EAS 301)

Introduction to Biogeochemistry (EAS/NTRES 303)

Insect Biology (ENTOM 212)

Insect Behavior (ENTOM 325)

Introductory Insect Systematics (ENTOM 331)

Maggots, Grubs, and Cutworms: Larval Insect Biology (ENTOM 333)

Techniques of Multivariate Analysis (ILRST 410)

Statistical Analysis of Qualitative Data (ILRST 411)

Human Biology and Evolution (NS/ANTHR 275)

Environmental Conservation (NTRES 201)

Applied Population Ecology (NTRES 310)

Global Ecology and Management (NTRES 322)

Forest Ecology (NTRES 420)

Forest Ecology, Laboratory (NTRES 421)

Wetland Ecology and Management, Lec/Lab (NTRES 422/423)

Fungi (PL PA 309)

GENETICS AND DEVELOPMENT (BIOGD)

BIOGD 132(1320) Orientation Lectures in Molecular Biology and Genetics (also BIOBM 132[1320])
Spring, weeks 1–3. 0 credits. Primarily for freshmen, sophomores, and transfer students. S-U grades only. Lec. Staff.
For description, see BIOBM 132.

BIOGD 280(2800) Lectures in Genetics
Fall, spring, or summer (eight-week session). 3 credits. Lec component of BIOGD 281. Not open to students majoring in biological sciences; may not be used to fulfill requirements for biological sciences major. Prerequisites: one year introductory biology or equivalent, or permission of instructor. Lec. Highly recommended: problem-solving sessions. T. D. Fox, R. J. MacIntyre, and D. Nero.
For description, see BIOGD 281.

BIOGD 281(2810) Genetics
Fall, spring, or summer (eight-week session). 5 credits. Not open to freshmen fall semester. Prerequisite: one year introductory biology or equivalent. Lec, lab. Highly recommended: problem-solving sessions. T. D. Fox, R. J. MacIntyre, and D. Nero.
General study of the fundamental principles of genetics in eukaryotes and prokaryotes. Topics include gene transmission, gene linkage and recombination, gene structure, gene and chromosome mutations, gene expression, and the manipulation of genes.

BIOGD 282(2820) Human Genetics
Spring. 2 or 3 credits; 2 credits if taken after BIOGD 281. Prerequisite: one year introductory biology or equivalent. S-U or letter grades. Lec. M. L. Goldberg.
Designed for nonmajors. Lectures provide the technical background needed to understand controversial personal, social, and legal implications of modern genetics that are discussed in section meetings.

BIOGD 385(3850) Developmental Biology
Fall. 3 credits. Prerequisite: BIOGD 281. Lec. K. Liu.
Introduction to the morphogenetic, molecular and cellular, and genetic aspects of the developmental biology of animals.

BIOGD 394(3940) Circadian Rhythms (also ENTOM/BIONB/PL PA 394[3940])
Fall. 2–3 credits. Prerequisite: ENTOM 212 or BIOGD 281 or BIONB 221 or 222 or permission of instructor. S-U or letter grades. Lec. K. Lee.
This course will explore a fundamental feature of living organisms found in all kingdoms: how the cellular 24-hour biological clock operates and influences the biological activities. The course will cover fundamental properties of biological rhythms and cellular and molecular structure of circadian oscillators of model organisms including cyanobacteria, fungi, insects, plants, and mammals. One-credit (optional) lab module offered in conjunction with lec.

BIOGD 400(4000) A Genomics Approach to Studying Life
Fall. 3 credits. Prerequisites: one year introductory biology plus BIOGD 281 or 330 or 333 or 331/332 or permission of instructor. S-U or letter grades. Lec. J. Schimenti.
Introduction to principles underlying the organization of genomes and the methods of studying them, emphasizing genome-wide approaches to research. Covers the application of genomics methodologies for addressing issues including evolution, complex systems, genetics and gene: phenotype relationships. Includes periodic, in-depth discussions of landmark or timely genomics papers.

BIOGD 401(4010) Genomic Analysis
Spring. 3 credits. Prerequisites: BIOGD 400 or permission of instructor. Lec. T. P. O'Brien.
Overview of approaches and tools used in genomics research. Covers experimental and computational technologies as well as theoretical concepts important for the study of genomes and their function. Topics include high-throughput DNA sequencing and genotyping, genetic mapping of simple and complex traits, RNA expression profiling, proteomics, genome modification and transgenesis, and computational genomics.

BIOGD 437(4370) Regulation of Cell Proliferation, Senescence, and Death (also BIOBM/TOX 437[4370])
Spring. Variable credit; students may take lec for 2 credits or lec and disc for 3 credits. Limited to about 20 students per disc; priority given to graduate students. Prerequisites: BIO G 101–102 and BIOBM 330 or 331/332. Recommended: BIOGD 281 and BIOBM 432. S-U or letter grades. S. Lee.
For description, see BIOBM 437.

BIOGD 439(4390) Molecular Basis of Human Disease (also BIOBM 439[4390])
Fall. 3 credits. Prerequisites: biochemistry and molecular biology (e.g., BIOBM 330, 331/332, or 333) and genetics (e.g., BIOGD 281) or permission of instructor. Recommended: cell biology (e.g., BIOBM 432 or BIOAP 316) and physiology (e.g., BIOAP 311 or 458). S-U or letter grades. Lec. W. L. Kraus.
For description, see BIOBM 439.

BIOGD 400(4000) A Genomics Approach to Studying Life
Fall. 3 credits. Prerequisites: one year introductory biology plus BIOGD 281 or 330 or 333 or 331/332 or permission of instructor. S-U or letter grades. Lec. J. Schimenti.
Introduction to principles underlying the organization of genomes and the methods of studying them, emphasizing genome-wide approaches to research. Covers the application of genomics methodologies for addressing issues including evolution, cloning, stem cells, complex systems, genetics and gene: phenotype relationships. Includes periodic, in-depth discussions of landmark or timely genomics papers.

BIOGD 440(4400) Stem Cell Biology: Basic Science and Clinical Applications
Spring. 3 credits. Limited to 30 students. Prerequisites: BIOBM 432 or BIOGD 385 or permission of instructor. S-U grades by permission of instructor. Lec, disc. T. Tumbar.
This course will cover basic aspects of tissue morphogenesis and homeostasis with emphasis on the biological role of embryonic and adult stem cells in development, and their possible clinical applications. The focus will be placed on mouse and human stem cells. The discussion will be structured around relevant research papers that allow more in-depth analysis of the material taught during lectures.

BIOGD 450(4500) Vertebrate Development
Fall. 3 credits. Prerequisites: BIOGD 281, and either BIOBM 432 or BIOGD 385. S-U or letter grades. M. J. Garcia-Garcia.
This course explores the developmental mechanisms employed by vertebrate organisms. Topics include the detailed analysis of the genetic, molecular, and cellular events underlying development in frogs, fish, mice, and humans. Course readings include original research articles. Students are encouraged to participate in class discussions.

BIOGD 452 Molecular Biology of Plant Organelles (also BIOPL 482, Sec 5)
Spring. 1 credit. Prerequisites: BIOPL 483 Sec 1 or BIOGD 281 and permission of instructor. S-U or letter grades. M. R. Hanson and D. B. Stern.
For description, see BIOPL 482, Sec 5.

[BIOGD 461(4610) Development and Evolution
Spring. 3 credits. Prerequisites: BIOEE 278, BIOGD 281, BIOBM 332 or 330 or 333. Recommended: BIOGD 385. Lec. Offered alternate years; next offered 2008–2009. M. Wolfner.
This course explores the molecular and genetic pathways and mechanisms that regulate animal development, and how they are modified through evolution to result in the dazzling array of forms and functions seen in the animal kingdom.]

[BIOGD 481(4810) Population Genetics
Fall. 4 credits. Prerequisite: BIOGD 281, BIOEE 278, or equivalents. Lec, disc. Next offered 2008–2009. C. F. Aquadro.
Population genetics is the study of the transmission of genetic variation through time and space. This course explores how to quantify this variation, what the distribution of variation tells us about the structure of natural populations, and about the processes that lead to evolution. Topics include the diversity and measurement of genetic variation, mating and reproductive systems, selection and fitness, genetic drift, migration and population structure, mutation, multilocus models, the genetics of speciation, quantitative traits, and the maintenance of molecular variation. Emphasis is placed on DNA sequence variation and the interplay between theory and the data from experiments and natural populations. Specific case studies include the population genetic issues involved in DNA fingerprinting, the genetic structure and evolution of natural and domesticated populations, and the study of adaptation at the molecular level. Examples are drawn from studies of animals, plants, and microbes.]

BIOGD 482(4820) Human Genetics and Society
Fall. 4 credits. Limited to 24 students. Prerequisite: biological sciences majors; priority given to seniors studying genetics and molecular and cell biology and biochemistry; BIOGD 281 and BIOBM 330 or 333 or 331 and 332. R. A. Calvo.
Presentation of some of the science and technology of human genetics, plus discussion of the ethical, social, and legal implications of recent advances in the field. Topics include assisted reproductive strategies, eugenics, genetic counseling, genetic screening (pre-implantation, prenatal, neonatal, pre-symptomatic, carrier, and workplace), wrongful life and wrongful birth, genetic effects of abused substances, genetics and behavior, human cloning, forensic uses of genetics, and therapy for genetic diseases. Students lead some discussions. There is a major writing component to the course.

BIOGD 484(4840) Molecular Evolution
Spring. 3 credits. Prerequisites: BIOGD 281. Lec. D. Barbash.
Explores the various processes by which DNA and protein sequences evolve over time, and how this evolution at the molecular level relates to changes in the morphology, behavior, and physiology of organisms that have occurred over time scales ranging from thousands to billions of years. After developing basic principles the course discusses the evolution and organization of genomes from microbes to higher eukaryotes including humans, and the relationship between molecular evolution at the sequence level and the evolution of developmental pathways and systems.

BIOGD 485(4850) Bacterial Genetics (also BIOMI/BIOBM 485[4850])
Fall. 2 credits. Prerequisite: BIOGD 281. Recommended: BIOMI 290 and BIOBM 330 or 331 and 332 or 333. Lec. J. E. Peters.
For description, see BIOMI 485.

BIOGD 486(4860) Advanced Eukaryotic Genetics
Spring. 4 credits. Enrollment may be limited to 50 students. Prerequisites: BIOGD 281, BIOBM 330 or 333 or 331 and 332. S-U or letter grades. E. E. Alani.
Develops fundamental skills in eukaryotic genetic analysis through lectures and by reading, analyzing, and presenting research articles. Concepts are presented within the context of a well-studied field, such as chromosome segregation. The basic tools that have been developed to study this field are used to analyze other topics such as vegetative and meiotic cell cycle control, embryonic development, pathogen resistance in plants, and human genetics.

BIOGD 487(4870) Human Genomics
Fall. 3 credits. Prerequisite: BIOGD 281. Lec. A. G. Clark.
Applies fundamental concepts of transmission, population, and molecular genetics to the problem of determining the degree to which familial clustering of diseases in humans has a genetic basis. Emphasizes the role of full genome knowledge in expediting this process of gene discovery. Stresses the role of statistical inference in interpreting genomic information. Population genetics, and the central role of understanding variation in the human genome in mediating variation in disease risk, are explored in depth. Methods such as homozygosity mapping, linkage disequilibrium mapping, and admixture mapping are examined. The format is a series of lectures with classroom discussion. Assignments include a series of problem sets and a term paper.

BIOGD 489(4890) Mammalian Embryology (also BIOAP 489[4890])
Spring. 3 credits. Prerequisite: introductory biology. Offered alternate years; next offered 2009–2010. D. M. Noden.
Examines the early formation of the mammalian body and placenta, emphasizing comparative aspects, and morphogenesis and histogenesis of each organ system.

BIOGD 490(4900) Manipulating the Mouse Genome (also NS 490[4900])
Fall. 2 credits. Course meets during first half of semester (R 1:25–3:20; Aug. 23–Oct. 4) and provides background information for VTBMS 701/TOX 701 Mouse Pathology and Transgenesis, which meets during second half. Students interested in both courses must register for them separately. Prerequisites: BIOGD 281 and BIOBM 330, 332, or 333 or NS 320. Letter grades only. P. D. Soloway.
Functional genomic analysis has benefited enormously from experimental manipulation of the genomes of many organisms. The mouse has been the model of choice for such studies

in mammals. This course explores the tools available for experimental manipulation of the mouse genome, including transgenesis, gene targeting, gene trapping, chemical mutagenesis, and cloning by nuclear transplant. Also discussed are use of recombinant inbred mice for complex trait analysis. Readings from the scientific literature focus on seminal applications of these methods.

BIOGD 608(6080) Epigenetics (also NS 608[6080])
Fall. 2 credits. Prerequisites: BIOGD 281 and BIOBM 330, 332, or 333 or NS 320. Letter grades only. Planned W F 11:15–12:05; occasional evening meetings for student presentations. P. D. Soloway.
Epigenetic effects refer to reversible alterations in chromatin structure that can stably and heritably influence gene expression. These changes include covalent modifications to DNA itself or to proteins bound to DNA as well as noncovalent remodeling of chromatin. This course examines selected epigenetic phenomena described in several eukaryotes, mechanisms regulating these effects, and their phenotypic consequences when normal regulation is lost. Reading materials are from current literature, and participation in class discussion is required.

BIOGD 610(6100) Genomes as Chromosomes
Fall. 3 credits. Limited to 15 students. Prerequisites: BIOGD 281 and BIOBM 330 or 333 or 331/332 or equivalent by permission of instructor. Letter grades only. T. P. O'Brien and P. E. Cohen.
The eukaryotic genome is partitioned into discrete structural units, the chromosomes. The course examines how chromosome organization is related to chromatin structure, gene expression, DNA replication, repair and stability. Special emphasis is placed on how the linear arrangement of sequence features along the chromosome, such as genes and regulatory modules, relate to the functional organization of the genome in the nucleus. Experimental and computational approaches used to address chromosome structure and function are studied.

BIOGD 611(6110) Genome Maintenance Mechanisms
Fall. 1 credit. Meets only during second half of semester beginning Oct. 15. Limited to 25 students. Prerequisites: BIOGD 281, as well as BIOBM 330, or 333, or 331/332 (or equivalents). S-U or letter grades. R. Weiss.
The course focuses on the molecular mechanisms utilized by eukaryotic cells to preserve genomic integrity. Topics to be discussed include endogenous and exogenous sources of mutation, DNA repair pathways, and cell cycle checkpoint mechanisms. Also addressed will be how genome maintenance impacts genome plasticity and evolution, as well as the relationship between genomic instability and disease, especially cancer.

BIOGD 612(6120) Overview of Model Genetic Organisms
Spring. 1 credit. Limited to 20 students. Prerequisites: BIOGD 281 or 400 or permission of instructor. S-U or letter grades. J. Schimenti and staff.
Presents the features of various model organisms and their relative merits for conducting various types of genomics/genetics research. Model systems discussed include: yeast, *Arabidopsis*, *Drosophila*, *C. elegans*, zebrafish, and mice.

BIOGD 613(6130) Genomics and Society
Spring, weeks 10–13. 1 credit. Prerequisite: BIOGD 281 or BIOGD 400 or permission of instructor. S-U or letter grades. Disc. S. Kresovich and S. Tanksley.
A multidisciplinary examination of four to six selected topics that relate to the applications of biological insights derived from genomic analysis. Technical, scientific, ethical, political, legal, and/or social aspects of each topic will be considered from various perspectives.

BIOGD 620(6200) Evolutionary Genomics of Bacteria
Spring. 1 credit. M. Stanhope.
Comparative genomics of bacteria is a valuable approach to deriving information on pathogenesis, antibiotic resistance, host adaptation, and genome evolution. This course provides an evolutionary perspective on comparative bacterial genomics, focusing in particular on pathogens of human and agricultural importance. The course will include lectures, discussion of relevant scientific literature, and hands-on bioinformatics sessions.

[BIOGD 638(6380) Filamentous Fungal Genomics and Development (also PL PA 638[6380])
Spring, last four weeks of semester. 1 credit. S-U or letter grades. Prerequisite: BIOGD 281 or equivalent, or permission of instructor. Lec. Offered alternate years; next offered 2008–2009. B. G. Turgeon.
For description, see PL PA 638.]

BIOGD 682(6820) Fertilization and the Early Embryo
Spring. 2 credits. Prerequisites: BIOGD 281; BIOBM 332, 330 or 333; and BIOGD 385 or permission of instructor. Lec. Offered alternate years. M. F. Wolfner.
We explore the latest molecular/cell/genetic findings about the biology of gametes, fertilization and early development—and their application to fertility modulation, "cloning" and stem cells.

[BIOGD 687(6870) Developmental Genetics
Fall. 2 credits. Limited to 20 students. Prerequisites: BIOGD 281 and 385 or equivalents. S-U or letter grades. Lec TBA. Offered alternate years; next offered 2008–2009. K. J. Kemphues.
Course focuses on methods of genetic analysis of fruitflies, nematodes, mice, and fish to understand mechanisms of development. No text. Lectures and problems from literature.]

[BIOGD 689(6890) Cellular Basis of Development
Fall. 2 credits. Limited to 20 students. Prerequisites: BIOGD 281, 385, and either BIOBM 330 or 331–332. Lec. S-U or letter grades. Next offered 2010–2011. J. Liu.
Focuses on the integration of different cellular processes in various developmental contexts. Topics include cell polarity, cell migration, cell adhesion and fusion, cell growth and proliferation, cell-cell communication, and cell death. Students are required to read current literature and participate in discussions in class.]

BIOGD 780(7800) Current Topics in Genetics and Development
Fall or spring. 1 credit; may be repeated for credit. Limited to 20 students. Primarily for graduate students; priority given to majors in field of genetics. Prerequisite: for undergraduates, written permission of instructor. No auditors. S-U grades only, by permission of instructor. Seminar TBA. Staff.

BIOGD 781(7810) Problems in Genetics and Development
Fall. 2 credits. Prerequisite: first-year graduate students in field of genetics and development. Disc TBA. Staff.
Introduction to the research literature in selected areas through weekly problem sets and discussions.

BIOGD 782–783(7820–7830) Current Genetics/Development Topics
Spring. 0.5 or 1 credit for each topic; may be repeated for credit. S-U grades only. Lec and sem on specialized topics. Staff.

BIOGD 784(7840) Introduction to Quantitative Analysis
Fall. 1 credit. Letter grades only. E. Alani (organizer), A. Clark, C. Bustamante, and M. Goldberg.
The goal of this course is to introduce bioinformatic and probability/statistical tools at an intuitive level that will be meaningful to first-year graduate students in Genetics and Development.

BIOGD 786(7860) Research Seminar in Genetics and Development
Fall and spring. 1 credit. Requirement for, and limited to second-, third-, and fourth-year graduate students in genetics and development. S-U grades only. Staff.
Each graduate student presents one seminar per year based on his or her thesis research. The student then meets with the thesis committee members for an evaluation of the presentation.

BIOGD 787(7870) Seminar in Genetics and Development
Fall and spring. 1 credit. Prerequisite: graduate students in Genetics and Development. S-U grades only. Sem, TBA. Staff.
Seminars in current research in genetics and developmental biology conducted by distinguished visitors and staff.

Related Courses in Other Departments

Advanced Plant Genetics (PL BR 606)

Biosynthesis of Macromolecules (BIOBM 633)

Current Topics in Biochemistry (BIOBM 732–737)

Evolutionary Biology (BIOEE 278)

Laboratory in Molecular Biology and Genetic Engineering of Plants (BIOPL 347)

Laboratory in Plant Molecular Biology (BIOPL 641)

Molecular Biology and Genetic Engineering of Plants (BIOPL 343)

Plant Cytogenetics (PL BR 446)

Plant Genome Organization (PL BR 483.3)

Plant Molecular Biology I (BIOPL 483)

Plant Molecular Biology II (BIOPL 482)

The Nucleus (BIOBM 639)

Undergraduate Research in Biology (BIO G 499)

Molecular Neurobiology BIONB 420/720 (also BIOBM 435/735)

MICROBIOLOGY (BIOMI)

BIOMI 290(2900) General Microbiology Lectures
Fall, spring, or summer (six-week session). 3 credits. Prerequisites: one year introductory biology for majors and one year college chemistry, or equivalent. Highly recommended: concurrent registration in BIOMI 291. W. C. Ghiorse.
Comprehensive overview of the biology of microorganisms, with emphasis on bacteria. Topics include microbial cell structure and function, physiology, metabolism, genetics, diversity, and ecology. Some material may overlap with BIOGD 281 and BIOBM 330. Also covers applied aspects of microbiology such as biotechnology, the role of microorganisms in environmental processes, and medical microbiology. 4-credit option involves one discussion per week led by faculty in the Department of Microbiology and will involve readings and a writing assignment. Students may not pre-register for 4-credit option: Interested students complete an application form on first day of class (enrollment will be limited to 20 students).

BIOMI 291(2910) General Microbiology Laboratory
Fall or spring, summer (six-week session). 2 credits. Pre- or corequisite: BIOMI 290. S. M. Merkel.
Study of the basic principles and techniques of laboratory practice in microbiology, and fundamentals necessary for further work in the subject.

BIOMI 292(2920) General Microbiology Discussion
Spring. 1 credit. Pre- or corequisite: BIOMI 290. S-U grades only. Staff.
Series of discussion groups in specialized areas of microbiology to complement BIOMI 290.

BIOMI 331(3310) General Parasitology (also VETMI 331[3310])
Spring. 2 credits. Prerequisites: one year introductory biology. D. Bowman.
Introduction to the basic animal parasites, stressing systematics, taxonomy, general biology, ecological interactions, and behavior of nonmedically important groups. Introduces the major animal parasites: protozoan, nematode, platyhelminth, acanthocephalan, annelid, and arthropod.

BIOMI 391(3910) Advanced Microbiology Laboratory
Fall. 3 credits. Prerequisites: BIOMI 290, 291, and BIOBM 330 or 331 or 333. Priority given to biological sciences students in microbiology program of study. W. C. Ghiorse, J. P. Shapleigh, and S. H. Zinder.
Illustrates basic principles of experimental microbiology. The course is organized into four modules that last three weeks each: (1) ecology, (2) physiology, (3) genetics, and (4) structure and function. Students are encouraged to take this course during their third year of study.

BIOMI 394(3940) Applied and Food Microbiology (also FD SC 394[3940])
Fall. 2–3 credits. Prerequisites: BIOMI 290–291. C. A. Batt.
For description, see FD SC 394.

[BIOMI 397(3970) Environmental Microbiology (also CSS 397[3970])
Spring. 3 credits. Prerequisites: BIOEE 261 or BIOMI 290 or CSS (SCAS) 260 or permission of instructor. Offered alternate odd-numbered years; next offered 2008–2009. E. L. Madsen.
Discusses the biological properties, evolution, and behavior of microorganisms in natural systems in relation to past and present environmental conditions on Earth and other living planets. Also considers the functional role of microorganisms in ecologically and environmentally significant processes through discussion of specific topics such as nutrient and toxic elemental cycles, transformation of pollutant chemicals, wastewater treatment, environmental biotechnology, and astrobiology.]

BIOMI 404(4040) Pathogenic Bacteriology and Mycology (also VETMI 404[4040])
Spring. 2 or 3 credits; 3 credits with lec and sem. Prerequisites: BIOMI 290 and 291; for undergraduates, permission of instructor. Highly recommended: BIO G 305. Offered alternate even years. D. Debbie.
For description, see VETMI 404.

BIOMI 409(4090) Principles of Virology (also VETMI/PL PA 409[4090])
Fall. 3 credits. Prerequisites: BIOMI 290, 291 or permission of instructor. Recommended: BIOBM 330–332, 432. Letter grades only. G. R. Whittaker and S. G. Lazarowitz.
For description, see VETMI 409.

[BIOMI 414(4140) Prokaryotic Diversity
Spring. 3 credits. Prerequisites: BIOMI 290 and 291. Recommended: BIOBM 330 or 331 or 333. Offered alternate odd-numbered years; next offered 2008–2009. S. H. Zinder.
Consideration of the evolutionary biology, physiology, ecology, genetics, and practical potential of important groups of prokaryotes. Topics include prokaryotic phylogeny, the evolution of diverse mechanisms of energy conservation, fixation of carbon and nitrogen, and adaptation to extreme environments.]

BIOMI 416(4160) Bacterial Physiology
Spring. 3 credits. Prerequisites: BIOMI 290, 291, and BIOBM 330 or 331, or equivalents. Offered alternate even years. J. P. Shapleigh.
Focuses on physiological and metabolic functions of bacteria. Consideration is given to chemical structure, regulation, growth, and energy metabolism. Special attention is given to those aspects of bacterial metabolism not normally studied in biochemistry courses.

BIOMI 418(4180) Microbial Ecology
Spring. 3 credits. Prerequisites: BIOMI 290 and 291, or 398 and permission of instructor, and BIOBM 330 or 331 and 332. E. R. Angert.
Understanding the role of microorganisms in natural environments is one of the greatest challenges facing microbiologists. This course introduces current biochemical and macromolecule sequence-based methods to assess community diversity and microbial activity in a variety of ecosystems. Other topics discussed include bacterial growth and survival, population biology, and microbial interactions.

[BIOMI 420(4200) Microbial Genomics
Spring. 2 credits. Prerequisites: BIOMI 290, BIO G 281, BIOBM 330, or equivalent. Offered alternate odd-numbered years; next offered 2008–2009. J. P. Shapleigh and J. D. Helmann.
Genomic information is revolutionizing biology. This course discusses the impact of genomic information on the study of microbial physiology, evolution, and biotechnology. Topics include both techniques (automated DNA sequencing, assembly, annotation, DNA chips) and applications (genome-wide analysis of transcription, functional genomics).]

BIOMI 431(4310) Medical Parasitology (also VETMI 431[4310])
Fall. 2 credits. Prerequisites: zoology and biology courses. D. Bowman.
For description, see VETMI 431.

BIOMI 482(4640)(Sec 02) Molecular Plant-Microbe Interactions (also BIOPL 482, Sec 02, PL PA 464[4640])
Spring. 1 credit. Prerequisites: BIOGD 281, BIOBM 330 or 331 or 333, and BIOPL 483 (sec 01) or equivalents. S-U or letter grades. Offered alternate even years. S. C. Winans.
For description, see BIOPL 482, Sec 02.

BIOMI 485(4850) Bacterial Genetics (also BIOGD/BIOBM 485[4850])
Fall. 2 credits. Prerequisite: BIOGD 281. Recommended: BIOMI 290 and BIOBM 330 or 331 and 332 or 333. J. E. Peters.
Students gain a detailed understanding of how bacteria maintain and pass on genetic information with a strong focus on the bacterium *Escherichia coli*. They discover the processes by which bacteria evolve through different mutations and the exchange of genetic information. The course explores how genes are regulated efficiently through negative and positive regulation and by global regulatory mechanisms. Upon completion of the course students should understand the tools used to manipulate bacterial genomes for the understanding of bacteria and other living organisms.

BIOMI 610(6100) Introduction to Chemical and Environmental Toxicology (also TOX 610[6100])
Fall. 3 credits. Prerequisite: graduate standing in field or permission of instructor. Letter grades. A. Hay.
Introduction to the general principles of toxicology including the sources, mechanisms, and targets of toxic agents. Gives special attention to the interaction between toxic agents and biological systems at both the organismal and ecological level. The effects of both anthropogenic and natural toxins are examined with respect to genetic and developmental toxicity as well as carcinogenesis and specific organ toxicity.

[BIOMI 651(6080) Genomics of Bacterium-Host Interactions (also PL PA 608[6080])
Fall, second half of semester. 1 credit. Prerequisites: BIOMI 290 or equivalent or permission of instructor. S-U or letter grades. Offered alternate even years; next offered 2008–2009. A. Collmer and S. Winans.
For description, see PL PA 608.]

BIOMI 690 Prokaryotic Biology
Fall and spring. 4 weeks/8 lec. 1 credit per sec to be offered.

Sec 1 Microbial Structure and Function
Fall. J. P. Shapleigh.
Discusses those macromolecules and assemblages of macromolecules that together define the structure of the prokaryotic cell. This includes external structures, such as cell wall, flagella, pili, and peptidoglycan and internal structures such as specialized vesicles and other large complexes.

Sec 2 Environmental Microbiology
Fall. E. L. Madsen.
Core course of concepts, methods, and current literature that reveals the multidisciplinary nature of environmental microbiology and its relationship to prokaryotic biology. Discusses the crucial roles that microorganisms play in catalyzing biogeochemical reactions throughout the biosphere.

Sec 3 Microbial Physiology/Diversity
Fall. S. H. Zinder.
Reviews the major energy-conserving modes of metabolism and their phylogenetic distributions among both bacteria and archaea. Topics include phylogenetic analysis, fermentation, respiration, photosynthesis, pathways of carbon and nitrogen fixation, and evolution of the three domains of life.

Sec 4 Microbial Genetics
Spring. J. D. Helmann.
Reviews the fundamental concepts of microbial genetics including mutations and their analysis, plasmids, conjugation, transformation, transduction, transposition, recombination, repair, and mutagenesis.

Sec 5 Microbial Pathogenesis
Spring. S. C. Winans.
Introduction to the fundamental concepts of bacterial pathogenesis including the normal flora, pathogen entry and colonization, the production and regulation of toxins, horizontal transfer of pathogenesis determinants, and the roles of both specific and nonspecific host defenses. Examples include bacterial pathogens of both animals and plants.

BIOMI 699(6990) Toxicology Journal Club Sec 01—Environmental Toxicology (TOX 6990)
Spring. 1 credit. Required for toxicology students until post A exam. A. G. Hay.

BIOMI 725(7250) Mechanisms of Microbial Pathogenesis (also VETMI 725[7250])
Spring. 3 credits. Prerequisites: for undergraduates, written permission of instructor; BIOMI 404, 409, 417, or equivalent. Highly recommended: completion of two of the three courses. D. Debbie, M. Hesse, H. Marquis, J. Parker, M. Scidmore, and G. Whittaker.
For description, see VETMI 725.

BIOMI 740(6430) Veterinary Perspectives on Pathogen Control in Animal Manure (also VTMED/BEE 740[6430])
Spring, eight weeks. 2 credits. Prerequisite: third- and fourth-year veterinary students. Letter grades only. D. D. Bowman.
For description, see VTMED 740.

BIOMI 791(7910) Advanced Topics in Microbiology
Fall or spring. 1 credit; may be repeated for credit. Prerequisite: graduate standing in microbiology. S-U grades only. Sec 01 Bacterial Genetics, S. C. Winans; Sec 02 Environmental Microbiology, E. R. Angert.
Reading and presentation by graduate students of current literature in selected areas of modern microbiology.

BIOMI 796(7960) Current Topics in Microbiology
Fall and spring. 0.5 or 1 credit for each topic; may be repeated for credit. Primarily for graduate students in microbiology. Prerequisite: upper-level courses in microbiology. S-U grades only. Lec. Staff.
Lectures and seminars on special topics in microbiology.

BIOMI 797(7970) Scientific Communication Skills
Fall and spring. 1 credit each semester. Requirement for graduate students in graduate field of microbiology for first two semesters; third semester optional. S-U grades only. Staff.
The ability to communicate effectively is essential for success as a scientist. The primary goal of this course is to provide students with an opportunity to develop self-confidence and refine their formal oral presentation skills. Students are asked to present topical seminars that are critically evaluated by the instructor. Feedback for improving the presentation and peer evaluations are emphasized.

BIOMI 798(7980) Graduate Research Seminar in Microbiology
Fall and spring. 1 credit each semester. Requirement for graduate students in graduate field of microbiology. S-U grades only. Staff.
All graduate students in the field of microbiology are required to attend and present a seminar concerning their research at least once each year.

BIOMI 799(7990) Microbiology Seminar
Fall and spring. Requirement for all graduate students in graduate field of microbiology. Open to all who are interested. Staff.

Related Courses in Other Departments

Advanced Food Microbiology (FD SC 607)

Advanced Immunology Lectures (BIO G/ VETMI 705)

Advanced Work in Bacteriology, Virology, or Immunology (VETMI 707)

Phytobacteriology Research Updates (PL PA 647)

Basic Immunology, Lectures (BIO G 305, VETMI 315)

Current Topics in Oomycete Biology (PL PA 644)

Food Microbiology, Laboratory (FD SC 395)

Food Microbiology, Lectures (FD SC 394)

Immunology of Infectious Diseases (BIO G 706, VETMI 719)

Introduction to Scanning Electron Microscopy (BIO G 401)

Fungi (PL PA 309)

Light and Video Microscopy for Biologists (BIO G 450)

Limnology: Ecology of Lakes, Lectures (BIOEE 457)

Magical Mushrooms, Mischievous Molds (PL PA 201)

Microbiology for Environmental Engineering (CEE 451)

Plant Virology (PL PA 645)

Principles of Biogeochemistry (BIOEE 668)

The Soil Ecosystem (CSS 366)

NEUROBIOLOGY AND BEHAVIOR (BIONB)

BIONB 111(1110) Brain Mind and Behavior (also PSYCH/COGST 111[1110])
Spring. 3 credits. Prerequisite: none. Intended for freshmen and sophomores in humanities and social sciences; not open to juniors and seniors. Not recommended for psychology majors; biology majors may not use for credit toward major. Letter grades only. Planned M W F 9:05. E. Adkins-Regan and R. R. Hoy.
For description, see COGST 111.

BIONB 221(2210) Neurobiology and Behavior I: Introduction to Behavior
Fall. 3, 4, or 5 credits; 4 credits with one disc per week; 5 credits with two disc per week and participation in Writing in the Majors program; 4- or 5-credit option required of students in neurobiology and behavior program of study. Limited to 15 students per 4-credit disc. Priority given to students studying neurobiology and behavior. Limited to 12 students in 5-credit option (students may not preregister for 5-credit option; interested students complete application form on first day of class). Not open to freshmen. Prerequisite: one year introductory biology for majors. May be taken independently of BIONB 222. S-U or letter grades. Planned M W F 12:20; disc TBA. P. W. Sherman and staff.
General introduction to the field of animal behavior. Topics include evolution and behavior, behavioral ecology, sociobiology, chemical ecology, communication, orientation and navigation, and hormonal mechanisms of behavior.

BIONB 221(2210) Neurobiology and Behavior I: Introduction to Behavior
Summer, six-week session. 3 or 4 credits; 4 credits with one disc per week. Limited to 30 students. Prerequisite: one year introductory college biology. S-U or letter grades. Course fee: none. Planned M–F TBA. Staff.
General introduction to the field of animal behavior. Topics include evolution and behavior, behavioral ecology, sociobiology, chemical ecology, communication, orientation and navigation, and hormonal mechanisms of behavior.

BIONB 222(2220) Neurobiology and Behavior II: Introduction to Neurobiology
Spring. 3 or 4 credits; 4 credits with disc and written projects; 4-credit option required of students studying neurobiology and behavior. Limited to 15 students per disc; priority given to students studying neurobiology and behavior. Not open to freshmen. Prerequisites: one year introductory biology for majors and one year of chemistry. May be taken independently of BIONB 221. S-U or letter grades. Planned M W F 12:20; disc TBA. C. D. Hopkins and staff.
General introduction to the field of cellular and integrative neurobiology. Topics include neural systems, neuroanatomy, developmental neurobiology, electrical properties of nerve cells, synaptic mechanisms, neurochemistry, motor systems, sensory systems, learning, and memory. Some discussion sections include dissections of preserved brains.

BIONB 231(2310) Sophomore Seminar: Topics in Cognitive Studies (also PSYCH 231/531[2310/6331], COGST 531[6331])
Spring. 4 credits. 231 limited to 15 students. Planned M W 2:55–4:10. S. Edelman.
For description, see PSYCH 231.

BIONB 321(3210) State of the Planet
Spring. 2 or 3 credits (3-cr. option includes disc sec). Prerequisites: none. S-U grades only. Planned M W 8:40–9:55; disc TBA. T. Eisner and M. L. Zeeman.
This interdisciplinary course is intended for any student with concern for the global crises we collectively face. During this course you will be introduced to current data and engaged in analysis of those data, establish a global context for your specialized education, and be provided with a toolbox to bring awareness, analysis and action to your lives and careers beyond graduation.

BIONB 322(3220) Hormones and Behavior (also PSYCH 322[3220])
Fall. 3 credits. Limited to 60 students. Prerequisites: junior or senior standing; any one of the following: PSYCH 223 or BIONB 221 or 222 or one year introductory biology plus psychology course. Two lec plus sec in which students read and discuss original papers in the field, give oral presentation, and write term paper. Letter grades only. Graduate students, see PSYCH 722. Planned M W F 11:15. E. Adkins-Regan.
For description, see PSYCH 322.

BIONB 323(3230) Methods in Animal Behavior
Fall. 4 credits. Limited to 24 students. Prerequisite: BIONB 221. Letter grades only. Offered alternate years. Planned M W 1:25–4:25. S. L. Vehrencamp and C. Botero.
This course provides hands-on experience with modern methods for studying animal behavior both in the field and in the laboratory. In-depth class projects will be complemented with a series of shorter workshops and demonstrations. Topics include animal sound recording, field videography radio-tracking, mapping, animal color analysis, capture/marking methods, odor analysis, measuring dominance hierarchies, and behavioral statistics.

[BIONB 324(3240) Biopsychology Laboratory (also PSYCH 324[3240])
Fall. 4 credits. Limited to 18 students. Prerequisites: junior or senior standing; PSYCH 223 or, BIONB 221 or 222, and permission of instructor. Planned T R 1:25–4:25. Letter grades only. Next offered 2008–2009. T. J. DeVoogd.
For description, see PSYCH 324.]

[BIONB 325(3250) Insect Behavior (also ENTOM 325[3250])
Spring. 3 credits. Limited to 55 students. Prerequisite: ENTOM 212 or BIONB 221. Intended for juniors, seniors, and beginning graduate students. S-U or letter grades. Planned T R 10:10–11:25. Offered alternate years; next offered 2008–2009. L. S. Rayor.
For description, see ENTOM 325.]

BIONB 326(3260) The Visual System
Spring. 4 credits. Limited to 25 students. Prerequisite: BIONB 222 or BIOAP 311 or permission of instructor. S-U or letter grades. Planned M W F 10:10; disc TBA. Offered alternate years. H. C. Howland.
The visual systems of vertebrates are discussed in breadth and depth as well as some aspects of invertebrate vision. Topics include the optics and anatomy of eyes, retinal neurophysiology, structure and function of higher visual centers, ocular motility, and ocular and visual system development.

[BIONB 327(3270) Evolutionary Perspectives on Human Behavior
Fall. 3 credits. Limited to 20 students. Prerequisites: BIONB 221 and permission of instructor. Letter grades only. Planned M W 2:55–4:10. Next offered 2008–2009. S. T. Emlen.
Socratically taught, discussion-based course dealing with evolutionary perspectives on human behavior.]

[BIONB 328(3280) Biopsychology of Learning and Memory (also PSYCH 332[3320])
Spring. 3 credits. Limited to 65 students. Prerequisites: one year of biology and either a biopsychology course or BIONB 222. S-U or letter grades. Graduate students, see PSYCH 632. Planned M W F 11:15. Next offered 2008–2009. T. J. DeVoogd.
For description, see PSYCH 332.]

[BIONB 329(3290) Ecology of Animal Behavior (also BIOSM 329[3290])
Summer. 4 credits. Limited to 12 students. Prerequisite: one year introductory college biology. Recommended: ecology, psychology, or behavior course. S-U or letter grades. Special two-week course offered at Shoals Marine Laboratory (SML), located on an island off Portsmouth, N.H. For more details and an application, contact SML office, G14 Stimson Hall. Daily lec, lab, and fieldwork for two weeks. Next offered summer 2009. SML faculty.
For description, see BIOSM 329.]

[BIONB 330(3300) Introduction to Computational Neuroscience (also PSYCH/COGST/BME 330[3300])
Fall. 3 or 4 credits; 4 credits includes lab providing additional computer simulation exercises. Limited to 25 students. Prerequisites: BIONB 222 or permission of instructor. S-U or letter grades. Offered alternate years; next offered 2008–2009. Planned M W 2:55–4:10. C. Linster.
Covers the basic ideas and techniques involved in computational neuroscience. Surveys neural dynamics of networks of cells, neural coding, learning, memory models, sensory coding.]

BIONB 331(3310) Human Sociobiology
Spring. 3 credits. Limited to 100 students. Prerequisite: BIONB 221 or PSYCH 223 or permission of instructor. S-U or letter grades. Planned M W 2:55–4:10. P. Barclay.
Lecture-based course drawing on research in evolutionary biology and animal behavior to investigate various aspects of human social behavior. Findings are presented from areas such as evolutionary psychology, anthropology, human behavioral ecology, and evolutionary game theory. Topics may vary slightly from year to year, but include mating, cooperation (with kin and nonkin), conflict and aggression, parental behavior, costly signaling, and culture.

BIONB 369(3690) Chemical Ecology (also BIOEE/ENTOM 369[3690])
Spring. 3 credits. Prerequisites: one semester of introductory biology for majors or nonmajors and one semester of introductory chemistry for majors or nonmajors or equivalents, or permission of instructor. S-U or letter grades. Planned M W F 11:15. A. Agrawal, G. Jander, A. Kessler, and J. Thaler.
For description, see BIOEE 369.

BIONB 392(3920) Drugs and the Brain
Fall. 4 credits. Limited to 90 students. Prerequisites: BIONB 222 or equivalent course in neurobiology by permission of instructor. Recommended: knowledge of biochemistry. S-U or letter grades. Planned T R 10:10–11:25; disc TBA. Offered alternate years. R. M. Harris-Warrick.
Introduction to neuropharmacology, with an emphasis on the neural mechanisms of psychoactive drugs. Topics include a brief introduction to neuropharmacology and a discussion of the major neurotransmitter families. The rest of the course covers the major psychoactive drugs, including cocaine, heroin, psychedelics, marijuana, and alcohol, as well as pharmaceuticals for the treatment of anxiety, schizophrenia, and depression. Includes a term paper in the form of a grant proposal to study a current problem in neuropharmacology.

BIONB 394(3940) Circadian Rhythms (also BIOGD/ENTOM/PL PA 394[3940])
Fall. 2 or 3 credits. Prerequisite: 200-level biology course. S-U or letter grades. Planned T 10:10–11:00; additional lab R 1:25–4:25 for 3-cr. option. K. Lee.
For description, see PL PA 394.

[BIONB 396(3960) Introduction to Sensory Systems (also PSYCH 396/696[3960/6960])
Spring. 4 credits. Limited to 25 students. Prerequisites: introductory biology or biopsychology, plus second course in behavior, biopsychology, cognitive science, neuroscience, or perception; knowledge of elementary physics, chemistry, and behavior. S-U or letter grades. Planned T R 10:10–11:25. Offered alternate years; next offered 2008–2009. B. P. Halpern.
For description, see PSYCH 396.]

BIONB 413(4130) Molecules of Social Behavior and Emotion
Spring. 3 credits. Prerequisite: permission of instructor. Letter grades only. Planned T R 10:10–11:25. Offered alternate years. D. P. McCobb.
Active-learning course with specific topics to be determined by students. Focuses on molecular, neural, and endocrine mechanisms underlying innate and learned behavior patterns, and their relationship to social, ecological, and evolutionary context. Neurotransmitters, hormones and receptors governing such behaviors as parental care, territoriality, cooperativity, courtship, and stress responses are examples of topics of interest. Format includes library research, oral and written presentations, teamwork, and peer review.

BIONB 420(4200) Topics in Neurobiology and Behavior
Fall or spring. Variable credit; may be repeated for credit. Primarily for undergraduates. S-U or letter grades. Staff.
Courses on selected topics in neurobiology and behavior; can include lecture and seminar courses. See department office (W363 Mudd Hall) for offerings.

BIONB 421(4210) Effects of Aging on Sensory and Perceptual Systems (also PSYCH 431/631[4310/6310])
Fall. 3 or 4 credits; 4-credit option involves term paper or creation of relevant web site. Limited to 35 students. Prerequisites: introductory course in biology or psychology, plus second course in perception, neuroscience, cognitive science, or biopsychology. Planned T R 10:10–11:25. B. P. Halpern.
For description, see PSYCH 431.

BIONB 422(4220) Modeling Behavioral Evolution
Fall. 4 credits. Limited to 25 students. Prerequisites: BIONB 221, one year of calculus, course in probability or statistics, and permission of instructor; advanced undergraduates and graduate students. S-U or letter grades. Planned T R 2:55-4:10; computer lab TBA. Offered alternate years. H. K. Reeve.
Intensive lecture and computer lab course on modeling strategies and techniques in the study of behavioral evolution. Population-genetic (including quantitative-genetic), static optimization, dynamic programming, and game-theoretic methods are emphasized. These approaches are illustrated by application to problems in optimal foraging, sexual selection, sex ratio evolution, animal communication, and the evolution of cooperation and conflict within animal social groups. Students learn to critically assess recent evolutionary theories of animal behavior, as well as to develop their own testable models for biological systems of interest or to extend pre-existing models in novel directions. The Mathematica software program is used as a modeling tool in the accompanying computer lab (no prior experience with computers required).

BIONB 423(4230) Cognitive Neuroscience (also PSYCH 425/625[4250/6250])
Fall. 4 credits. Limited to 20 students Prerequisites: introductory biology; biopsychology or neurobiology (e.g., PSYCH 223 or BIONB 221); and introductory course in perception, cognition, or language (PSYCH 102, 209, 214, or 215 essential). S-U or letter grades. Graduate students, see PSYCH 625. Planned M W F 9:05. One lab in sheep brain dissection. Offered alternate years. B. L. Finlay.
For description, see PSYCH 425.

BIONB 424(4240) Neuroethology (also PSYCH 424[4240])
Fall. 3 credits. Limited to 50 students. Prerequisites: BIONB 221 or 222, or one year introductory biology for majors and permission of instructor. S-U or letter grades. Planned MWF 10:10. Offered alternate years. C. D. Hopkins.
Neuroethologists take a comparative and evolutionary approach to study the nervous system. They ask, how do brains of animals compare and how did they evolve? How are neural circuits adapted to species-typical behavior? What is the hope and interest in the study of a large diversity of animals, compared with a specialized look at just a few mammalian species? Can we hope to understand how animals with specialized behaviors have specialized nervous systems? What is the sensory world of a real animal and how does it vary from species to species? These and other questions derive this introductory survey of neuroethology, including exotic senses, amazing motor programs, and surprising integration.

BIONB 425(4250) Molecular Neurophysiology
Fall. 3 credits. Limited to 20 students. Prerequisite: BIONB 222 or permission of instructor. S-U or letter grades. Planned T R 2:55–4:10. Offered alternate years. D. P. McCobb.
Focuses on ion channels, the primary proteins generating cellular electrical signals in nerve cells and other excitable cells (e.g., muscle, heart, glands). Reviews the latest electrophysiological and molecular genetic experiments. Diversity of electrophysiology deriving from channel structure and expression patterns is considered in the contexts of behavior and behavioral plasticity (learning), neural development, and channel evolution. Format includes written and oral presentations, reviewing scientific literature in selected areas, and proposing new experiments.

BIONB 426(4260) Animal Communication
Spring. 4 credits. Limited to 50 students. Prerequisite: BIONB 221. Letter grades only. Planned T R 2:55–4:10; disc TBA. Offered alternate years. J. W. Bradbury and S. L. Vehrencamp.
Communication is the "glue" that holds societies together. This course examines how and why animals communicate. Topics include the role of the environment in shaping animal signals, whether animals tell the truth to each other, why some bird songs are simple and others complex, and what kinds of signals might be exchanged between species.

[BIONB 427(4270) Animal Social Behavior
Fall. 4 credits. Limited to 30 students. Prerequisites: BIONB 221 and BIOEE 261 or 278, and permission of instructor. Letter grades only. Planned T R 2:30–4:25. Offered alternate years; next offered 2008–2009. P. W. Sherman.
Writing-intensive advanced course for upper-division students. Lectures, discussions, student presentations examine topics in animal behavioral ecology, human sociobiology, Darwinian medicine.]

[BIONB 428(4280) Clinical Neurobiology
Fall. 3 credits. Limited to 20 students. Prerequisites: two courses from BIONB 222, BIOGD 281, BIOBM 330 or 331; co-registration in one of the two is acceptable by permission of instructor. Open to advanced undergraduates. S-U or letter grades. Planned M W 2:30–4:25. Offered alternate years; next offered 2008–2009. R. Booker.
This course focuses on the etiology, epidemiology, cellular and molecular basis, and strategies for treating a number of neurodiseases (e.g., Alzheimer's disease, depression, ADHD).]

[BIONB 429(4290) Olfaction and Taste: Structure and Function (also PSYCH 429[4290])
Spring. 3 or 4 credits; 4-credit option requires term paper. Priority given to junior and senior psychology and biology majors and graduate students. Graduate students, see PSYCH 629. Prerequisite: one 300-level course in biopsychology or equivalent. Planned T R 10:10–11:25. Offered alternate years; next offered 2008–2009. B. P. Halpern.
For description, see PSYCH 429.]

[BIONB 430(4300) Experimental Molecular Neurobiology (also BIOBM 443[4430])
Spring. 4 credits. Limited to 12 students. Corequisite: BIOBM 440 lab. Letter grades only. Planned T all day; disc TBA. Offered alternate years; next offered 2008–2009. D. L. Deitcher.
Experiments include PCR, cloning of DNA fragments, RNA purification, restriction digests, bacterial transformation, DNA sequencing, and protein interactions. Emphasis on molecular techniques to study neurobiological problems.]

BIONB 431(4310) Genes and Behavior
Spring. 3 credits. Limited to 50 students. Prerequisite: BIONB 222. S-U or letter grades. Planned T R 2:55–4:10. Offered alternate years. J. R. Fetcho.
Our genes influence how we behave. This lecture course explores the current understanding of how genes influence the behavior of a variety of animals, including humans. Topics include the genetic basis of hearing, movement, learning, memory, intelligence, sexual behavior, aggression, sleep, and diseases of behavior. The focus is on the unprecedented insight that modern molecular and genetic tools are providing into the genetic basis of behavior.

BIONB 442(4420) Instrumentation for Biology
Fall. 4 credits. Limited to 12 students. Prerequisite: one semester of calculus. Letter grades only. Planned T R 8:40–9:55, lab W 1:25–4:25. B. R. Land.

Introduction to biological electronics, computer interfacing techniques, and data reduction. Gives a basic understanding of the techniques for using electrical recording combined with a computer in a biological context. Examples are drawn from practical neurobiological instrumentation problems and the electronic basis of neural circuitry.

[BIONB 444(4440) Neural Computation
Spring. 3 credits. Limited to 10 students. Prerequisites: BIONB 222 or permission of instructor. S-U or letter grades. Planned T R 2:30–3:20, lab T R 3:35–4:25. Offered alternate years; next offered 2008–2009. T. A. Cleland.
Lecture and computer lab course covering the biophysical mechanisms underlying neural computation and information coding by neurons and networks.]

BIONB 470(4700) Biophysical Methods (also A&EP/VETMM 470[4700])
Fall. 3 credits. Prerequisites: solid knowledge of basic physics and mathematics through sophomore level. Recommended: knowledge of cellular biology. Letter grades only. Planned M W 2:55–4:10. M. Lindau.
For description, see A&EP 470.

BIONB 491(4910) Principles of Neurophysiology (also BME 491[4910])
Spring. 4 credits. Limited to 20 students. Prerequisite: BIONB 222 or written permission of instructor. S-U or letter grades for graduate students by permission of instructor. Planned M W 10:10; lab planned M or T 12:20–4:25. B. R. Johnson.
Laboratory-oriented course designed to teach the theory and techniques of modern cellular neurophysiology including computer acquisition and analysis of laboratory results. Lecture time is used to introduce laboratory exercises and discuss results, to supplement laboratory topics, and to discuss primary research papers. Extracellular and intracellular recording and voltage clamp techniques explore motor neuron and sensory receptor firing properties, and examine the cellular basis for resting and action potentials and synaptic transmission. Invertebrate preparations are used as model systems. See instruct1.cit.cornell.edu/courses/bionb491/index.html.

[BIONB 492(4920) Sensory Function (also PSYCH 492/692[4920/6920])
Spring. 4 credits. Limited to 25 students. Prerequisite: 300-level course in biopsychology, or BIONB 222, or BIOAP 311, or equivalent; knowledge of elementary physics, chemistry, and behavior. S-U or letter grades. Graduate students, see PSYCH 692. Planned M W F 10:10. Offered alternate years; next offered 2008–2009. H. C. Howland and B. P. Halpern.
For description, see PSYCH 492.]

BIONB 493(4930) Developmental Neurobiology
Fall. 3 credits. Limited to 20 students. Prerequisite: BIONB 222 or permission of instructor. S-U or letter grades by permission of instructor. Planned M W 2:55–4:10. Offered alternate years. R. Booker.
Lectures covering the development of the nervous system, taking examples from both vertebrates and invertebrates. Emphasis is on cellular and molecular issues, that is, how do nerve cells differentiate both morphologically and biochemically? The role of cues such as hormones and developmental genes in neural development is discussed. Readings are taken from original journal articles.

BIONB 494(4940) Brain Evolution and Behavior
Spring. 3 credits. Limited to 50 students. Intended for juniors, seniors, and graduate students. Prerequisite: BIONB 222 or equivalent. S-U or letter grades. Planned T R 2:55–4:10. Offered alternate years. A. H. Bass.
Organization and evolution of neuroanatomical pathways as substrates for species-typical vertebrate behaviors. The course is divided into three major sections: development, general principles of brain organization, and co-evolution of vertebrate brain and behavior.

[BIONB 495(4950) Molecular and Genetic Approaches to Neuroscience
Fall. 3 credits. Limited to 25 students. Prerequisites: junior, senior, or graduate standing; BIONB 222 and BIOBM 330 or 332. Letter grades only. Planned T R 2:55–4:10. Offered alternate years; next offered 2008–2009. D. L. Deitcher.
Focuses on how molecular and genetic approaches have led to major advances in neuroscience. Lectures, student presentations, and discussions examine research articles.]

[BIONB 496(4960) Bioacoustic Signals in Animals and Man
Fall. 3 credits. Limited to 12 students. Prerequisites: junior, senior, or graduate standing; one year introductory biology, PHYS 101–102 or 207–208, and permission of instructor. S-U or letter grades. Planned M W 9:05; lab TBA. Offered alternate years; next offered 2008–2009. C. W. Clark and R. R. Hoy.
Teaches students about animal acoustic signaling by introducing them to various animal acoustic systems.]

BIONB 720(7200) Seminar in Advanced Topics in Neurobiology and Behavior
Fall or spring. Variable credit; may be repeated for credit. Prerequisite: graduate standing or permission of instructor. S-U or letter grades. Staff and students.
Designed to provide several study groups each semester on specialized topics. A group may meet for whatever period is judged adequate to enable coverage of the selected topics. Ordinarily, topics are selected and circulated during the preceding semester. Discussion of current literature is encouraged. Suggestions for topics should be submitted by faculty or students to the chair of the Department of Neurobiology and Behavior.

BIONB 721(7210) Introductory Graduate Survey in Neurobiology and Behavior
Fall. 2 credits. Requirement for graduate students majoring in neurobiology and behavior. Concurrent registration in BIONB 221 and 222 not required. S-U grades only. Planned W 4:00–6:00. D. L. Deitcher and staff.
Lectures, readings, and discussion introduce first-year graduate students to the research activities of the faculty in the graduate field of neurobiology and behavior. Class meets weekly for two hours. Students also prepare a research proposal on a potential topic for their thesis research (in the format of an NSF or NIH grant). This proposal is prepared in consultation with one or more relevant faculty members.

Related Courses in Other Departments

Evolutionary Perspectives on Behavior (PSYCH 535)

Biopsychology of Normal and Abnormal Behavior (PSYCH/NS 361)

Developmental Biopsychology (PSYCH 422)

Evolution of Human Behavior (PSYCH 326)

Topics in Biological Anthropology (ANTHR 490)

Primate Behavior and Ecology (ANTHR 390)

Teaching Experience (BIO G 498)

The Brain and Sleep (PSYCH 440/640)

Undergraduate Research in Biology (BIO G 499)

OTS Undergraduate Semester Abroad Programs

Shoals Marine Laboratory Program

Spider Biology (ENTOM 215)

Navigation, Memory, and Context: What Does the Hippocampus Do? (PSYCH 423/623)

PLANT BIOLOGY (BIOPL)

BIOPL 240(2400) Green World/Blue Planet
Fall. 3 credits. S-U or letter grades. Lec. T. Silva.
Focuses on helping individuals understand how scientific information relates to the issues they face as citizens, in management decision making, and in public policy. To what extent should genetic engineering of crop plants be permitted? Should we place limits on fossil fuel consumption as a means of limiting global warming and global climate change? Must human endeavors be restricted in certain areas to maintain diversity? The format of this course is interactive, with lectures and discussions about how we as a society deal with controversial issues.

BIOPL 241(2410) Introductory Botany
Fall. 3 credits. Lec, lab. K. J. Niklas.
Introductory botany for those interested in the plant sciences. Emphasizes structure, reproduction, and classification of angiosperms and the history of life on earth. Laboratory emphasizes development of skills in handling plant materials, including identification. First and second weeks of laboratory are field trips, starting with the first day of classes. *Those who register for an evening laboratory are still required to attend the afternoon field trips.*

BIOPL 242(2420) Plant Function and Growth Lectures
Spring. 3 credits. Primarily for undergraduates in agricultural sciences but also for any biological sciences students wanting to know about plant function; suitable as second-level course for nonmajors to satisfy biology distribution requirement. Prerequisites: one year introductory biology and/or BIOPL 241. Corequisite for plant science undergraduates (and highly recommended for other science majors): BIOPL 244. Recommended: one year

introductory chemistry. May not be taken for credit after BIOPL 342 except by written permission of instructor. S-U or letter grades. Evening prelims. P. J. Davies.

How plants function and grow. Examples deal with crop plants or higher plants where possible, though not exclusively. Topics include cell structure and function; plant metabolism, including photosynthesis; light relations in crops; plant-water relations; water uptake, transport, and transpiration; irrigation of crops; sugar transport; mineral nutrition; growth and development—hormones, responses to light, flowering, fruiting, dormancy, and abscission; stress; tissue culture; and genetic engineering of plants.

[BIOPL 243(2430) Taxonomy of Cultivated Plants (also HORT 243[2430])

Fall. 4 credits. Prerequisite: one year introductory biology or written permission of instructor. May not be taken for credit after BIOPL 248. Lec, lab. Offered alternate years; next offered 2008–2009. M. A. Luckow.

Study of ferns and seed plants, their relationships, and their classification into families and genera, emphasizing cultivated plants. Particular emphasis is placed on gaining proficiency in identifying and distinguishing families and in preparing and using analytic keys. Attention is also given to the economic importance of taxa, to the basic taxonomic literature, and to the elements of nomenclature.]

BIOPL 244(2440) Plant Function and Growth, Laboratory

Spring. 2 credits. Limited to 14 students per sec. Corequisite: BIOPL 242. May not be taken for credit after BIOPL 344. Disc and lab; students must take lab and disc on same day. T. Silva.

Experiments exemplify concepts covered in BIOPL 242 and offer experience in a variety of biological and biochemical techniques, from the cellular to whole plant level.

BIOPL 245(2450) Plant Biology

Summer, six-week session. 3 credits. Limited to 24 students. Lec, lab. T. Silva.

Introductory botany, including plant identification. Emphasizes structure, reproduction, and classification of flowering plants. Much of the laboratory work is conducted outdoors taking advantage of several outstanding natural areas available for study. Those who lack college-level biology are expected to work closely with the instructor on supplemental instructional materials.

[BIOPL 247(2470) Ethnobiology

Fall. 3 credits. S-U or letter grades. Lec, disc. Offered alternate years; next offered 2008–2009. Staff.

Consideration of the principles, methods, and issues of ethnobiology. Emphasis is on the past and present ecological, evolutionary, economic, and cultural interrelationships of humans in traditional and lay societies with their plants and animals, as a means of understanding the place and future of humans in the biosphere. Traditional medicines, underutilized organisms, resource management, and ownership of nature, and methodology are among the topics covered.]

BIOPL 248(2480) Taxonomy of Vascular Plants

Spring. 4 credits. Prerequisite: one year introductory biology. May not be taken for credit after BIOPL 243. S-U or letter grades. Lec, lab. Offered alternate years; not offered 2008–2009. J. I. Davis.

Introduction to the classification of vascular plants, with attention to the goals of taxonomy, the processes of plant evolution, and the means of analyzing evolutionary relationships among plants. The laboratory presents an overview of vascular plant diversity, with particular attention to the flowering plants.

BIOPL 342(3420) Plant Physiology, Lectures

Spring. 3 credits. Prerequisites: one year introductory biology. Corequisite: BIOPL 344 or written permission of instructor. May not be taken for credit after BIOPL 242 unless written permission obtained from instructor. Lec. T. G. Owens.

Integrated and interdisciplinary study of the processes that contribute to the growth, competition, and reproduction of plants. Topics include, but are not limited to, plant-water relations, membrane properties and processes, photosynthesis, plant respiration, mineral and organic nutrition, stress physiology, control of growth and development, and responses to the environment. Emphasis is on the relationship between structure and function from the molecular to the whole-plant level.

BIOPL 343(3430) Molecular Biology and Genetic Engineering of Plants

Spring. 2 credits. Prerequisite: one year general biology or permission of instructor. S-U or letter grades. Lec. M. E. Nasrallah.

Introduction to current studies involving recombinant DNA technology and its application to the improvement of plants. Emphasizes genetic transformation methodology, gene expression systems, and strategies for increasing productivity. The course is directed toward undergraduates who wish to become familiar with the theory and practice of plant biotechnology.

BIOPL 344(3440) Plant Physiology, Laboratory

Spring. 2 credits. Corequisite: BIOPL 342. May not be taken for credit after BIOPL 244. Similar to BIOPL 244 but at more advanced level. Lab, disc. T. Silva.

Experiments exemplify concepts covered in BIOPL 342 and offer experience in a variety of biological and biochemical techniques, from the cellular to whole plant level, with emphasis on experimental design.

BIOPL 345(3450) Plant Anatomy

Fall. 4 credits. Limited to 15 students. Prerequisite: one year introductory biology or a semester of botany. Lec, lab. A. Gandolfo.

Descriptive course with equal emphasis on development and mature structure. Lecture, laboratory, and reading are integrated in a study guide. The laboratory offers the opportunity to develop the practical skills required to make anatomical diagnoses and to write anatomical descriptions.

BIOPL 347(3470) Laboratory in Molecular Biology and Genetic Engineering of Plants

Spring. 2 credits. Limited to 24 students. Prerequisite: BIOPL 343 or permission of instructor. Recommended: concurrent enrollment in BIOPL 343. S-U or letter grades. Lab. M. E. Nasrallah.

Companion to BIOPL 343 with laboratory activities that focus on the practice of plant biotechnology. Students transfer genes to plants by a variety of methods and analyze their expression in the host genome by use of reporter gene assays and by the preparation and analysis of nucleic acids.

BIOPL 348(3480) The Healing Forest

Spring. 2 credits. Prerequisites: introductory biology or plant biology or permission of instructor. Lec/disc. Offered alternate years. E. Rodriguez.

Ethnobotanical and ethnopharmacological consideration of the role of plants, fungi, and insects in traditional and western medicine. Studies of indigenous and lay societies illustrate the ecological, systematic, biochemical, and cultural aspects of herbal medicines and are placed in the broader context of such interdependent themes as the conservation of biological and cultural diversity, human health, bioprospecting, compensation for indigenous knowledge, and sustainable development.

[BIOPL 359(3590) Biology of Grasses

Spring 2 credits. Prerequisite: one year introductory biology or course in plant systematics or permission of instructor. S-U or letter grades. Lec. Lab. Offered alternate years; next offered 2008–2009. J. I. Davis.

Systematics and related aspects of the biology of the graminoid plant families (grasses, sedges, and rushes), with the principal emphasis on grasses. Major topics include phylogenetics, taxonomy, physiology, reproductive biology, speciation, and biogeography. The roles of graminoid plants in natural and human-disturbed environments are discussed, as are the origins of cultivated species.]

BIOPL 380(3800) Strategies and Methods in Drug Discovery

Spring. 2 credits. Prerequisite: one year introductory biology and organic chemistry course or permission of instructor. S-U or letter grades. M. A. Aregullin.

Covers strategies and methodologies in chemotaxonomy, chemical ecology, and ethnobotany, as they are used in chemical prospecting for new pharmaceuticals. Discusses the biosynthesis and distribution of plant secondary metabolites, the use of techniques in isolation and structure elucidation of natural products, and biological assays in the discovery of chemicals with pharmacological activity.

BIOPL 404(4040) Crop Evolution, Domestication and Diversity (also PL BR/IARD 404[4040])

Fall. 2 credits. Prerequisites: BIOGD 281 or PL BR 225 or permission of instructor. S-U or letter grades. Lec. S. Kresovich.

For description, see PL BR 404.

BIOPL 422(4220) Plant Development
Fall. 2 credits. Lec. Prerequisites: course work in molecular biology (e.g., BIOBM 330, 331/332, or 333), and genetics (e.g., BIOGD 281), or permission of instructor. S-U or letter grades. J. Hua.
Introduction to plant development, studying the mechanisms of morphogenesis and cell fate determination at the organismal, cellular, and molecular levels.

[BIOPL 440(4400) Phylogenetic Systematics (also ENTOM 440[4400])
Spring. 4 credits. Limited to 24 students. Prerequisite: introductory biology or permission of instructor. Lec, lab. Offered alternate years; next offered 2008–2009. K. C. Nixon.
Basic and advanced theory and methods of phylogenetic analysis. Introduces students to cladistic analysis using parsimony and gain experience with computer-aided analysis of taxonomic data, including both morphological and molecular data sources. Topics include applications of phylogenetic methods to biogeography and evolutionary studies.]

BIOPL 442(4420) Current Topics in Ethnobiology
Fall. 2 credits. Limited to 12 students. Prerequisite: permission of instructor. S-U or letter grades. Lec/disc. Offered alternate years. Staff.
Explores the interrelationships of plants and animals with humans from a wide range of perspectives. Topics considered are contemporary issues, theory, and methodology of ethnobotany and ethnobiology, and the role of plants and animals in human lives, in subsistence and exchange, and in thought.

BIOPL 443(4430) Topics and Research Methods in Systematics
Fall or spring. 1–2 credits; 1 credit per sec. Prerequisite: written permission of instructor. S-U or letter grades. K. C. Nixon.
Series of 1-credit modules on specialized topics in systematics. Topics and instructors vary each semester. May not be taught every semester. Topics and instructors are listed in the division's catalog supplement issued at the beginning of the semester.

[BIOPL 444(4440) Plant Cell Biology
Fall. 4 credits. Limited to 24 students. Prerequisites: one year introductory biology or permission of instructor. Lec, lab. Next offered 2008–2009. R. O. Wayne.
Uses evidence from microscopy, physiology, biochemistry, and molecular biology to try to unravel the mystery of the living cell. Studies the dynamics of protoplasm, membranes, and the various organelles. The mechanisms of cell growth and division, the relationship of the cytoskeleton to cell shape and motility, the interaction of the cell with its environment, and the processes that give rise to multicellular differentiated plants are investigated.]

BIOPL 447(4470) Molecular Systematics
Fall. 3 credits. Prerequisites: BIOEE 278 or BIOGD 281 or BIOBM 330, or BIOBM 332, or written permission of instructor. Lec. Offered alternate years. J. J. Doyle.
Theory and practice of using molecular evidence, particularly DNA sequence data, for addressing diverse systematic and evolutionary questions. Emphasis is on phylogeny reconstruction, particularly in eukaryotic systems. The organization and evolution of nuclear and organellar genomes is described from the standpoint of their suitability for systematic and evolutionary studies.

[BIOPL 448(4480) Plant Evolution and the Fossil Record
Spring. 3 credits. Prerequisite: BIOPL 241 or equivalent, or permission of instructor. Lec, lab. Offered alternate years; next offered 2008–2009. K. J. Niklas and W. L. Crepet.
Introduction to evolution, surveying major changes in plants from the origin of life to the present. Emphasizes plant form and function, adaptations to particular ecologic settings, and evolutionary theory as it relates to plants.]

BIOPL 449(4490) Green Signals and Triggers—The Plant Hormones (also HORT 449[4490])
Spring. 2 credits. Prerequisite: one year introductory biology and plant physiology (BIOPL 242 or 342) or permission of instructor. S-U or letter grades. Offered alternate years. P. J. Davies.
Study of plant hormones and how they regulate plant growth and development. Topics include the discovery, role in growth and development, mode of action, and practical uses of the plant hormones auxin, gibberellins, cytokinins, abscisic acid, ethylene, and brassinosteroids.

BIOPL 452(4520) Systematics of Tropical Plants
Fall. 3 credits. Prerequisite: BIOPL 243 or 248. Letter grades only. Lec, lab. Offered every three years. K. C. Nixon.
The families of plants encountered solely or chiefly in tropical regions are considered in a phylogenetic context in lectures, discussions, and laboratory, with the aim of providing basic points of recognition for, and an understanding of, diversity and relationships in these families.

BIOPL 453(4530) Principles and Practice of Historical Biogeography (also ENTOM 453[4530])
Fall. 3 credits. Prerequisite: systematics course or permission of instructors. S-U or letter grades. Lec, lab. Offered alternate years. J. K. Liebherr and M. A. Luckow.
For description, see ENTOM 453.

BIOPL 454(4540) Systematics of Tropical Plants: Field Laboratory
Spring. 1 credit. Limited to 15 students. Prerequisite: BIOPL 452 or permission of instructor. Letter grades only. For more details and application, contact L. H. Bailey Hortorium, 467 Mann Library. Offered every three years. K. C. Nixon.
Intensive orientation to families of tropical flowering plants represented in forests of the American Tropics. Emphasis is on field identification combined with laboratory analysis of available materials in a "whole-biology" context. Two-week field trip over winter break.

BIOPL 462(4620) Plant Biochemistry
Spring. 3 credits. Prerequisites: BIOPL 242 or 342 or equivalent and BIOBM 330 or 331 or equivalent or permission of instructor. Letter grades only. Lec. J. Rose and K. Van Wijk.
Focuses on biochemistry of plant specific processes, with the aim to obtain an integrative overview of plant biochemistry. Examples include processes such as cell wall biochemistry, pigment biosynthesis and degradation, secondary metabolism, senescence, defense mechanisms, amino acid biosynthesis, and small molecule transport. Genomics-based experimental tools such as proteomics and metabolomics are discussed.

BIOPL 482 Plant Molecular Biology II
Spring. 1–6 credits; 1 credit per sec. Prerequisites: BIOGD 281 and BIOBM 330 or 332, or equivalents. Recommended: BIOBM 331. S-U or letter grades.
Series of four-week modules on specialized topics. Coordinator: J. B. Nasrallah.

Sec 01 Molecular Plant-Pathogen Interactions I and II (also PL PA 462.1)
1 credit. 12 lec. A. Collmer, S. G. Lazarowitz, G. Martin, and B. G. Turgeon.
Examination of the molecular and cellular factors that control pathogen-plant interactions from the perspectives of pathogen biology and plant responses to pathogen infection. Beginning spring 2004, alternate years focus on: (1) plant perception of microbial pathogens and the interplay of plant defenses and pathogen counterstrategies that result in resistance or susceptibility to disease production, with topics including the genetic nature of dominant and recessive resistance, induction of pathogen defense genes, apoptotic responses that limit infection, and RNA interference; and (2) the genetic and molecular mechanisms of microbial pathogenesis, with an emphasis on fungal and bacterial virulence proteins, toxins, and their deployment systems.

Sec 02 Molecular Plant-Microbe Interactions (also BIOMI 482, Sec 2, PL PA 464)
1 credit. S-U or letter grades. 12 lec. Offered alternate years. S. C. Winans.
Focuses on the interactions of *Agrobacteria* and *Rhizobia* with plants. Topics on *Agrobacterium*-plant interactions include plant-microbe recognition mechanisms, T-DNA transfer process, oncogenesis, and use of *Agrobacterium* to produce transgenic plants. Topics on *Rhizobium*-plant interactions include regulation of nitrogenase activity and expression, organization and function of the *sym* plasmid, nodule development, and plant genetics involved in plant-microbe interaction.

Sec 03 Light Signal Transduction in Plants
1 credit. S-U or letter grades. 12 lec. Offered alternate years. T. Brutnell.
In addition to providing plants with energy for photosynthesis, light plays an essential role in the development of higher plants. Light quality and intensity is carefully monitored by the plant to avoid neighboring vegetation, set the circadian clock, and adjust photosynthesis rates. This course focuses on recent studies that have illuminated the molecular basis of light signal transduction networks in higher plants. Readings are assigned from current literature with an emphasis on those that use genomics tools such as microarray analysis to address fundamental questions in red/far-red and blue light signal transduction.

[Sec 04 Plant Gene Evolution and Phylogeny
1 credit. 12 lec. Offered alternate years; next offered 2008–2009. J. J. Doyle.
Practical applications of molecular systematics/evolution for plant molecular biologists and other non-systematists. The course focuses on two basic issues: methods and principles for inferring relationships among genes and the use of data to hypothesize relationships

among plants. Evolutionary patterns and processes of genes and gene families are discussed, as well as rates of sequence evolution, paralogy and orthology, the effects of recombination and concerted evolution of gene phylogenies, and the implications of using gene or allele phylogenies to infer organismal evolutionary patterns.]

Sec 05 Molecular Biology of Plant Organelles (also BIOGD 452)
1 credit. S-U grades by permission of instructor. 12 lec. M. R. Hanson and D. B. Stern.
Plants contain three different genomes—in the nucleus, chloroplasts, and mitochondria. This course examines the organization, expression, and evolution of plant organelle genomes. Special topics include RNA editing and stability, effects of organelle mutations on plant reproduction and photosynthesis, and chloroplast transformation for expression of useful foreign proteins.

Sec 06 Plant Biotechnology (also PL BR 482.6, PL PA 462.2)
1 credit. S-U or letter grades. 12 lec. E. D. Earle.
Deals with production and uses of transgenic plants for agricultural and industrial purposes. Topics include procedures for gene introduction and control of gene expression, as well as strategies for obtaining transgenic plants that are resistant to insects, diseases, and herbicides, produce useful products, or have improved nutritional and food processing characteristics. Regulatory and social issues relating to plant biotechnology are discussed.

Sec 07 Plant Cell Walls: Structure to Proteome
1 credit. S-U or letter grades. 12 lec. Offered alternate years. J. Rose.
Examines the structure and function of plant cell walls, exploring their dynamic nature and fundamental contribution to numerous aspects of plant growth and development. Topics include wall biosynthesis; wall structure and composition; regulation of cell expansion and differentiation; defense against pathogens and signaling; the apoplast as a metabolically active subcellular compartment; and analytical techniques: from biochemistry to proteomics.

[Sec 08 Plant Imaging
1 credit. 4 weeks. Limited to 12 students. Priority given to graduate students. S-U or letter grades. Offered alternate years; next offered 2008–2009. R. Turgeon.
At some point, most research projects involve structural analysis. This may necessitate hand sectioning, in situ hybridization, electron microscopy, confocal imaging, or any of a host of other possibilities. The key to success is having a proper foundation so that the correct choice of procedures can be made. This course provides an overview of the theory of practical light and electron microscopy focusing on plant tissue preparation, hand and microtome sectioning, staining, optical techniques, histochemistry, and the localization of macromolecules. Students will gain an appreciation of the potentials and limitations of available methods and learn how these methods can be combined to answer specific research questions. The course will consist of six lectures and four two-hour labs, plus a short project.]

BIOPL 483 Plant Molecular Biology I
Fall. 1–5 credits; 1 credit per sec. Prerequisites: BIOGD 281 and BIOBM 330 or 332, or equivalents. Recommended: BIOBM 331. S-U or letter grades. Coordinator: J. B. Nasrallah.
Series of four-week modules on specialized topics.

Sec 01 Concepts and Techniques in Plant Molecular Biology (also PL PA 463.01, PL BR 483.01)
2 credits. Lec. S. R. McCouch, J. Giovannoni, and J. Rose.
Introductory module that provides a broad overview of molecular biology concepts relevant to the plant sciences. Serves as a prerequisite to other modules in the BIOPL 483 (fall) and BIOPL 482 (spring) series. The course is divided into three sections: (1) Gene discovery: covers genetic, molecular, and genomics approaches to the isolation of plant genes; (2) Gene characterization: covers DNA sequence analysis, assessment of gene expression, functional genomics approaches, and production of transgenic plants; (3) Analysis and characterization of proteins and metabolites: includes proteomics approaches to the analysis of plant proteins, protein-protein interactions, and metabolic profiling through emerging metabolomic techniques. This course consists of two lectures and one day of discussion per week. Course material is coordinated with BIOPL 641 (lab). Emphasis is on understanding techniques and approaches appropriate for different experiments and objectives.

Sec 02 Proteomics in Plant Biology
1 credit. S-U or letter grades. 12 lec. K. van Wijk.
Introduction to proteomics and mass spectrometry and its application in plant biology. Includes discussion of protein separation, protein tagging and visualization techniques; principles of biological mass spectrometry and interpretation of spectra; bioinformatics tools in proteomics; comparative proteomics; phosphorylation mapping. Discusses limitations and possibilities of proteomics on plants for which little sequence information is available and experimental papers involving plant proteomics.

[Sec 03 Plant Genome Organization and Function (also PL BR 483.3)
1 credit. 12 lec. Offered alternate years; next offered 2008–2009. S. D. Tanksley.
Covers the structure and variation of plant nuclear genomes, including changes in genome size, centromere/telomere structure, DNA packaging, transposable elements, genetic and physical mapping, positional gene cloning, genomic sequencing and comparative genomics.]

[Sec 04 Molecular Aspects of Plant Development I (also BIOBM 483.4)
1 credit. 12 lec. Next offered 2008–2009. J. B. Nasrallah.
Focuses on the molecular genetics of plant development with an emphasis on plant reproductive biology. Current approaches to the elucidation of the molecular signals and pathways that lead to the establishment of the differentiated state of floral cells and organs are discussed. Topics include cell-cell signalling in the establishment of pattern and functional differentiation of specialized cell types, and the control of developmental pathways by endogenous and external cues. The module is a companion to BIOPL 482, Sec 02 (Molecular Plant-Microbe Interactions).]

Sec 05 Molecular Breeding (also PL BR 483.5)
1 credit. 12 lec. Offered alternate years. S. D. Tanksley.
Application of DNA markers to the identification, manipulation, and isolation of genes important to plant and animal productivity using molecular genetic techniques. Students learn how to design and execute experiments to identify quantitative trait loci (QTLs), as well as how to apply molecular markers to plant and animal breeding programs.

Sec 06 Plant Senescence (also HORT 625.2)
1 credit. S-U or letter grades. (12 lec). S. Gan.
Introduces molecular, genetics, and genomics approaches in plant senescence and postharvest research. Topics include gene expression, regulation, and function associated with physiological and biochemical changes in senescing, maturing, and/or ripening plants or parts. Genetic manipulation of senescence/ripening processes are also discussed.

BIOPL 641(6410) Laboratory in Plant Molecular Biology (also BIOBM 641[6410])
Fall. 4 credits. Prerequisites: BIOGD 281 or equivalent, BIOBM 330 or 331 or equivalent, and permission of instructor. S-U grades by permission of instructor. Lab. M. R. Hanson, H. Wang, T. Brutnell, G. Jander, J. Hua, M. Scanlon, and K. van Wijk.
Includes selected experiments on gene expression, biolistic transformation, confocal microscopy, laser capture microdissection, microarray analysis, genetic mapping and mutant analysis, transposon tagging, proteomics, and metabolite analysis.

[BIOPL 642(6420) Plant Mineral Nutrition (also CSS 642[6420])
Spring. 3 credits. Prerequisite: BIOPL 342 or equivalent. Lec. Offered alternate years; next offered 2008–2009. L. V. Kochian and R. M. Welch.
Detailed study of the processes by which plants acquire and use mineral nutrients from the soil. Topics include the uptake, translocation, and compartmentation of mineral elements; root-soil interactions; the metabolism of mineral elements; the involvement of mineral nutrients in various physiological processes; and the nutrition of plants adapted to extreme environmental stresses (e.g., acid soils). Specific mineral elements are emphasized to illustrate these topics.]

BIOPL 647(6470) Systematic Biology Journal Club
Fall or spring. 1 credit; may be repeated for credit. Intended for graduate students and advanced undergraduates in systematic biology. S-U grades only. Disc TBA. Bailey Hortorium staff.
Discussions led by staff, visitors, and students on topics of current importance to systematic biology.

[BIOPL 649(6490) Solute Transport in Plants (also BEE 649[6490])
Fall. 3 credits. Letter grades only. Lec. Offered alternate years; next offered 2008–2009. R. M. Spanswick.
For description, see BEE 649.]

BIOPL 651(6510) Water Transport in Plants (also BEE 647[6470])
Fall. 2 credits. Letter grades only. Lec. Offered alternate years. R. M. Spanswick.
For description, see BEE 647.

BIOPL 654(6540) Botanical Nomenclature
Fall. 1 credit. Prerequisite: written permission of instructor. S-U grades only. Lec and disc. Offered alternate years. M. A. Luckow.
Analysis of the International Code of Botanical Nomenclature and its application to various plant groups.

BIOPL 656(6560) Topics in Plant Evolution
Spring. 1 credit. Prerequisite: BIOPL 448 or equivalent background in evolution, or written permission of instructor. Lab and disc. Offered alternate years. K. J. Niklas.
Series of selected topics to provide a background in plant evolution, paleobotanical literature, and evolutionary theory. Among the topics discussed are the origin of a terrestrial flora, the evolution of the seed plants, and the origin and adaptive radiation of the angiosperms.

BIOPL 740(7400) Plant Biology Seminar
Fall and spring. 0 credits (no official registration). Requirement for graduate students doing work in plant biology. W. L. Crepet.
Lectures on current research in plant biology, presented by visitors and staff.

BIOPL 741(7410) Problems in Plant Cell and Molecular Biology
Spring. 2 credits. Prerequisite: first- and second-year graduate students in Plant Cell and Molecular Biology Program. Disc.
Introduction to the research literature in plant molecular and cellular biology through weekly problem sets and discussions.

BIOPL 742(7420) Current Papers in Plant Biology
Fall or spring. 1 credit. Limited enrollment. Primarily for graduate students, with priority given to majors or minors in plant molecular biology. Prerequisite: for undergraduates, written permission of instructor. S-U grades only. Sem. Staff.

BIOPL 743(7430) Faculty Research in Plant Cell and Molecular Biology
Fall. 1 credit. Prerequisite: graduate standing or written permission from member of Plant Cell and Molecular Biology Program or from coordinator for undergraduates. Disc TBA. Staff.
Introduction for graduate students to the research being conducted by Cornell faculty in the Plant Cell and Molecular Biology Program.

BIOPL 744(7440) Graduate Research in Plant Cell and Molecular Biology
Fall or spring. 1 credit. Requirement for, and limited to, second-, third-, and fourth-year graduate students in Plant Cell and Molecular Biology. Sem. Staff.
Each student presents one seminar per year on his or her thesis research and then meets with the thesis committee members for evaluation.

BIOPL 745(7450) Seminar in Systematic Botany
Fall. 1 credit. Prerequisite: graduate standing or permission of instructor. S-U grades only. Sem. Bailey Hortorium staff.
Seminar with student presentations of current topics in systematics.

BIOPL 746(7460) Seminar in Systematic Botany: Student Research
Spring. 1 credit. Prerequisite: graduate standing or permission of instructor. Letter grades only. Sem. Bailey Hortorium staff.
Student-led seminar presentation based on his or her thesis research or a related topic.

BIOPL 749(7490) Graduate Research in Botany
Fall or spring. Variable credit; may be repeated for credit. S-U or letter grades. Staff.
Similar to BIO G 499 but intended for graduate students who are working with faculty members on an individual basis.

Related Courses in Other Departments

Current Topics in Plant Molecular Ecology (BIOEE 675)

Fungi (PL PA 309)

Seaweeds, Plankton, and Seagrass: The Ecology and Systematics of Marine Plants (BIOSM 449)

Fungal Biology (PL PA 649)

Physiological Plant Ecology, Lectures and Laboratory (BIOEE 466/468)

Plant Behavior–Induced Plant Responses to Biotic Stresses (BIOEE 446)

Plant Cytogenetics Laboratory (PL BR 446)

Teaching Experience (BIO G 498)

Undergraduate Research in Biology (BIO G 499)

COURSES IN MARINE SCIENCE

Cornell offers an extensive listing of undergraduate courses in marine science.

Undergraduates interested in pursuing studies in marine science are encouraged to explore the undergraduate specialization in marine biology offered through the Office of Undergraduate Biology, the undergraduate specialization in ocean sciences offered through the Science of Earth Systems Program, and the summer program of courses offered by the Shoals Marine Laboratory. Further information on these programs can be found at the Cornell Marine Programs Office, G14 Stimson Hall, or at www.sml.cornell.edu.

Undergraduate Specialization in Marine Biology and Oceanography

Biological sciences majors in the Ecology and Evolutionary Biology program of study have the option of specializing their program of study in the area of Marine Biology. This specialization is intended for students with interests in understanding the unique aspects of organismal biology in the marine environment. In addition to fulfilling the major and the ecology and evolutionary biology program of study requirements, students in marine biology are encouraged to enroll in the following courses:

1. BIOEE 154 The Sea: An Introduction to Oceanography
2. BIOSM 364 Field Marine Science or BIOSM 375 Field Marine Biology and Ecology and at least one 400-level BIOSM field course at the Shoals Marine Laboratory
3. BIOEE 462 Marine Ecology

Undergraduate Specialization in Ocean Sciences

Science of Earth Systems majors have the option of specializing their program of study in the area of ocean sciences. This interdisciplinary specialization is intended for students with interests in understanding the interaction of biological, chemical, geological, and physical processes in ocean systems. In addition to fulfilling the Science of Earth Systems general requirements (see the SES program description in Interdisciplinary Centers, Programs, and Studies section of catalog), students in ocean sciences are required to take four advanced courses from the following list to fulfill their major requirements:

1. BIOEE 373 Biology of the Marine Invertebrates
2. BIOEE 457 Limnology
3. BIOEE 462 Marine Ecology
4. BIOEE 478 Ecosystem Biology
5. BIOEE 490 Topics in Marine Biology
6. BIOSM 377 Diversity of Fishes
7. BIOSM 310 Marine Symbiosis
8. BIOSM 309 Climates and Ecosystems
9. BIOSM 329 Ecology of Animal Behavior
10. BIOSM 364 Field Marine Science
11. BIOSM 365 Underwater Research
12. BIOSM 374 Field Ornithology
13. BIOSM 375 Field Marine Biology and Ecology
14. BIOSM 413 Research in Marine Biology
15. BIOSM 449 Seaweeds, Plankton and Seagrass
16. BIOSM 376 Marine Invertebrate Zoology (Note: Not same as BIOEE 373)
17. BIOSM 477 Marine Vertebrates
18. EAS 375 Sedimentology and Stratigraphy
19. EAS 455 Geochemistry
20. EAS 475 Special Topics in Oceanography
21. EAS 479 Paleobiology

Sea Semester

BIOSM 366 SEA: Introduction to Oceanography

BIOSM 367 SEA: Introduction to Maritime Studies

BIOSM 368 SEA: Introduction to Nautical Science

BIOSM 369 SEA: Practical Oceanography I

BIOSM 370 SEA: Practical Oceanography II

BIOSM: 372 SEA: Practical Oceanography III

BIOSM 378 SEA: Oceans and Climate: Oceans in the Global Carbon Cycle

BIOSM 379 SEA: Ocean Science and Public Policy

BIOSM 380 SEA: Oceanographic Field Methods

BIOSM 381 SEA: Independent Research in Oceans and Climate

BIOSM 362 SEA: Maritime History and Culture

BIOSM 371 SEA: Marine Environmental History

Students in both marine science specializations are exposed to an integrated program of study, emphasizing a natural progression of formal course work combined with ample opportunities for practical field experience.

These courses must be taken concurrently. Special program run by the Sea Education Association. Contact the Marine Programs office (255–3717) for more details.

SHOALS MARINE LABORATORY (BIOSM)

G14 Stimson Hall, 255–3717

The objective of the Shoals Marine Laboratory (SML) is to provide undergraduates and other interested adults a unique opportunity to explore marine sciences in an island setting noted for its biota, geology, and history. SML has established a national reputation for excellence and has become North America's largest marine field station focusing on undergraduate education.

The summer population of Appledore Island is limited to about one hundred people at any one time. Participants and faculty members can literally and figuratively immerse themselves in their explorations, free from distractions common to most academic institutions. Because SML is a residential facility, a sense of community develops that makes courses and seminars at SML outstanding educational and intellectual experiences. Participants learn from and exchange ideas with a wide range of specialists whose primary interests are marine but whose perspectives often differ, providing fertile ground for lively discussions.

Credit courses at Shoals Marine Laboratory are full-time, intensive learning experiences. Courses may be taken sequentially, but **not** concurrently. A typical day combines lecture sessions, laboratory and field work, field trips to nearby islands and the mainland, and collecting and research excursions aboard the laboratory's 47-foot research vessel, *John M. Kingsbury*, or the 36-foot research vessel, *John B. Heiser*. Field experience is an integral component of all courses, using Appledore's extensive intertidal and subtidal zones, wading bird rookeries, and seabird colonies. Faculty, drawn from Cornell University, the University of New Hampshire, and other leading academic institutions, are selected based not only on their academic excellence but also on their teaching ability in the field. In addition, there are numerous guest lecturers including engineers, coastal planners, and specialists from private industry, government, and the academic community.

The Ithaca campus functions of the Shoals Marine Laboratory are centered in the Cornell Marine Programs office, G14 Stimson Hall. The office serves as an advising center for students interested in the marine sciences, maintains a browsing library with updated information on graduate study and career opportunities as well as on marine programs at other institutions, and administers the SEA Semester, a 17-credit program offered in cooperation with the Sea Education Association (SEA).

The following marine sciences courses are currently administered by the Cornell Marine Programs Office. (Not all of these courses are offered each semester; consult the SML web site for current offerings: www.sml.cornell.edu.)

BIOSM 111(1110) A Marine Approach to Introductory Biology

Summer. 8 credits. Prerequisite: score of 4 or higher on AP Biology Exam (which fulfills introductory biology requirement for biology majors). W. E. Bemis and J. B. Heiser.

A four-week course for pre-freshmen at Shoals Marine Lab on Appledore Island in the Gulf of Maine including daily fieldwork, boat trips, outdoor adventure, and practices for sustainable living. Intensive lectures, laboratory, and fieldwork occur in a learning environment emphasizing individual skill building, project design and execution, and collaboration with faculty and peers. We explore four major themes—ecology, behavior, development, and genomics—and connect them using examples from evolution. Social issues discussed range from global environmental change to sustainable fisheries, emerging infectious diseases, and stem cell research.

BIOSM 123(1230) Ocean Sciences

Summer. 4 credits. Prerequisite: permission of instructor. Letter grades only. D. Taylor.

An inquiry-based, hands-on introduction to marine biology using the rocky intertidal and open sea as a natural laboratory. Students will learn the skills necessary for success in science courses: understanding disciplinary discourse; reading scientific papers critically; generating scientific hypotheses; designing experiments and interpreting data using basic statistics; and constructing, presenting and understanding data in graphs and tables. Students will learn and apply these skills to field exercises centered on textbooks, primary literature, lectures, seminars and discussions.

BIOSM 160(1600) The Oceanography of the Gulf of Maine

Summer. 4 credits. Limited to 24 students. Special two-week course offered aboard a SEA vessel and at Shoals Marine Laboratory (SML), located on an island off Portsmouth, N.H. For more details or an application, contact SML office, G14 Stimson Hall or Sea Education Association office, P.O. Box 6, Woods Hole, MA 02543. Daily lec, lab, and fieldwork for two weeks. SML faculty.

Exciting opportunity to explore the offshore and near-coastal environments of the Gulf of Maine for advanced high school students. Students spend 10 days aboard the Sea Education Association's sailing vessels round trip between Woods Hole, Mass., and the Isles of Shoals via Georges Bank and the Gulf of Maine. Besides operating the ship, students study the many characteristics of this unique ocean environment. Following the sea component, students spend seven days at the Shoals Marine Laboratory collecting data characteristic of the Isles of Shoals coastal environment.

BIOSM 161(1610) Introduction to Marine Science

Summer. 4 credits. S-U or letter grades. Special two-week course offered at Shoals Marine Laboratory (SML), located on an island off Portsmouth, N.H. For more details or an application, contact SML office, G14 Stimson Hall. Daily lec, lab, and fieldwork for two weeks.

Allows students who are not biology majors to experience the breadth of the marine sciences under field conditions at an island laboratory. Aspects of biology, geology, earth science, chemistry, and physics are included. Specific topics include beach, salt marsh, tidal mud flat, tide pool, and benthic offshore environments; identification of marine plants and animals; chemical and physical oceanography; marine geology; and ecology of kelp beds and urchin barrens.

BIOSM 162(1620) Marine Environmental Science

Summer. 4 credits. Prerequisite: open to high school students who have successfully completed two high school science courses. Special two-week course offered at Shoals Marine Laboratory (SML), located on an island off Portsmouth, N.H. For more details or an application, contact SML office, G14 Stimson Hall. Daily lec, lab, and fieldwork for 14 days. SML faculty.

Environmental studies have become an integral component of high school programs all around the country; however, opportunities to apply this course work to the marine environment are limited. Marine Environmental Science focuses on coastal marine habitats, with an emphasis on issues as they relate to global habitats and concerns. Laboratory exercises and fieldwork include explorations along Appledore Island's rocky intertidal zone and excursions to neighboring islands to observe harbor seal and seabird colonies. Offshore cruises include oceanographic sampling exercises and field trips to seabird and whale foraging grounds. Lectures and discussions expose MES students to topics ranging from fishes to fisheries, seaweeds to lobsters, and plankton to whales. Fundamental scientific research methods and equipment are introduced, and each student has the opportunity to be involved in group research projects.

BIOSM 204(2040) Biological Illustration

Summer. 2 credits. Special one-week course offered at Shoals Marine Laboratory (SML), located on an island off Portsmouth, N.H. For more details or an application, contact SML office, G14 Stimson Hall. Daily sessions for one week. SML faculty.

General discussion of scientific publishing, illustration labeling, color techniques, and printing processes. Provides the scientist or science student a chance to experience several illustration techniques with the goal of obtaining an overview of scientific and wildlife illustrations. The student may choose a single technique to explore in depth. Course size is limited so that individual attention can be emphasized.

BIOSM 210(2100) Boats for Biologists

Summer. 2 credits. S-U or letter grades. W. E. Bemis.

Marine and freshwater biologists rely on boats—small and large—for transportation, environmental sampling, data collection, and other tasks. This course offers biologists at all stages of their careers a chance to learn basic boat handling, piloting, navigation, and common sampling techniques to enhance their opportunities for research and education. This course meets all certification requirements for basic small boat handling by state-specific agencies and National Association of Boating Law Administrators.

BIOSM 225(2250) Sustainability in the 21st Century
Summer. 4 credits. W. E. Bemis.
Students will consider the challenges of institutionalizing sustainability. Through guest lectures and fieldwork, they will grapple with challenges inherent to the field, devising strategies to enhance sustainability on Appledore Island. Topics include: systems thinking, food and fisheries, engineering and energy, and climate science.

BIOSM 276(2760) Seabird Conservation
Summer. 2 credits. J. Ellis.
Combines lectures from specialists (e.g., ecologists and wildlife veterinarians) with a variety of field-based activities related to seabird ecology and conservation. Topics will include: seabird identification, behavioral studies, census techniques, population threats (e.g., fisheries bycatch, pollution), and restoration. A field trip to a nearby seabird restoration island will be included.

BIOSM 308(3080) Field Microbial Ecology
Summer. 4 credits. Prerequisite: introductory biology or permission of instructor. E. Zettler and L. A. Zettler.
The microbial world dominates the biosphere in terms of biomass, diversity, and metabolic flexibility. This course will introduce students to collecting, observing, and identifying live representatives of these fascinating microbial organisms including bacteria, protists, fungi, and microscopic animals. Taxonomy and ecology of the basic groups of microorganisms will be covered while students learn to collect in the field for observation, experimentation and isolation.

BIOSM 309(3090) Coastal Ecology and Bioclimates
Summer. 4 credits. Prerequisite: one year college-level biology; background preferred in physics/physical geography. S-U or letter grades. Special two-week course offered at Shoals Marine Laboratory (SML), located on an island off Portsmouth, N.H. For more details or an application, contact SML office, G14 Stimson Hall. Daily lec, lab, and fieldwork for two weeks. SML faculty.
Study of the fundamentals of organism-environment interaction developed through defining and measuring abiotic factors including solar radiation, temperature, atmospheric moisture, precipital wind, and currents. On-site exploration of the dynamics of meteorology and the role of abiotic and biotic factors in the life of coastal and marine plants and animals including humans.

BIOSM 310(3100) Marine Symbiosis
Summer. 4 credits. Prerequisite: one full year college-level biology. Recommended: background in microbiology or cell biology. S-U or letter grades. Special two-week course offered at Shoals Marine Laboratory (SML), located on an island off Portsmouth, N.H. For more details or an application, contact SML office, G14 Stimson Hall. Daily lecs and fieldwork for two weeks. SML staff.
Introduction to the concepts of symbiosis as applied to marine organisms, with an emphasis on microbial symbionts. Students develop the ability to analyze symbioses using a comprehensive set of criteria, including duration, propagation, specificity, integration and modes of interaction. Morning lectures are followed by afternoons collecting, preparing and studying live specimens. Each student learns to use a variety of light microscopic techniques, and contributes, through fieldwork and by written reports, to a comprehensive survey of symbiotic associations on and around Appledore Island.

BIOSM 312(3120) Biology of the Lobster
Summer. 2 credits. Prerequisite: one year of college level biology. J. Factor.
An introduction to the biology of the American lobster, *Homarus americanus*. The course will include an overview of this ecologically and economically important species, as well as cover several major topics in depth, each taught by a lobster biologist expert in that field. Topics may include life history, larval development and metamorphosis, anatomy, physiological adaptation, fisheries and fishing methods, feeding mechanisms, ecology, and behavior. Course will include lecture, laboratory, discussion, and the natural field environment of Appledore Island.

BIOSM 320(3200) Functional Morphology of Marine Organisms
Summer. 4 credits. Prerequisite: one year introductory biology or one semester introductory biology, general zoology, and general botany. F. Fish.
A study of the structure, form, and function of morphological adaptations in marine plants and animals as examined through a mechanical and ecological perspective. The course will investigate the biomechanics of marine organisms through lecture, laboratory demonstrations, and independent research projects.

BIOSM 329(3290) Ecology of Animal Behavior (also BIONB 329[3290])
Summer. 4 credits. Prerequisite: one year introductory college biology. Recommended: course work in ecology, psychology, or behavior. S-U or letter grades. Special two-week course offered at Shoals Marine Laboratory (SML), located on an island off Portsmouth, N.H. For more details and an application, contact SML office, G14 Stimson Hall. Daily lec, lab, and fieldwork for two weeks. SML faculty.
The ecological significance of behaviors of coastal organisms, with emphasis on field and laboratory research methods. Lectures and readings address the major subareas of behavior (communication, orientation, social behavior, foraging, predator avoidance, and sensory mechanisms). Each student engages in short-term behavioral observation and prepares a research proposal for studying a problem within the course subject area.

BIOSM 364(3640) Field Marine Science (FMS)
Summer. 8 credits. Prerequisite: one year college biology. S-U or letter grades. Special four-week course offered twice each summer at Shoals Marine Laboratory (SML), located on an island off Portsmouth, N.H. Students may not take FMS after taking FMBE (BIOSM 375). For more details or an application, contact SML Office, G14 Stimson Hall. Daily lec, lab, and fieldwork for four weeks. Three core faculty members assisted by up to 15 visiting lecturers, including representatives of governmental agencies. SML faculty.
Designed for the student who desires an initial overview of the marine sciences, this course emphasizes living material in natural habitats. Most of the course work is concerned with the biology of intertidal plants and animals, biological oceanography, ichthyology, and fisheries. Attention is also given to introductory physical and chemical oceanography and marine geology. Marine ecology and the effects of human activity on the marine environment are included. Students apply this knowledge by conducting a transect study toward the end of the course. FMS places emphasis on ichthyology, fisheries biology, general oceanography (biological, physical, and chemical), and marine geology. FMBE (BIOSM 375) places an additional emphasis on ecology, especially in the intertidal zone; ecological, evolutionary and physiological adaptations of marine organisms; and field experiments.

BIOSM 365(3650) Underwater Research
Summer. 4 credits. Prerequisites: one year college-level biology, recognized SCUBA certification, and medical exam. S-U or letter grades. Special two-week course offered at Shoals Marine Laboratory (SML), located on an island off Portsmouth, N.H. For more details or an application, contact SML office, G14 Stimson Hall. Daily lec and fieldwork for two weeks.
Covers the philosophy of research, hypothesis testing and experimental design, sampling methods, various underwater techniques, diving physics and physiology, and use of dive tables. Emphasizes subtidal ecological research. Requirements include critical evaluation of several journal articles and production of a research proposal.

BIOEE 373(3730) Biology of the Marine Invertebrates
Fall (but course must be taken previous summer at Shoals Marine Laboratory [SML]), three-week, full-time course. 5 credits (students enroll for credit during fall semester). Limited to 24 students. Prerequisites: one year introductory biology for majors; permission of faculty because off campus. Letter grades only. Daily and evening lec, lab, and fieldwork. Offered alternate years. C. D. Harvell and J. G. Morin.

BIOSM 374(3740) Field Ornithology
Summer. 4 credits. Prerequisite: one year college-level biology. S-U or letter grades. Special two-week course offered at Shoals Marine Laboratory (SML), located on an island off Portsmouth, N.H. For more details or an application, contact SML office, G14 Stimson Hall. Daily lec and fieldwork for two weeks. SML faculty.
Introduction to field ornithology focusing on the biology, ecology, and behavior of the avifauna on the Isles of Shoals. Focuses on fieldwork designed to observe and study many concepts frequently taught in the classroom setting including territoriality, breeding biology, and survivorship. Students learn and apply numerous ornithological field methods including various census techniques, territory mapping, banding, behavioral observations, and creating a field notebook.

BIOSM 375(3750) Field Marine Biology and Ecology (FMBE)
Summer. 8 credits. Prerequisites: one full year college-level biology. S-U or letter grades. Four-week course offered at Shoals Marine Laboratory (SML), located on an island off Portsmouth, N.H. For more details or an application, contact SML office, G-14 Stimson Hall. Daily lec, lab, and fieldwork for four weeks. SML faculty.

Designed for students seeking an introduction to the marine sciences and marine ecology; FMBE emphasizes fieldwork in natural habitats. Examines aspects of the biology and ecology of marine organisms, including intertidal plants and invertebrates, fishes, marine mammals and birds, biological oceanography, and human impacts on the marine environment. FMBE places a special emphasis on the ecology of the intertidal zone and ecological, evolutionary, and physiological adaptations of marine organisms. Students may not take FMBE after taking FMS (BIOSM 364).

[BIOSM 376(3760) Marine Invertebrate Zoology

Summer. 6 credits. Prerequisite: one year introductory biology and permission of instructors. Students may not take BIOSM 376 after taking BIOEE 373. S-U or letter grades. Special three-week course offered at Shoals Marine Laboratory (SML), located on an island off Portsmouth, N.H. For more details or an application, contact SML office, G14 Stimson Hall. Daily lec, lab, and fieldwork for three weeks. Offered alternate years; offered summer 2008. SML faculty.

Introduction to the biology and evolution of the major invertebrate phyla, concentrating on marine representatives. Emphasizes the evolution of form and function, and the ecology, behavior, physiology, chemical ecology, and natural history of invertebrates. Appledore Island's unique location provides an excellent venue for the study of freshly collected and *in situ* representatives of most of the major phyla.]

BIOSM 377(3770) Diversity of Fishes

Summer. 6 credits. Prerequisite: one full year college-level biology. Recommended: background in vertebrate biology. S-U or letter grades. Special two-week course offered at Shoals Marine Laboratory (SML), located on an island off Portsmouth, N.H. For more details or an application, contact SML office, G14 Stimson Hall. Daily lecs and fieldwork for two weeks. SML staff.

Intensive lecture, laboratory, and field course. Lectures cover the basic anatomy and physiology of fishes with examples drawn from a wide variety of fishes from throughout the world. The course emphasizes the diversity of fishes in two aspects, diversity of evolutionary solutions to problems faced by fishes and the great diversity of different types of fishes that inhabit the world. Laboratory exercises cover the anatomy and osteology of teleost fishes and identification of local species. Each student selects a different local species of teleost fish to study and dissect and prepares a comprehensive paper on its morphology, soft anatomy, and osteology.

BIOSM 410(4100) The Herring Gull's World

Summer. 2 credits. Prerequisite: introductory biology. T. Seeley, P. Sherman, and J. Shellman Sherman.

An introduction to the study of animal behavior in the field by focusing on the behavior of the herring gulls nesting on Appledore Island. Topics will include natural selection and behavior, levels of analysis, animal communication, territoriality, kin recognition, orientation, and mating systems. *The Herring Gull's World*, the classic book of Nobel Laureate Niko Tinbergen, will be read and discussed. Methods of measuring behavior and designing experiments will be taught, and students will conduct individual research projects.

BIOSM 413(4130) Research in Marine Biology

Summer. 6 credits. Prerequisite: one year college-level biology. Recommended: experience in ecology or physiology. S-U or letter grades. Special three-week course offered at Shoals Marine Laboratory (SML), located on an island off Portsmouth, N.H. For more details or an application, contact SML office, G14 Stimson Hall. Daily lec, lab, and fieldwork for three weeks. SML faculty.

Introduction to the physiological ecology and functional morphology of marine plants and animals, with emphasis on selected algal and invertebrate examples from the Gulf of Maine. Topics include photosynthesis in the marine environment; respiration in intertidal organisms; carbohydrates, proteins, and lipids as nutrients in the sea; acclimation and tolerance of tide-pool biota; and biological responses to competition and grazing. Field and laboratory exercises explore principles and procedures used to characterize the physical, chemical, and biotic environment of intertidal and shallow subtidal organisms, including determination of temperature, light, salinity, oxygen and nutrient levels, and *in vivo* functional analyses of metabolic phenomena. The process of scientific investigation is the predominant theme of the course.

BIOSM 445(4450) Forensic Science for Marine Biologists

Summer. 2 credits. Prerequisite: satisfactory completion of college-level course in biology, ecology, or marine science. W. Lord.

Forensic science represents the unique merging of scientific insight and the law. Forensic Science for Marine Biologists provides a field-oriented introduction to the forensic science domain and the utilization of marine biology within the justice system. Students receive comprehensive instruction concerning the recognition, documentation, collection, and preservation of physical evidence. Additionally, students develop practical incident response, scene management, and forensic teamwork skills.

BIOSM 449(4490) Seaweeds, Plankton, and Seagrass: The Ecology and Systematics of Marine Plants

Summer. 4 credits. Prerequisite: BIOSM 364 or one year introductory biology. S-U or letter grades. Special two-week course offered at Shoals Marine Laboratory (SML), located on an island off Portsmouth, N.H. For more details or an application, consult SML office, G14 Stimson Hall. Daily lec, lab, and fieldwork for two weeks. SML faculty.

Overview of the major marine algal groups, including aspects of anatomy, morphology, development, life histories, physiology, and use. Laboratories and fieldwork emphasize relationships between distribution and major environmental parameters and involve student projects.

BIOSM 465(4650) Sharks: The Biology, Evolution, and Conservation of Sharks and Their Allies

Summer. 2 credits. Prerequisite: vertebrates or comparative anatomy and ichthyology or permission of SML director. J. Morrissey and W. E. Bemis.

The last 30 years have produced an explosion of new information on the biology of the approximately 1,000 living species of sharks, skates, rays, and chimaeras, which collectively make up the group Chondrichthyes. This course will cover advanced topics in the evolution, diversity, anatomy, functional morphology, neurobiology, sensory systems, behavior, reproduction, development, and conservation of cartilaginous fishes.

BIOSM 472(4720) Molecular Systematics

Summer. 4 credits. Prerequisite: one year introductory biology; genetics and/or cell biology with laboratory components. Recommended: evolutionary biology, ecology vertebrate/invertebrate zoology. A. Shedlock.

An introduction to basic concepts in systematic biology, evolutionary genetics, molecular ecology, and conservation biology emphasizing the natural history of marine organisms. Students integrate field sampling techniques, taxonomy, and curation of specimens from Appledore Island and surrounding waters with molecular diagnostics completed in the laboratory. Standard methods for DNA purification, amplification, sequencing, and genotyping are used to address questions about population structure, kinship, and species phylogeny.

BIOSM 477(4770) Marine Vertebrates

Summer. 6 credits. Prerequisites: vertebrate biology course. S-U or letter grades. Special three-week course offered at Shoals Marine Laboratory (SML), located on an island off Portsmouth, N.H. For more details or an application, consult SML office, G14 Stimson Hall. Daily lec, lab, and fieldwork for three weeks. SML faculty.

Topics in marine vertebrate biology emphasizing laboratory studies, field collections or observations, and readings from the current literature. Topics include systematics of fishes of the Gulf of Maine; elasmobranch physiology; interpretation of life history and parameters from otolith microstructure; teleost skeletomuscular structure and function; population biology and the contemporary Gulf of Maine fishery; Mesozoic marine reptiles; the biology of sea turtles in cold water; coloniality in sea birds; avian adaptations to life at sea; evolution and systematics of marine mammals; diving physiology; and ecology and conservation of existing marine mammal populations. Dissection of vertebrate animals is a part of one or more laboratory sessions.

BIOSM 495(4950) Research Methods in Marine Biology

Summer. 1 credit. Corequisite: BIOSM 499 or permission of instructor. Primarily for undergraduates. Special eight-week course offered at the Shoals Marine Laboratory (SML). For more details or an application, contact SML office, G14 Stimson Hall. Weekly sem for eight weeks. SML faculty.

Seminar course on research methodology, experimental design, statistical analyses, and scientific writing. The course is designed to assist students in the research they are conducting while enrolled in BIOSM 499.

BIOSM 499(4990) Research in Biology

Summer. Variable credit; 2 credits per seven days on site. For more details and an application, contact SML office, G14 Stimson Hall.

Section A: Independent Biological Research: Independent study with a member of the Shoals Marine Laboratory core faculty, based on student faculty interest and available facilities. A short proposal of research must be sent with application materials.

Research Experiences for Undergraduates (REU)

0 credits. The National Science Foundation (NSF) Research Experiences for Undergraduates (REU) program provides support for undergraduates to pursue supervised, independent research projects at the Shoals Marine Laboratory. Nine students are selected from a competitive, national pool to participate in the eight-week summer program. For more information and an application, contact SML office, G14 Stimson Hall, or view SML's web site at www.sml.cornell.edu.

BIOSM 650(6500) Field Marine Ecology and Environmental Science for Teachers

Summer. 2 credits. Prerequisites: one year college-level biology. Recommended: teaching experience. A special one-week course offered at Shoals Marine Laboratory (SML), located on an island off Portsmouth, N.H. For more details or an application, contact SML office, G-14 Stimson Hall. Daily lec and fieldwork for one week. SML faculty.

Intended for teachers of grades 6–12 but also open to undergraduate junior and senior students interested in teaching. Teachers develop hands-on, experiential approaches to the marine sciences, with an emphasis on coastal and environmental issues. Extensions to freshwater ecology also are included. Fieldwork is emphasized, with numerous excursions to the rocky intertidal and with off-shore ocean sampling. Lectures focus on biodiversity, adaptations, predator-prey interactions, environmental sustainability, and how to engage and motivate students with aquatic projects.

BIOSM 699(6990) Research in Biology for Teachers

Summer. 2 credits per week. Prerequisite: BIOSM 650. Special course offered at Shoals Marine Laboratory (SML), located on an island off Portsmouth, N.H. For more details or an application, contact SML office, G14 Stimson Hall.

Opportunity for teachers who have taken BIOSM 650 to return to Shoals to pursue in greater depth a topic of their choosing under the direction of the BIOSM 650 faculty.

SEA Semester

In cooperation with the Sea Education Association (SEA), the Shoals Marine Laboratory offers a semester-length sequence of courses designed to provide college undergraduates with a thorough academic, scientific, and practical understanding of the sea. *This sequence is repeated approximately once every two months throughout the year.* Students spend the first half of SEA Semester (a six-week shore component) in Woods Hole, Mass., receiving instruction in oceanography, nautical science, and maritime studies. The second half of SEA Semester (a six-week sea component) is spent at sea aboard the SSV *Robert C. Seamans* or the SSV *Corwith Cramer*. Enrollment is open to both men and women judged capable of benefiting from SEA semester; a student must have successfully completed **at least one college-level laboratory science course** (or its equivalent) in order to be admitted to SEA Semester or SEA Summer Session. **No prior sailing experience is necessary**. Cornell students enrolled in the SEA Semester must take the entire sequence.

For more information, contact Shoals Marine Laboratory office, G14 Stimson Hall, or call SEA directly at 800–552–3633. Program costs are to be paid in place of regular Cornell tuition and fees.

Instructors for the SEA Semester include faculty of the Sea Education Association and the Woods Hole Oceanographic Institution and others.

SEA Basic Semester

BIOSM 366(3660) SEA Introduction to Oceanography

3 credits. Corequisites: BIOSM 367 and 368. Survey of the characteristics and processes of the global ocean. Introduces oceanographic concepts and develops them from their bases in biology, physics, chemistry, and geology. Provides a broad background in oceanography with special attention to areas pertinent to the subsequent cruise. Guest lecturers from the Woods Hole research community interpret current trends and activities in this rapidly evolving field. Students develop individual projects to be carried out at sea.

BIOSM 367(3670) SEA Introduction to Maritime Studies

3 credits. Corequisites: BIOSM 366 and 368. Interdisciplinary consideration of our relationship with the marine environment. Covers the elements of maritime history, law, literature, and art necessary to appreciate our marine heritage and to understand the political and economic problems of contemporary maritime affairs.

BIOSM 368(3680) SEA Introduction to Nautical Science

3 credits. Corequisites: BIOSM 366 and 367. An introduction to the technologies of operation at sea. The concepts of navigation (piloting, celestial and electronic), naval architecture, ship construction, marine engineering systems, and the physics of sail are taught from their bases in astronomy, mathematics, and physics. Provides the theoretical foundation for the navigation, seamanship, and engineering that students employ at sea.

BIOSM 369(3690) SEA Practical Oceanography I

4 credits. Prerequisite: BIOSM 366. Theories and problems raised in the shore component are tested in the practice of oceanography at sea. Students are introduced to the tools and techniques of the practicing oceanographer. During lectures and watch standing, students are instructed in the operation of basic oceanographic equipment; in the methodologies involved in the collection, reduction, and analysis of oceanographic data; and in the attendant operations of a sailing oceanographic research vessel.

BIOSM 370(3700) SEA Practical Oceanography II

4 credits. Prerequisites: BIOSM 368 and 369. Building on the experience of Practical Oceanography I, students assume increasing responsibility for conducting oceanographic research and overseeing operations of the vessel. The individual student is ultimately responsible directly to the chief scientist and the master of the vessel for the safe and orderly conduct of research activities and related operations of the vessel. Each student undertakes an individual research project designed during the shore component.

BIOSM 372(3720) SEA Practical Oceanography III

Summer. 3 credits. Prerequisites: BIOSM 366, 367, and 368.

Theories and problems raised in class are tested in the practice of oceanography at sea. During lectures and watch standing, students are instructed in the operation of basic oceanographic equipment, in the methodologies involved in the collection, analysis, and reduction of oceanographic data, and in the attendant operations of sailing an oceanographic research vessel. Group research projects are completed.

SEA Oceans and Climate Semester

BIOSM 368(3680) SEA Introduction to Nautical Science

BIOSM 378(3780) SEA Oceans and Climate: Oceans in the Global Carbon Cycle

Fall, spring. 4 credits. Prerequisite: 3 lab science courses or permission of instructor. SML faculty.

This course examines the role of the oceans in the climate system, addressing topics such as the global carbon cycle, the thermohaline circulation, and aspects of global change including warming and sea level rise.

BIOSM 379(3790) SEA Ocean Science and Public Policy (HA)

Fall, spring. 3 credits. SEA faculty.

This course seeks to provide students with a fundamental understanding of the intersection between climate change and governmental policy and the interrelationship between science and governmental policy. After an introduction to the development of maritime law and sovereignty on the high seas, students will examine why societies funded oceanic research.

BIOSM 380(3800) SEA Oceanographic Field Methods

Fall, spring. 3 credits. Prerequisite: successful completion of BIOSM 378. SEA faculty.

This course introduces students to all aspects of oceanographic fieldwork. Students learn practical skills in the operating principles and safe deployment of oceanographic instrumentation. Skills acquired enable students to carry out an independent research project.

BIOSM 381(3810) SEA Independent Research in Oceans and Climate

Fall, spring. 4 credits. Prerequisite: successful completion of BIOSM 378. SEA faculty.

This course provides upper-level study focused on oceanography and climate, including the design and completion of an independent research project that is comparable in scope to an undergraduate senior research thesis.

SEA: Documenting Change in the Caribbean Semester

BIOSM 362(3620) SEA Maritime History and Culture (CA) (HA)

Fall, spring. 4 credits. SEA faculty.

In this course, students will explore political, cultural and social changes in the Caribbean since just before Europeans arrived at the end of the 15th century. Student will see how the physical nature of the region has influenced patterns of settlement and development and the impact of European expansion.

BIOSM 366(3660) SEA Practical Oceanography I

BIOSM 368(3680) SEA Introduction to Nautical Science

BIOSM 370(3700) SEA Practical Oceanography II

BIOSM 371(3710) SEA Marine Environmental History (CA) (LA)
Fall, spring. 4 credits. SEA faculty.
This course is designed to explore the interaction of ecological factors in ocean, coastal and island environments; the impact of human actions on those environments; and the need for local, regional and international responses and strategies to mitigate and manage that impact.

FACULTY ROSTER

New York State College of Agriculture and Life Sciences

Adler, Kraig K., Ph.D., U. of Michigan. Prof., Neurobiology and Behavior
Agrawal, Anurag, Ph.D., U. of California, Davis. Assoc. Prof., Ecology and Evolutionary Biology/Entomology
Alani, Eric E., Ph.D., Harvard U. Assoc. Prof., Molecular Biology and Genetics
Anderson, John M., Ph.D., New York U. Prof. Emeritus, Molecular Biology and Genetics
Angert, Esther R., Ph.D., Indiana U. Asst. Prof., Microbiology
Barbash, Daniel A., Ph.D., U. of California, Berkeley. Asst. Prof., Molecular Biology and Genetics
Bates, David M., Ph.D., U. of California, Los Angeles. Prof. Emeritus, Plant Biology (Bailey Hortorium)
Bemis, William E., Ph.D., U. of California, Berkeley. Prof., Ecology and Evolutionary Biology/Shoals Marine Laboratory
Bruns, Peter J., Ph.D., U. of Illinois. Prof. Emeritus, Molecular Biology and Genetics
Cade, Thomas J., Ph.D., U. of California, Los Angeles. Prof. Emeritus, Ecology and Evolutionary Biology
Calvo, Joseph M., Ph.D., Washington State U. William T. Keeton Professor in Biological Sciences, Molecular Biology and Genetics
Chabot, Brian F., Ph.D., Duke U. Prof., Ecology and Evolutionary Biology
Clayton, Roderick K., Ph.D., California Inst. of Technology. Prof. Emeritus, Plant Biology
Crepet, William L., Ph.D., Yale U. Prof., Plant Biology (Bailey Hortorium)*
Davies, Peter J., Ph.D., U. of Reading (England). Prof., Plant Biology
Davis, Jerrold I., Ph.D., U. of Washington. Assoc. Prof., Plant Biology (Bailey Hortorium)
Dhondt, André A., Ph.D., Ghent State U. (Belgium). Edwin H. Morgens Professor of Ornithology, Ecology and Evolutionary Biology/Laboratory of Ornithology
Dondero, Norman C., Ph.D., Cornell U. Prof. Emeritus, Microbiology
Doyle, Jeffrey J., Ph.D., Indiana U. Prof., Plant Biology (Bailey Hortorium)
Dress, William J., Ph.D., Cornell U. Prof. Emeritus, Plant Biology (Bailey Hortorium)
Eisner, Thomas, Ph.D., Harvard U. Jacob Gould Schurman Professor Emeritus, Neurobiology and Behavior/Ecology and Evolutionary Biology*
Emlen, Stephen T., Ph.D., U. of Michigan. Jacob Gould Schurman Professor, Neurobiology and Behavior
Feeny, Paul P., Ph.D., Oxford U. (England). Prof., Ecology and Evolutionary Biology
Fitzpatrick, John W., Ph.D., Princeton U. Prof., Ecology and Evolutionary Biology/ Laboratory of Ornithology
Flecker, Alexander S., Ph.D., U. of Maryland. Assoc. Prof., Ecology and Evolutionary Biology
Fox, Thomas D., Ph.D., Harvard U. Prof., Molecular Biology and Genetics
Fu, Jianhua, Ph.D., U. Pittsburgh. Asst. Prof., Molecular Biology and Genetics
Ghiorse, William C., Ph.D. Rensselaer Polytechnic Inst. Prof., Microbiology
Gibson, Jane, Ph.D., U. of London (England). Prof. Emeritus, Molecular Biology and Genetics
Goldberg, Michael L., Ph.D., Stanford U. Prof., Molecular Biology and Genetics
Hanson, Maureen R., Ph.D., Harvard U. Prof., Molecular Biology and Genetics/Liberty Hyde, Prof., Plant Biology
Harrison, Richard G., Ph.D., Cornell U. Prof., Ecology and Evolutionary Biology
Harris-Warrick, Ronald M., Ph.D., Stanford U. Prof., Neurobiology and Behavior
Harvell, C. Drew, Ph.D., U. of Washington. Prof., Ecology and Evolutionary Biology
Hay, Anthony, Ph.D., U. of California. Assoc. Prof., Microbiology
Helmann, John D., Ph.D., U. of California, Berkeley. Prof., Microbiology
Henry, Susan, Ph.D., U. of California, Berkeley. Prof., Molecular Biology and Genetics and Dean CALS
Hopkins, Carl D., Ph.D., Rockefeller U. Prof., Neurobiology and Behavior
Howarth, Robert W., Ph.D., Massachusetts Inst. of Technology/Woods Hole Oceanographic Institution. David R. Atkinson Professor of Ecology and Environmental Biology, Ecology and Evolutionary Biology
Hua, Jian, Ph.D., California Inst. of Technology. Asst. Prof., Plant Biology
Ingram, John W., Ph.D., U. of California, Berkeley. Prof. Emeritus, Plant Biology (Bailey Hortorium)
Jagendorf, André T., Ph.D., Yale U. Liberty Hyde Bailey Professor of Plant Physiology Emeritus, Plant Biology
Kemphues, Kenneth J., Ph.D., Indiana U. Prof., Molecular Biology and Genetics
Kessler, André, Ph.D., Max Planck Inst. for Chemical Ecology/Friedrich Schiller U. of Jena (Germany). Asst. Prof., Ecology and Evolutionary Biology/Boyce Thompson Inst. for Plant Research
Kingsbury, John M., Ph.D., Harvard U. Prof. Emeritus, Plant Biology
Kraus, W. Lee, Ph.D., U. of Illinois. Asst. Prof., Molecular Biology and Genetics
Lis, John T., Ph.D., Brandeis U. Prof., Molecular Biology and Genetics
Lovette, Irby J., Ph.D., U. of Pennsylvania. Assoc. Prof., Ecology and Evolutionary Biology/Laboratory of Ornithology
Luckow, Melissa A., Ph.D., U. of Texas, Austin. Assoc. Prof., Plant Biology (Bailey Hortorium)
MacDonald, Russell E., Ph.D., U. of Michigan. Prof. Emeritus, Molecular Biology and Genetics
MacIntyre, Ross J., Ph.D., Johns Hopkins U. Prof., Molecular Biology and Genetics
Madsen, Eugene L., Ph.D., Cornell U. Assoc. Prof., Microbiology
Marks, Peter L., Ph.D., Yale U. Prof. Emeritus, Ecology and Evolutionary Biology
McCune, Amy R., Ph.D., Yale U. Prof., Ecology and Evolutionary Biology
Morin, James G., Ph.D., Harvard U. Prof., Ecology and Evolutionary Biology
Mortlock, Robert P., Ph.D., U. of Illinois. Prof. Emeritus, Microbiology
Nasrallah, June B., Ph.D., Cornell U. Prof., Plant Biology
Nasrallah, Mikhail E., Ph.D., Cornell U. Prof., Plant Biology
Naylor, Harry B., Ph.D., Cornell U. Prof. Emeritus, Microbiology
Niklas, Karl J., Ph.D., U. of Illinois. Prof., Plant Biology
Nixon, Kevin C., Ph.D., U. of Texas, Austin. Assoc. Prof., Plant Biology (Bailey Hortorium)
Owens, Thomas G., Ph.D., Cornell U. Assoc. Prof., Plant Biology
Paolillo, Dominick J., Jr., Ph.D., U. of California, Davis. Prof. Emeritus, Plant Biology
Parthasarathy, Mandayam V., Ph.D., Cornell U. Prof. Emeritus, Plant Biology
Peters, Joseph, Ph.D., U. of Maryland. Asst. Prof., Microbiology
Raguso, Robert A., Ph.D., U. of Michigan. Assoc. Prof., Neurobiology and Behavior
Reeve, H. Kern, Ph.D., Cornell U. Prof., Neurobiology and Behavior
Roberts, Jeffrey W., Ph.D., Harvard U. Robert J. Appel Professor of Cellular and Molecular Biology, Molecular Biology and Genetics
Rodriguez, Eloy, Ph.D., U. of Texas. Prof., Plant Biology (Bailey Hortorium)
Root, Richard B., Ph.D., U. of California, Berkeley. Prof. Emeritus, Ecology and Evolutionary Biology/Entomology
Rose, Jocelyn, Ph.D., U. of California, Davis. Asst. Prof., Plant Biology
Russell, James B., Ph.D., U. of California, Davis. Prof., Microbiology
Scanlon, Michael, Ph.D., Iowa State U. Assoc. Prof., Plant Biology
Seeley, Jr., Harry W., Ph.D., Cornell U. Prof. Emeritus, Microbiology
Shalloway, David I., Ph.D., Massachusetts Inst. of Technology. Greater Philadelphia Prof., Molecular Biology and Genetics
Shapleigh, James P., Ph.D., U. of Georgia. Assoc. Prof., Microbiology
Stinson, Harry T., Ph.D., Indiana U. Prof. Emeritus, Molecular Biology and Genetics
Tye, Bik-Kwoon, Ph.D., Massachusetts Inst. of Technology. Prof., Molecular Biology and Genetics
Uhl, Charles H., Ph.D., Cornell U. Prof. Emeritus, Plant Biology
Uhl, Natalie W., Ph.D., Cornell U. Prof. Emeritus, Plant Biology (Bailey Hortorium)
Van Wijk, Klaas J., Ph.D., Groningen U. (The Netherlands). Assoc. Prof., Plant Biology
Vogt, Volker M., Ph.D., Harvard U. Prof., Molecular Biology and Genetics
Walcott, Charles, Ph.D., Cornell U. Prof., Neurobiology and Behavior
Wayne, Randy O., Ph.D., U. of Massachusetts. Assoc. Prof., Plant Biology
Winans, Stephen C., Ph.D., Massachusetts Inst. of Technology. Prof., Microbiology
Winkler, David W., Ph.D., U. of California, Berkeley. Prof., Ecology and Evolutionary Biology
Wu, Ray, Ph.D., U. of Pennsylvania. Prof., Molecular Biology and Genetics
Zahler, Stanley A., Ph.D., U. of Chicago. Prof. Emeritus, Molecular Biology and Genetics
Zinder, Stephen H., Ph.D., U. of Wisconsin. Prof., Microbiology

Other Teaching Personnel

Blankenship, James E., M.S., Cornell U. Sr. Lec., Molecular Biology and Genetics
Calvo, Rita A., Ph.D., Cornell U. Sr. Lec., Molecular Biology and Genetics
Chen, Kuei-chiu, Ph.D., New York U. Lec., Neurobiology and Behavior
Ely, Susan, Ph.D., Tufts U. Lec., Molecular Biology and Genetics
Hester, Laurel, Ph.D., U. Michigan. Lec., Neurobiology and Behavior
Lorr, Nancy, Ph.D., U. of Oregon. Lec., Physiology
McGuire, Betty A., Ph.D., U. of Massachusetts. Sr. Lec., Ecology and Evolutionary Biology
Merkel, Susan, M.S., Cornell U. Sr. Lec., Microbiology
Nivison, Helen T., Ph.D., U. of California, Davis. Lec., Molecular Biology and Genetics
Rehkugler, Carole M., M.S., Cornell U. Sr. Lec., Microbiology
Silva, Thomas, Ph.D., Cornell U. Sr. Lec., Plant Biology
Southard, Laurel E., M.S., Tulane U. Lec., Undergraduate Biology

Joint Appointees

Baldwin, Ian T., Adjunct Prof., Max Planck Inst. for Chemical Ecology/Ecology and Evolutionary Biology
Bloom, Stephen E., Prof., Veterinary/ Microbiology and Immunology
Bradbury, Jack, Prof., Neurobiology and Behavior/Library of Natural Sounds
Brutnell, Thomas, Prof., Plant Breeding/Plant Biology
Doyle, Jeffrey J., Prof., Plant Biology (Bailey Hortorium)/Plant Biology General
Foote, Robert H., Jacob Gould Schurman Prof. Emeritus, Animal Science/Physiology
Giovannoni, James G., Adjunct Asst. Prof., USDA Science and Education Administration/Plant Biology
Hanson, Maureen, Prof., Molecular Biology and Genetics/Plant Biology
Hrazdina, Geza, Prof., Food Science and Technology Geneva/Plant Biology Ithaca
Jahn, Margaret M., Assoc. Prof., Plant Breeding/Plant Biology
Jander, Georg, Adjunct Asst. Prof., Boyce Thompson Inst./Plant Biology
Kochian, Leon V., Adjunct Prof., USDA Science and Education Administration/Plant Biology
Korf, Richard P., Prof. Emeritus, Plant Pathology/Plant Biology (Bailey Hortorium)
Kresovich, Stephen, Prof., Plant Breeding/Plant Biology
Liebherr, James K., Assoc. Prof., Entomology/ Plant Biology (Bailey Hortorium)
McClure, Polley A., Prof., Information Technologies/Ecology and Evolutionary Biology
McCouch, Susan R., Assoc. Prof., Plant Breeding/Plant Biology
Pimentel, David, Prof. Emeritus, Entomology/ Ecology and Evolutionary Biology
Rossman, Michael J., Adjunct Prof., Purdue U./ Molecular Biology and Genetics
Stern, David B., Adjunct Prof., Boyce Thompson Institute/Plant Biology
Tanksley, Steven, Prof., Plant Breeding/Liberty Hyde Bailey Prof., Plant Biology
Thaler, Jennifer S., Assoc. Prof., Entomology/ Ecology and Evolutionary Biology
Thompson, John F., Adjunct Prof., USDA Science and Education Administration/Plant Biology
Vehrencamp, Sandra, Prof., Neurobiology and Behavior/Library of Natural Sounds
Wang, Haiyang, Adjunct Asst. Prof., Boyce Thompson Inst./Plant Biology

College of Arts and Sciences

Adkins-Regan, Elizabeth, Ph.D., U. of Pennsylvania. Prof., Neurobiology and Behavior/Psychology
Aquadro, Charles F., Ph.D., U. of Georgia. Prof., Molecular Biology and Genetics/ Ecology and Evolutionary Biology
Bass, Andrew H., Ph.D., U. of Michigan. Prof., Neurobiology and Behavior
Blackler, Antonie W., Ph.D., U. of London (England). Prof., Molecular Biology and Genetics
Booker, Ronald, Ph.D., Princeton U. Assoc. Prof., Neurobiology and Behavior
Bretscher, Anthony P., Ph.D., Leeds U. (England). Prof., Molecular Biology and Genetics
Brown, William J., Ph.D., U. of Texas Health Science Center, Dallas. Prof., Molecular Biology and Genetics
Clark, Andrew G., Ph.D., Stanford U. Prof., Molecular Biology and Genetics/Ecology and Evolutionary Biology
Chuang, Huai-hu, Ph.D., U. of California. Asst. Prof., Molecular Physiology
Deitcher, David, Ph.D., Harvard Medical School. Assoc. Prof., Neurobiology and Behavior
Ellner, Stephen P., Ph.D., Cornell U. Prof., Ecology and Evolutionary Biology
Feigenson, Gerald W., Ph.D., California Inst. of Technology. Prof., Molecular Biology and Genetics
Fetcho, Joseph R., Ph.D., U. of Michigan. Prof., Neurobiology and Behavior
Finlay, Barbara, Ph.D., Massachusetts Inst. of Technology. Prof., Psychology
Garcia Garcia, Maria J., Ph.D., U. Autonoma de Madrid Spain. Asst. Prof., Molecular Biology and Genetics
Geber, Monica A., Ph.D., U. of Utah. Assoc. Prof., Ecology and Evolutionary Biology
Gibson, Quentin H., Ph.D./D.Sc., Queen's U. (Northern Ireland). Greater Philadelphia Professor Emeritus in Biological Sciences, Molecular Biology and Genetics
Goodale, Christine L., Ph.D., U. of New Hampshire. Asst. Prof., Ecology and Evolutionary Biology
Greene, Harry W., Ph.D., U. of Tennessee. Prof., Ecology and Evolutionary Biology
Hairston, Nelson G., Jr., Ph.D., U. of Washington. Frank H. T. Rhodes Professor of Environmental Science, Ecology and Evolutionary Biology
Halpern, Bruce P., Ph.D., Brown U. Prof., Neurobiology and Behavior/Psychology
Heppel, Leon A., Ph.D., U. of California, Berkeley. Prof. Emeritus, Molecular Biology and Genetics
Hess, George P., Ph.D., U. of California, Berkeley. Prof., Molecular Biology and Genetics
Hinkle, Peter C., Ph.D., New York U. Prof., Molecular Biology and Genetics
Howland, Howard C., Ph.D., Cornell U. Prof., Neurobiology and Behavior/Biomedical Sciences
Hoy, Ronald R., Ph.D., Stanford U. Merksamer Prof., Neurobiology and Behavior
Huffaker, Tim C., Ph.D., Massachusetts Inst. of Technology. Prof., Molecular Biology and Genetics
Ke, Ailong, Ph.D., Johns Hopkins U. School of Medicine. Asst. Prof., Molecular Biology and Genetics
Kennedy, Kenneth A. R., Ph.D., U. of California, Berkeley. Prof. Emeritus, Ecology and Evolutionary Biology
Lee, Siu Sylvia, Ph.D., Bailor Coll. of Medicine. Asst. Prof., Molecular Biology and Genetics
Leonard, Samuel L., Ph.D., U. of Wisconsin. Prof. Emeritus, Molecular Biology and Genetics
Linster, Christine, Ph.D., Pierre and Marie Curie U. Assoc. Prof., Neurobiology and Behavior
Liu, Jun Kelly, Ph.D., Cornell U. Asst. Prof., Molecular Biology and Genetics
McCobb, David, Ph.D., U. of Iowa. Assoc. Prof., Neurobiology and Behavior
MacDonald, June M. Fessenden, Ph.D., Tufts U. Assoc. Prof. Emeritus, Molecular Biology and Genetics/Program on Science, Technology, and Society
Nicholson, Linda, Ph.D., Florida State U. Assoc. Prof., Molecular Biology and Genetics
Power, Alison G., Ph.D., U. of Washington. Prof., Ecology and Evolutionary Biology/ Science and Technology Studies
Provine, William B., Ph.D., U. of Chicago. Charles A. Alexander Professor of Biological Sciences, Ecology and Evolutionary Biology/History
Schimenti, John C., Ph.D., U. of Cincinnati. Prof., Molecular Biology and Genetics
Seeley, Thomas D., Ph.D., Harvard U. Prof., Neurobiology and Behavior
Shaw, Kerry L., Ph.D., Washington U., St. Louis. Prof., Neurobiology and Behavior
Sherman, Paul W., Ph.D., U. of Michigan. Prof., Neurobiology and Behavior
Sparks, Jed P., Ph.D., Washington State U. Asst. Prof., Ecology and Evolutionary Biology
Tumbar, Tudorita, Ph.D., U. of Illinois, Urbana-Champaign. Asst. Prof., Molecular Biology and Genetics
Turgeon, Robert, Ph.D., Carleton U. (Canada). Prof., Plant Biology
Wallace, Bruce, Ph.D., Columbia U. Prof. Emeritus, Molecular Biology and Genetics
Wilson, David B., Ph.D., Stanford U. Prof., Biochemistry, Molecular Biology and Genetics
Wolfner, Mariana F., Ph.D., Stanford U. Prof., Molecular Biology and Genetics
Zamudio, Kelly R., Ph.D., U. of Washington. Assoc. Prof., Ecology and Evolutionary Biology

Other Teaching Personnel

Balko, Elizabeth A., Ph.D., College of Environmental Science and Forestry. Sr. Lec., Plant Biology
Johnson, Bruce R., Ph.D., Boston U. Sr. Lec., Neurobiology and Behavior
Land, Bruce R., Ph,.D., Cornell U., Sr. Lec., Neurobiology and Behavior

Joint Appointees

Levin, Simon A., Adjunct Prof., Princeton U./ Ecology and Evolutionary Biology
Likens, Gene E., Adjunct Prof., Institute of Ecosystem Studies/Ecology and Evolutionary Biology

College of Veterinary Medicine

Alcaraz, Ana, D.V.M., Ph.D., Cornell U. Lec., Biomedical Sciences
Beyenbach, Klaus W., Ph.D., Washington State U. Prof., Biomedical Sciences
Bezuidenhout, Abraham, D.V.Sc., U. of Pretoria (South Africa), Sr. Lec., Biomedical Sciences

Buckles, Elizabeth, D.V.M., Ph.D., U. of Wisconsin. Asst. Prof., Pathology
Catalfamo, James, M.S., Ph.D., Union Coll. Sr. Res. Assoc., Population Medicine and Diagnostic Services
Chuang, Huai-hu, Ph.D., U. of California. Asst. Prof., Molecular Physiology
Cohen, Paula, Ph.D., U. of London (England). Asst. Prof., Genetics
Farnum, Cornelia E., D.V.M., Ph.D., U. of Wisconsin, Madison. Prof., Biomedical Sciences
FitzMaurice, Marnie C., V.M.D., Ph.D., U. of Pennsylvania. Instr., Biomedical Sciences
Fortune, Joanne E., Ph.D., Cornell U. Prof., Biomedical Sciences
Gilmour, Robert F., Ph.D., SUNY Upstate Medical Center. Prof., Biomedical Sciences
Gleed, Robin, BVSc, MRCVS, U. of Liverpool (England). Assoc. Prof., Clinical Sciences
Gunn, Teresa M., Ph.D., U. of British Columbia (Canada). Asst. Prof., Biomedical Sciences
Hermanson, John W., M.S., Ph.D., U. of Florida Gainesville. Assoc. Prof., Biomedical Sciences
Houpt, Katherine A., V.M.D., Ph.D., U. of Pennsylvania. Prof., Clinical Sciences
Kotlikoff, Michael I., Ph.D., U. of California, Davis. Prof., Biomedical Sciences
Lin, David, Ph.D., U. of California, Berkeley. Asst. Prof., Biomedical Sciences
Loew, Ellis R., Ph.D., U. of California, Los Angeles. Prof., Biomedical Sciences
Lorr, Nancy, Ph.D., U. of Oregon. Lec., Biomedical Sciences
Ludders, John, D.V.M., Washington State U. Prof., Clinical Sciences
Maza, Paul, D.V.M., U. of St. Kitts (West Indies). Lec., Biomedical Sciences
McDonough, Sean, D.V.M., Ph.D., U. of Pennsylvania. Assoc. Prof., Biomedical Sciences
Meyers-Wallen, Vicki, V.M.D., Ph.D., U. of Pennsylvania. Assoc. Prof., Biomedical Sciences
Minor, Ronald. V.M.D., Ph.D., U. of Pennsylvania. Prof., Biomedical Sciences
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College of Engineering

Joint Appointees

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Webb, Watt W., Prof., Applied and Engineering Physics/Biological Sciences

Biological Sciences

Joint Appointees

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Division of Nutritional Sciences

Joint Appointees

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Bensadoun, Andre, Prof., Nutritional Sciences/ Physiology
Kazarinoff, Michael N., Assoc. Prof., Nutritional Sciences/Molecular Biology and Genetics
Wright, Lemuel D., Prof. Emeritus, Nutritional Sciences/Molecular Biology and Genetics

*Joint appointment with College of Arts and Sciences

†Joint appointment with College of Veterinary Medicine

‡Joint appointment with College of Agriculture and Life Sciences

§Joint appointment with College of Engineering