

Biology

In the College of Sciences

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Faculty

Emeritus: Alexander, Alfred, Atkins, Barnett, Baxter, Bohnsack, Carmichael, Carpenter, Chen, Clark, Cohn, Collier, B., Collier, G., Cox, Daugherty, Davis, C., Dexter, Diehl, Dowler, Ebert, Etheridge, Ford, Futch, Hanscom, Hazen, Huffman, Hunsaker, Johnson, A., Johnson, G., Johnson, K., Kelly, Krekorian, Krisans, Kummerow, McBlair, Monroe, Moore, Neel, Norland, Olson, Parsons, Phelps, Phleger, Plymale, Ratty, Rinehart, Schapiro, Shepard, Sloan, Taylor, Thwaites, Van Steenberg, Walch, Wedberg, Wilson, Zedler, J., Zedler, P., Zyskind

Chair: Glembotski

Professors: Archibald, Bernstein, Berta, Bizzoco, Breindl, Buono, Davis, R., Fisher, Franklin, Frey, Glembotski, Hemmingsen, Hurlbert, Maloy, McClenaghan, McGuire, Oechel, Paolini, Perrault, Pozos, Sabbadini, R., Simpson, Tsoukas

Associate Professors: Avila, Harris, Reeder, Segall, Williams

Assistant Professors: Anderson, Arenas-Mena, Bohonak, Burns, Deutschman, Diffendorfer, Edwards, Hedin, Hentschel, Hovel, Kelley, Lipson, Waters, Zeller

Lecturers: Garver, Gibbins, Krown, Martin, Sabbadini, G., Wingerd, M.

Offered by the Department

Doctor of Philosophy degree in biology and ecology.

Master of Arts degree in biology.

Master of Science degree in biology.

Master of Science degree in microbiology.

Major in biology with the B.A. degree in liberal arts and sciences.

Major in biology with the B.S. degree in applied arts and sciences.

Emphasis in bioengineering.

Emphasis in cellular and molecular biology.

Emphasis in ecology.

Emphasis in evolution and systematics.

Emphasis in marine biology.

Emphasis in zoology.

Major in microbiology with the B.A. degree in liberal arts and sciences.

Major in microbiology with the B.S. degree in applied arts and sciences.

Emphasis in medical technology and public health microbiology.

Program of study in biology in preparation for the single subject teaching credential in science.

Minor in biology.

Certificate in biotechnology.

The Majors

Biology. The Department of Biology offers a dynamic and modern program in biology which prepares students both academically and practically for vocations in science and science-related fields or for entry into graduate studies. The major is designed to present a basic background in modern biology and in the supportive disciplines of chemistry, mathematics and physics, and to provide specialized training selected by the student from a variety of areas. The wide range of faculty expertise and research interest allows the department to offer a curriculum which includes general and advanced courses in plant and animal sciences, marine sciences, genetics and physiology, ecology, molecular biology, microbiology, immunology, endocrinology, entomology, evolution, and systematics. Formal programs of

study within the major include Emphases in Bioengineering, Cell and Molecular Biology, Ecology, Evolution and Systematics, Marine Biology, and Zoology. Special studies opportunities with SDSU faculty and scientists at cooperating institutions allow qualified students to gain research experience on an individual basis.

The department offers a specific program of courses to fulfill the state of California's science requirements for the Single Subject Teaching Credential in Biological Science. Students successfully completing one of these programs may be certified by the department as having demonstrated subject competency as required in part for acceptance into College of Education single subject credential program.

The department also offers a program leading to the Biotechnology Certificate. The purpose of this program is to prepare undergraduate and graduate students for employment in public and private organizations utilizing biotechnology.

The rapid advances in theoretical and applied biology, the growing demands in health care and the expansion of general interest in and concern for the environment are just a few of the factors which continue to increase society's need for biologists. Some examples: a biology degree is the common precursor for the medical, dental, veterinarian and allied health professions; government agencies involved in environment protection, public health and conservation need ecologists, inspectors, laboratory technicians and wildlife, forest, coast and park managers; government and private agriculture agencies need entomologists and botanists; private companies, government laboratories and universities involved in biotechnology need microbiologists and molecular biologists; zoos, wild animal parks and aquaria need zoologists; the secondary school system needs biology teachers; textbook and scientific supply companies need science majors. Whether your goal is to work in a laboratory or a forest, there is opportunity for fulfillment and growth in the field of biology.

Microbiology. Microbiology is the study of bacteria, viruses, yeasts, molds, algae and protozoa. These microorganisms are found associated with plants and animals, in soil, and in fresh and marine waters. Many of the free-living species participate in maintaining the quality of our environment. Certain species affect the health and well-being of plants and animals, including humans, by causing infectious diseases. Microorganisms are often used in the molecular biology laboratory as research tools, for experiments in genetic engineering, and in the manufacture of food and chemicals.

The microbiology major is designed to provide the student with a background in basic biology, microbiology, and the disciplines of chemistry, mathematics and physics. The curriculum includes introductory and advanced courses (most with laboratories) in general and pathogenic microbiology, immunology, virology, physiology, and genetics as well as courses in food and industrial microbiology, marine microbiology, and molecular biology.

Microbiologists find positions with governmental agencies, in university and private research laboratories, in biotechnology, medical and industrial laboratories, in schools as teachers, with scientific supply companies, or with textbook companies. Depending on the situation, a microbiologist may conduct fundamental and applied research, identify disease-causing microorganisms in medical or veterinary specimens, participate in studies of the environment (e.g., soil, ocean, lakes), aid in the manufacture of pharmaceuticals, food, or beverages, or provide quality and safety control. The microbiology major is excellent preparation for entrance into medical, dental, veterinarian, and graduate schools. The Emphasis in Medical Technology and Public Health Microbiology prepares students to become, after a postgraduate internship, licensed medical technologists or certified public health microbiologists.

Impacted Programs

The biology and microbiology majors are impacted programs. Students must enter the University under the biology premajor code (04010) or the microbiology premajor code (04110). To be admitted to the biology or microbiology major, students must meet the following criteria:

- Complete with a minimum GPA of 2.70 and a grade of C or higher: Biology 201A, 201B, 215; Chemistry 200, 201, 231; and Mathematics 121 and 122. These courses cannot be taken for credit/no credit (Cr/NC);
- Clear the competency requirement in writing. Refer to Graduation Requirements section of this catalog for details;
- Have a cumulative GPA and SDSU GPA of 2.60 or higher;
- To gain entry into the major, students must fulfill the premajor requirements described in the catalog in effect at the time they declare the premajor at SDSU (assuming continuous enrollment).
- Students choosing an emphasis in bioengineering have a different set of courses to complete in the preparation for the major. To be admitted to the major, bioengineering students must complete Biology 201A, 201B; Chemistry 200, 201, 231; Mathematics 150 and 151 with at least a C in each course; have a cumulative GPA of 2.70 or higher; have an SDSU GPA of 2.60 or higher; and complete the lower division writing competency requirement. Students may not elect credit/no credit grading for coursework needed to satisfy preparation for the major requirements.

To complete the major, students must fulfill the degree requirements for the major described in the catalog in effect at the time they are accepted into the premajor at SDSU (assuming continuous enrollment).

Biology Major

With the B.A. Degree in Liberal Arts and Sciences (Premajor Code: 04010) (Major Code: 04011)

All candidates for a degree in liberal arts and sciences must complete the graduation requirements listed in the section of this catalog on "Graduation Requirements." A total of 40 upper division units must be taken, of which 24 must be selected from the General Biology Degree Requirements and the list of courses acceptable for electives. No more than 48 units in biology courses can apply to the degree.

A minor is not required with this major.

Foreign Language Requirement. Competency (successfully completing the third college semester or fifth college quarter) is required in one foreign language as part of the preparation for the major. Refer to section of catalog on "Graduation Requirements."

Upper Division Writing Requirement. Passing the University Writing Examination or completing one of the approved writing courses with a grade of C (2.0) or better.

Biology Major

With the B.S. Degree in Applied Arts and Sciences (Premajor Code: 04010) (Major Code: 04011)

All candidates for a degree in applied arts and sciences must complete the graduation requirements listed in the section of this catalog on "Graduation Requirements." A total of 36 upper division units must be selected from the General Biology Degree Requirements and the list of courses acceptable for electives.

A minor is not required with this major.

General Biology Degree Requirements

Preparation for the Major. Biology 201A, 201B, 215; Chemistry 200, 201, and 231 or 232 and 232L; Mathematics 121 and 122; Physics 180A, 180B, 182A, 182B. (39 units)

Upper Division Writing Requirement. Passing the University Writing Examination or completing one of the approved writing courses with a grade of C (2.0) or better.

Major. A minimum of 24 upper division units for the B.A. degree or 36 upper division units for the B.S. degree to include Biology 352, 354, 366, 366L, and Chemistry 365. Elective courses include all upper division biology courses numbered 350 and above, Oceanography 541, and all upper division chemistry courses (except Chemistry 497, 560A-560B). A minimum of two elective courses must be biology laboratory courses, at least one of which must be an organismal level course selected from Biology 350, 460, 512, 514, 515, 520, 523, 524, 525, 526, 533, 588/588L.

No transfer course will substitute for Biology 352, 354, 366, or 366L, Chemistry 365 or for the organismal level requirement without the specific approval of the department.

All courses not included above must have specific approval of the department.

Time Limitation. All courses for the major must be completed within seven years of the granting of the undergraduate degree. Exceptions for individual courses must be approved by the department and be filed with the Office of Advising and Evaluations.

Emphasis in Bioengineering

San Diego State University is in the process of securing approval for the Emphasis in Bioengineering. For further information, contact the Department of Biology.

Preparation for the Major. Biology 201A, 201B; Chemistry 200, 201, and 231 or 232 and 232L; Engineering 190; Electrical Engineering 203; Engineering Mechanics 200; Mechanical Engineering 260; Mathematics 150, 151, 252; Physics 195, 196, 197. (55 units)

Upper Division Writing Requirement. Passing the University Writing Examination or completing one of the approved writing courses with a grade of C (2.0) or better.

Major. A minimum of 38 upper division units to include Biology 366, 366L and either Biology 350 or 590; Chemistry 365; Civil Engineering 301; Mathematics 342A; Mechanical Engineering 352, 490A*, 490B; 12 units selected from the following courses, at least six of which must be biology courses: Biology 499 or Mechanical Engineering 499; Biology 350, 467, 474, 555; either 556 or 557, 560, 569, 575 or 590; Chemistry 431; Electrical Engineering 303, 503; Exercise and Nutritional Sciences 306; Mechanical Engineering 310, 512, 540, 590.

No transfer courses will substitute without the approval of the department.

Time Limitation. All courses for the major must be completed within seven years of the granting of the undergraduate degree. Exceptions for individual courses must be approved by the department adviser and be filed with the Office of Advising and Evaluations.

* Additional prerequisites may be required.

Emphasis in Cellular and Molecular Biology

Preparation for the Major. Biology 201A, 201B, 215; Chemistry 200, 201, and 231 or 232 and 232L; Mathematics 121 and 122; Physics 180A, 180B, 182A, 182B. (39 units)

Upper Division Writing Requirement. Passing the University Writing Examination or completing one of the approved writing courses with a grade of C (2.0) or better.

Major. A minimum of 36 upper division units to include Biology 350, 352, 354, 366, 366L, 467, Chemistry 365 and 467L, and at least 11 units of electives selected from Biology and Chemistry 496 and/or 596 (maximum 3 units), Biology 499 and/or Chemistry 497 (maximum 3 units), Biology 521, 521L, 549, 550, 551, 551L, 552, 554, 555, 556, 557, 563, 565, 569, 570, 575, 580, 584, 485 or 585, 588/588L, 590, 594, 595, and Chemistry 431. At least one course must be an organismal level course. Approval of the Emphasis in Cellular and Molecular Biology adviser is required for credit in Biology and Chemistry 496,

499, and 596 and other courses not listed above to be included in the emphasis. This approval must be filed with the Office of Advising and Evaluations.

Other than Biology 352, 354, 366, 366L and Chemistry 365, only one course in this emphasis may be used for credit in another emphasis offered by the department.

No transfer course will substitute for Biology 352, 354, 366, 366L, 467 or Chemistry 365 and 467L without the approval of the Emphasis in Cellular and Molecular Biology adviser.

Time Limitation. All courses for the major must be completed within seven years of the granting of the undergraduate degree. Exceptions for individual courses must be approved by the department adviser and be filed with the Office of Advising and Evaluations.

Emphasis in Ecology

Preparation for the Major. Biology 201A, 201B, 215; Chemistry 200, 201, and 231 or 232 and 232L; Mathematics 121 and 122; Physics 180A, 180B, 182A, 182B. A computer programming course (e.g. Computer Science 106 or 107) is recommended. (39 units)

Upper Division Writing Requirement. Passing the University Writing Examination or completing one of the approved writing courses with a grade of C (2.0) or better.

Major. A minimum of 36 upper division units to include Biology 352, 354, 354L, 366, 366L, Chemistry 365, and at least 15 units of electives selected from Biology 496 and/or 596 (maximum 3 units), 499 (maximum 3 units), 507 (maximum 6 units), 526 or 533, 508, 509, 512, 517, 519, 527, 535, 538, 540, 541, 560, 563, 597A. At least one of the above electives must be a laboratory course. The remaining units must include an organismal level course selected from Biology 350, 460, 512, 515, 520, 523, 524, 525, 526, 533, 588/588L. Other electives include all biology courses numbered 350 and above (except Biology 452), Oceanography 541, and all upper division chemistry courses (except Chemistry 497, 560A-560B). Approval of the Emphasis in Ecology adviser is required for credit in Biology 496, 499, 507, 596, and other courses not listed above to be included in the 15 units of ecology electives. This approval must be filed with the Office of Advising and Evaluations.

Other than Biology 352, 354, 366, 366L, and Chemistry 365, only one course in this emphasis may be used for credit in another emphasis offered by the department.

No transfer course will substitute for Biology 352, 354, 366, 366L, or Chemistry 365 without the approval of the Emphasis in Ecology adviser.

Time Limitation. All courses for the major must be completed within seven years of the granting of the undergraduate degree. Exceptions for individual courses must be approved by the department adviser and be filed with the Office of Advising and Evaluations.

Emphasis in Evolution and Systematics

Preparation for the Major. Biology 201A, 201B, 215; Chemistry 200, 201, and 231 or 232 and 232L; Mathematics 121 and 122; Physics 180A, 180B, 182A, 182B. (39 units)

Upper Division Writing Requirement. Passing the University Writing Examination or completing one of the approved writing courses with a grade of C (2.0) or better.

Major. A minimum of 36 upper division units to include Biology 352, 354, 366, 366L, 509, Chemistry 365, and at least 12 units of electives selected from Biology 496 and/or 596 (maximum 3 units), 499 (maximum 3 units), 460, 508, 512, 515, 520, 521, 521L, 523, 524, 525, 526, 530, 531, 588/588L. Two of the above electives must be laboratory courses, one of which must be an organismal level course selected from Biology 512, 515, 520, 523, 524, 525, 526, 588/588L. Other electives include all biology courses numbered 350 and above (except Biology 452), Oceanography 541, and all upper division chemistry courses (except Chemistry 497, 560A-560B). Approval of the Emphasis in Evolution and Systematics adviser is required for credit in Biology 496, 499, 507, 596, and other courses not listed above to be included in the 12 units of evolution and systematics electives. This approval must be filed with the Office of Advising and Evaluations.

Other than Biology 352, 354, 366, 366L, and Chemistry 365, only one course in this emphasis may be used for credit in another emphasis offered by the department.

No transfer course will substitute for Biology 352, 354, 366, 366L, or Chemistry 365 without the approval of the Emphasis in Evolution and Systematics adviser.

Time Limitation. All courses for the major must be completed within seven years of the granting of the undergraduate degree. Exceptions for individual courses must be approved by the department adviser and be filed with the Office of Advising and Evaluations.

Emphasis in Marine Biology

Preparation for the Major. Biology 201A, 201B, 215; Chemistry 200, 201, and 231 or 232 and 232L; Mathematics 121 and 122; Physics 180A, 180B, 182A, 182B. (39 units)

Upper Division Writing Requirement. Passing the University Writing Examination or completing one of the approved writing courses with a grade of C (2.0) or better.

Major. A minimum of 36 upper division units to include Biology 352, 354, 366, 366L, Chemistry 365, and at least 15 units of electives selected from Biology 496 and/or 596 (maximum 3 units), 499 (maximum 3 units), 507, 512, 514, 515, 517, 519, 520, 541, and Oceanography 541. At least two of the above electives must be laboratory courses, at least one of which must be one of the organismal courses Biology 512, 514, 515 or 520. The remaining units must be selected from biology courses numbered 350 and above (except Biology 452), all upper division chemistry courses (except Chemistry 497, 560A-560B), and may include three units selected from Economics 454, Geography 504, Geological Sciences 540, 545, Oceanography 561. Approval of the Emphasis in Marine Biology adviser is required for credit in Biology 496, 499, 507, 596, and other courses not listed above to be included in the 15 units of marine biology electives. This approval must be filed with the Office of Advising and Evaluations.

Other than Biology 352, 354, 366, 366L, and Chemistry 365, only one course in this emphasis may be used for credit in another emphasis offered by the department.

No transfer course will substitute for Biology 352, 354, 366, 366L, or Chemistry 365 without the approval of the Emphasis in Marine Biology adviser.

Time Limitation. All courses for the major must be completed within seven years of the granting of the undergraduate degree. Exceptions for individual courses must be approved by the department adviser and be filed with the Office of Advising and Evaluations.

Emphasis in Zoology

Preparation for the Major. Biology 201A, 201B, 215; Chemistry 200, 201, and 231 or 232 and 232L; Mathematics 121 and 122; Physics 180A, 180B, 182A, 182B. (39 units)

Upper Division Writing Requirement. Passing the University Writing Examination or completing one of the approved writing courses with a grade of C (2.0) or better.

Major. A minimum of 36 upper division units to include Biology 352, 354, 366, 366L, Chemistry 365, and at least 15 units of electives selected from Biology 496 and/or 596 (maximum 3 units), 499 (maximum 3 units), and 515, 526, 588/588L (invertebrate group), 512, 520, 523, 524, 525 (vertebrate group), 508, 509, 527, 560, 577 (general zoology group). At least three units must be selected from each of the three groups. Two or more of the above electives must be laboratory courses, at least one of which must be an organismal level course selected from Biology 512, 515, 520, 523, 524, 525, 526, 588/588L. The remaining units must be selected from biology courses numbered 350 and above (except Biology 452), Oceanography 541, and all upper division chemistry courses (except Chemistry 497, 560A-560B). Approval of the Emphasis in Zoology adviser is required for credit in Biology 496, 499, 596, and other courses not listed above to be included in the 15 units of zoology electives. This approval must be filed with the Office of Advising and Evaluations.

No transfer course will substitute for Biology 352, 354, 366, 366L, or Chemistry 365 without the approval of the Emphasis in Zoology adviser.

Other than Biology 352, 354, 366, 366L, and Chemistry 365, only one course in this emphasis may be used for credit in another emphasis offered by the department.

Time Limitation. All courses for the major must be completed within seven years of the granting of the undergraduate degree. Exceptions for individual courses must be approved by the department adviser and be filed with the Office of Advising and Evaluations.

Microbiology Major

With the B.A. Degree in Liberal Arts and Sciences (Premajor Code: 04110) (Major Code: 04111)

All candidates for a degree in liberal arts and sciences must complete the graduation requirements listed in the section of this catalog on "Graduation Requirements." No more than 48 units in biology courses can apply to the degree.

A minor is not required with this major.

Preparation for the Major. Biology 201A, 201B, 215; Chemistry 200, 201, and 231 or 232 and 232L; Mathematics 121 and 122; Physics 180A, 180B, 182A, 182B. (39 units)

Foreign Language Requirement. Competency (successfully completing the third college semester or fifth college quarter) is required in one foreign language as part of the preparation for the major. It is recommended that students select French, German or Russian to satisfy this requirement. Refer to section of catalog on "Graduation Requirements."

Upper Division Writing Requirement. Passing the University Writing Examination or completing one of the approved writing courses with a grade of C (2.0) or better.

Major. A minimum of 26 upper division units to include Biology 350, 352, 354, 366, 366L, 521L, 549, Chemistry 365 and 467L.

No transfer course will substitute for Biology 352, 354, 366, 366L, or Chemistry 365, 467L without the specific approval of the Microbiology adviser.

All courses not included above must have the prior approval of the Microbiology adviser and be filed with the Office of Advising and Evaluations.

Time Limitation. All courses for the major must be completed within seven years of the granting of the undergraduate degree. Exceptions for individual courses must be approved by the department and be filed with the Office of Advising and Evaluations.

Microbiology Major

With the B.S. Degree in Applied Arts and Sciences (Premajor Code: 04110) (Major Code: 04111)

All candidates for a degree in applied arts and sciences must complete the graduation requirements listed in the section of this catalog on "Graduation Requirements."

A minor is not required with this major.

Preparation for the Major. Biology 201A, 210B, 215; Chemistry 200, 201, and 231 or 232 and 232L; Mathematics 121 and 122; Physics 180A, 180B, 182A, 182B. (39 units)

Upper Division Writing Requirement. Passing the University Writing Examination or completing one of the approved writing courses with a grade of C (2.0) or better.

Major. A minimum of 36 upper division units to include Biology 350, 352, 354, 366, 366L, 467, 521 or 584, 521L, 549, Chemistry 365, and at least four units of electives selected from Biology and Chemistry 496 and 596 (maximum 3 units), Biology 499 and Chemistry 497 (maximum 3 units), Biology 521, 550, 551, 551L, 552, 554, 555, 556, 557, 569, 580, 584, 485 or 585, 588, 588L, 590, 595, Chemistry 431, 467L. Approval of the Microbiology adviser is required for credit in Biology 496, 499, 596, and other courses not listed above to be included in the electives. This approval must be filed with the Office of Advising and Evaluations.

No transfer course will substitute for Biology 352, 354, 366, 366L, 467 or Chemistry 365 and 467L without the approval of the Microbiology adviser.

Time Limitation. All courses for the major must be completed within seven years of the granting of the undergraduate degree. Exceptions for individual courses must be approved by the department and be filed with the Office of Advising and Evaluations.

Emphasis in Medical Technology and Public Health Microbiology

The emphasis in medical technology and public health is a program of required and elective courses which prepares students for the Public Health Microbiologist and Clinical Laboratory Technologist academic certification and licensing examinations.

Preparation for the Major. Biology 201A, 201B, 215; Chemistry 200, 201, and 231 or 232 and 232L; Mathematics 121 and 122; Physics 180A, 180B, 182A, 182B. (39 units)

Upper Division Writing Requirement. Passing the University Writing Examination or completing one of the approved courses with a grade of C (2.0) or better.

Major. A minimum of 36 upper division units to include Biology 350, 352, 354, 366, 366L, 485 or 585, 521L, 549, 584, Chemistry 365. The remaining units to be selected from Biology 521, 551, 551L, 554, 555, 556, 557, 569, 580, 588, 588L, 590, 595, Chemistry 431, 467L. To be included in this major courses not listed above must have the prior approval of the Microbiology adviser and be filed with the Office of Advising and Evaluations.

No transfer course will substitute for Biology 352, 354, 366, 366L, or Chemistry 365 and 467L without the approval of the Microbiology adviser.

Time Limitation. All courses for the major must be completed within seven years of the granting of the undergraduate degree. Exceptions for individual courses must be approved by the department and be filed with the Office of Advising and Evaluations.

Biology Major

In preparation for the Single Subject Teaching Credential in Science/Biological Sciences

With the B.S. Degree in Applied Arts and Sciences (Premajor Code: 04010) (Major Code: 04011)

Students applying to the College of Education's graduate program for the Single Subject Teaching Credential in Science/Biological Sciences must be certified by this department for subject matter competency. This certification requires earning a B or better in Biology 452 and either (1) passing the required examinations (PRAXIS and SSAT), or (2) completing the subject matter preparation program described below.

Certification through the accomplishment of appropriate coursework requires (1) completion of the courses described under the General Biology Degree Requirements, B.S. degree (preparation for the major and major) including the following electives in the major: Biology 436, 452, 460 or 533, 560 or 590, Oceanography 541, and at least one course from Biology 515, 520, 523, 524, 525, or 526 (it is recommended that Biology 499 and Chemistry 467L be included if the major is being sought); (2) earning a B or better in Biology 452, (3) completing Astronomy 101, Geological Sciences 100 and 101. The Department of Biology credential adviser (LS-135) must be consulted for certification.

Please refer to the Teacher Education section of this catalog for other requirements and prerequisites for the credential program.

Time Limitation. All courses for the major must be completed within seven years of the granting of the undergraduate degree. Exceptions for individual courses must be approved by the department and be filed with the Office of Advising and Evaluations.

All courses not included above must have the prior approval of the Department and the substitution filed with the Office of Advising and Evaluations.

Biology Minor

Biology 100 and 100L or 201A are prerequisites to the biology minor and do not count towards the units in the minor; some areas include additional prerequisites not counted towards the minor.

The minor in biology consists of a minimum of 16-22 units to include Biology 201B and at least 12 units of upper division courses selected from one of the areas below. At least one of the selected courses must be a biology laboratory course numbered 350 or above. A maximum of three units of Biology 499 may be included in the minor with prior approval of the department. For courses requiring Biology 215 as a prerequisite, a college level course in statistics may be acceptable with the approval of the instructor.

Animal Behavior

Required: Biology 527. Electives: Biology 307, 324, 339, 354, 354L, 507, 524, Anthropology 500 and Psychology 417. Requirements for all biology minors (above) apply.

Biology for Physiological Psychology

Required: Biology 321, 336, 436, 570. Electives: Biology 307 or 339. At least one college course in chemistry is strongly recommended to complement this minor. Requirements for all biology minors (above) apply.

Cell Biology and Genetics

Prerequisites: Chemistry 200, 201, 231, 365. Electives: Biology 350, 352, 366L, 467, 521, 521L, 549, 563, and 590. Requirements for all biology minors (above) apply.

Ecology

Required: Biology 354. Electives: Biology 315, 324, 327, 339, 350, 354L, 509, and 540. Requirements for all biology minors (above) apply.

Elementary Education

Required: Biology 315, 336, 436, at least two units of Biology 499, and a minimum of two units of electives selected from any upper division biology course. A college level course in chemistry is strongly recommended to complement this minor. Requirements for all biology minors (above) apply.

Evolutionary Biology

Required: Biology 319 or 352 or 509, and an additional nine units of upper division biology courses selected from the following electives: Biology 319, 352, 508, 509, 526. Requirements for all biology minors (above) apply.

Human Biology

Required: Biology 336, 577, and a course in college chemistry, or Biology 261 or 590. Electives: Biology 307, 321, 326, 352, and 590. Requirements for all biology minors (above) apply.

Marine Biology

Required: Biology 515 or 520. Electives: Biology 324, 515, 517, 519, 520, and 524. Requirements for all biology minors (above) apply.

Plant Biology

Required: Biology 460, 531, 533, 535. Electives: Biology 326, 530, and 563. Requirements for all biology minors (above) apply.

Secondary Education

Prerequisite: College level course in statistics. Required: Biology 354, 452, 533. Electives (at least one course from each group): Biology 336, 560, 590; Biology 520, 524, 525 or 527. Basic courses in genetics, microbiology, and organic chemistry are recommended. (20-21 units)

Courses in the minor may not be counted toward the major, but may be used to satisfy preparation for the major and general education requirements, if applicable. A minimum of six upper division units must be completed at San Diego State University.

Biotechnology Certificate

Matriculated students must apply for admission to the program before completion of 15 certificate units and must complete all prerequisite and required courses with a GPA of 2.5 or better and Biology 551 and 552 with a grade of B or better.

The certificate requires 13 prerequisite units – Biology 350, 366, 366L, Chemistry 365 and 24-28 certificate units including Biology 467, 498 or 499 (5 units as approved by the certificate adviser), 551, 552, 594, Chemistry 467L, and three electives selected from Biology 521, 521L, 549, 554, 569, 570, 575, 580, 584, 585, 590. Biology 551 and 552 must be taken at San Diego State University, either in residence or through Open University. Prerequisite and certificate courses may be utilized in the biology, chemistry, and microbiology majors and minors as appropriate.

Courses in the certificate may not be counted toward the minor.

Courses (BIOL)

LOWER DIVISION COURSES

100. General Biology (3) I, II

Prerequisite recommended: Concurrent registration in Biology 100L.

A beginning course in biology stressing processes common to living organisms. Not open to students with credit in Biology 203 or biological sciences majors; see Biology 201A, 201B.

100L. General Biology Laboratory (1) I, II

Three hours of laboratory.

Prerequisite: Credit or concurrent registration in Biology 100.

A laboratory course in biology stressing processes common to living organisms. Not open to students with credit in Biology 203 or biological sciences majors; see Biology 201A, 201B.

101. World of Animals (3)

Animal adaptation and diversity and their relationship to the development of evolutionary theory. Not open to biological sciences majors.

101L. World of Animals Laboratory (1)

Three hours of laboratory.

Prerequisite: Credit or concurrent registration in Biology 101.

Laboratory course on evolution and diversity of animals involving field trips and laboratory investigations. Not open to biological sciences majors.

200. Concepts in Biology (3) I

Two lectures and one hour of discussion.

Prerequisite: First semester freshman standing.

Concepts and emphases of modern biology to include nature and methods of science, relationship between structure and function, homeostasis, genetic continuity, evolution, systematics and ecology. Designed for and enrollment limited to first semester freshmen whose preparation for the major includes Biology 201B. Students with credit in Biology 200 and 201B will receive a total of four units toward a degree.

201A. Principles of Cell and Molecular Biology (4) I, II

Three lectures and three hours of laboratory.

Prerequisite: Chemistry 200.

Principles of biology applying to all organisms, including cell structure, membrane transport, energy metabolism, cell division, classical and molecular genetics, recombinant DNA, population genetics, mechanisms of evolution, and the basis of classification. (Formerly numbered Biology 202.)

201B. Principles of Organismal Biology (4) I, II

Three lectures and three hours of laboratory.

Prerequisite: Satisfaction of the English Placement Test requirement. Strongly recommended: Completion of Biology 201A.

Principles of biology covering all organisms, including systematics and diversity of bacteria, protista, fungi, plants and animals, and concepts of physiology, reproduction, development and differentiation, ecology, and the causes of the endangerment of a species. (Formerly numbered Biology 201.)

203. Understanding Biology (4) II

Three lectures and two hours of laboratory.

Major conceptual principles of biology, with emphasis on evolution, inheritance, cellular life, biodiversity, ecology, and behavior. Evaluation of learning strategies and initial alternative conceptions about biology. Not open to students with credit in Biology 100 and 100L or to biological sciences majors.

210. Fundamentals of Microbiology (4) I, II

Two lectures and six hours of laboratory.

Prerequisites: Biology 201A; or Biology 100, Chemistry 100 and 130.

For nursing and foods and nutrition majors. Study of microorganisms of the environment, including disease-producing organisms, their actions and reactions. Not open to biological sciences majors; see Biology 350.

212. Human Anatomy (4) I, II

Two lectures and six hours of laboratory.

Prerequisite: Biology 100 or 201A.

Gross and microscopic anatomy of organ system of human body.

215. Biostatistics (3) I, II

Two lectures and three hours of laboratory.

Prerequisites: Credit or concurrent registration in Biology 201A or 201B and Mathematics 121 or 141.

Methods and experience in defining and solving quantitative problems in biology, including design of experiments, and parametric and nonparametric statistical techniques. Students with credit or concurrent registration in the following lower division courses will be awarded a total of four units for the two (or more) courses: Biology 215; Civil Engineering 160; Economics 201; Political Science 201; Psychology 270; Sociology 201; Statistics 119, 250. Same course as Biology 216-216L.

224. Marine Topics at Sea World (1) (Offered only in Extension)

Prerequisite: College course in biology.

Marine topics of current interest. May be repeated with different topic and consent of instructor for maximum credit four units. See Extension catalog for specific content.

246. Colloquium in Biomedical Sciences (1) II

Prerequisite: University level biology course.

Current biomedical research projects ranging from cell biology to behavioral research. Research paper required. Maximum credit two units.

247. Advanced Degree Programs in the Sciences: Application Strategies (1)

Prerequisite: Junior or senior standing.

Instruction in preparing competitive applications to sciences' M.S. and Ph.D. degree programs to include development of the required personal statement. Introduction to sources of financial support, such as national fellowship programs, and development of interview skills and materials. Maximum credit one unit for any combination of Biology 247, 248, 249, 250A-250B-250C.

248. Careers in Biological Sciences (1) Cr/NC

Career opportunities in biological sciences. Specialists in major biological areas will present information about their fields and how best to prepare for careers. Maximum credit one unit for any combination of Biology 247, 248, 249, 250A-250B-250C.

249. Career Choices in the Health Professions (1)

Career opportunities in allied health professions; trends in health care; discussion of medical ethics; practicing professionals will present about their fields and how best to prepare for careers in their area of health care. Maximum credit one unit for any combination of Biology 247, 248, 249, 250A-250B-250C.

250. Preprofessional Topics (1) Cr/NC

A. Topics in Medicine.

B. Topics in Dentistry.

C. Topics in Veterinary Medicine.

Designed to expose the preprofessional student to the profession of his/her choice through speakers and selected readings. Emphasis on alternatives and meeting stresses as a preprofessional student. Maximum credit one unit for any combination of Biology 247, 248, 249, 250A-250B-250C.

261. Human Physiology (4) I, II

Three lectures and three hours of laboratory.

Prerequisites: Chemistry 100; Biology 100 or 201A, 212; credit or concurrent registration in Chemistry 130.

Human function viewed from cellular through organ system levels of organization. Intended primarily for prenursing students. Not open to biological sciences majors or students with credit in Biology 336, 436, or 590.

277. Medical Terminology (2)

Prerequisite: Biology 201B.

Words and word components used in medical and allied medical practice translated, investigated, and applied.

291. Biology Laboratory (1) I, II

Prerequisites: Recommendation by department and consent of instructor.

Special course to allow makeup of program laboratory deficiencies. Student will be assigned to a laboratory section of the appropriate course.

A. Laboratory for Biology 201B.

B. Laboratory for Biology 201A.

C. Laboratory for Biology 215.

296. Experimental Topics (1-4)

Selected topics. May be repeated with new content. See Class Schedule for specific content. Limit of nine units of any combination of 296, 496, 596 courses applicable to a bachelor's degree.

299. Special Study (1-2)

Individual research experience and interaction with researchers at an introductory level. Projects involve approximately 45 hours of laboratory or fieldwork per unit and a research report. Hours are flexible and arranged between the student and the researcher. Maximum credit four units.

UPPER DIVISION COURSES (Intended for Undergraduates)

Writing Requirements: Completion of the English Placement Test and Writing Competency requirements is a prerequisite for all upper division biology courses numbered 350 and above.

307. Biology of Sex (3) I, II, S

Prerequisite: Completion of the General Education requirement in Foundations II.A.2. Life Sciences. If a biological science course is not taken to satisfy General Education II.A.2. Life Sciences, a college course in biological science is required.

Reproductive adaptations in humans, and comparatively in other species. Topics include sex differences, mate choice and mating behavior, fertility regulation, fertilization and embryonic development, sex ratios, parental investment, effects of aging, and life history strategies. Not applicable to biological sciences majors.

315. Ecology and Human Impacts on the Environment (3)

Prerequisite: Completion of the General Education requirement in Foundations II.A. Natural Sciences and Quantitative Reasoning. If a biological science course is not taken to satisfy General Education II.A.2. Life Sciences, a college course in biological science is required.

Ecological characteristics of natural ecosystems and basic effects of human society upon those systems, emphasizing resource management, food production, global environmental problems, and future directions. Not applicable to biological sciences majors.

318. The Origins of Life (3)

Prerequisite: Completion of the General Education requirement in Foundations II.A. Natural Sciences and Quantitative Reasoning. A college level course in chemistry or physics. If a biological science course is not taken to satisfy General Education II.A.2. Life Sciences, a college course in biological science is required.

Theories of chemical evolution with emphasis on multidisciplinary aspects involving geology, geochemistry, cosmochemistry and molecular biology. Not applicable to biological sciences majors. (Formerly numbered Natural Science 431.)

319. Evolution (3)

Prerequisite: Completion of the General Education requirement in Foundations II.A.2. Life Sciences. If a biological sciences course is not taken to satisfy General Education II.A.2. Life Sciences, a college course in biological sciences is required.

Modern theory of organic evolution with emphasis on processes involved as they relate to past, present, and future evolution of mankind. Not applicable to biological sciences majors; see Biology 352.

321. Human Heredity (3) I, II

Prerequisite: Completion of the General Education requirement in Foundations II.A.2. Life Sciences. If a biological sciences course is not taken to satisfy General Education II.A.2. Life Sciences, a college course in biological sciences is required.

Selected principles of human inheritance with emphasis on relationships to other fields of human studies. Not applicable to biology or microbiology majors; see Biology 352.

324. Life in the Sea (3)

Prerequisite: Completion of the General Education requirement in Foundations II.A.2. Life Sciences. If a biological sciences course is not taken to satisfy General Education II.A.2. Life Sciences, a college course in biological sciences is required.

Overview of complexity of marine life. Diverse interactions of organisms in the intertidal zone, over the continental shelves and in the open oceans. Current controversies concerning the marine biosphere. Not applicable to biological sciences majors.

326. Plants, Medicines, and Drugs (3)

Prerequisite: Completion of the General Education requirement in Foundations II.A.2. Life Sciences. If a biological sciences course is not taken to satisfy General Education II.A.2. Life Sciences, a college course in biological sciences is required.

Medicinal plants, toxic-poisonous plants, herbal medicines, psychoactive plants, preparation of medicines and mechanisms of action; current research results on medicinal plants and drugs used in diseases such as diabetes, cancer, and heart diseases. Not applicable to biological sciences majors.

327. Conservation of Wildlife (3) I, II

Prerequisite: Completion of the General Education requirement in Foundations II.A.2. Life Sciences. If a biological sciences course is not taken to satisfy General Education II.A.2. Life Sciences, a college course in biological sciences is required.

Global ecosystems and their dynamics, with emphasis on sustainable human use and preservation and biodiversity. Not applicable to biological sciences majors.

336. Principles of Human Physiology (3) I, II

Prerequisite: Completion of the General Education requirement in Foundations II.A.2. Life Sciences. If a biological sciences course is not taken to satisfy General Education II.A.2. Life Sciences, a college course in biological sciences is required.

Systems of the human body, their interrelationships and control systems which regulate them. Not open to students with credit in a college course in human physiology. Not applicable to biological sciences majors.

339. Sociobiology (3)

Prerequisites: Biology 100 or 101 or Anthropology 102 or Psychology 101, and completion of the General Education requirement in Foundations II.A.2. Life Sciences.

Biological bases of social behavior in animals with emphasis on altruism, aggression, territoriality, mating systems, mate choice, parental care, communication, cooperative hunting, and predator avoidance. Not applicable to biological sciences majors.

340A. Preventive Dentistry Program (1-2) Cr/NC

Four hours of clinical and other activities per unit.

Prerequisites: Upper division standing and active pre dental file in the Preprofessional Health Advising Office.

Participation in clinic, dental observation, marketing activities and two field trips. Maximum credit four units. Not applicable to biological sciences majors.

340B. Preventive Dentistry Leaders (2-4)

Four hours of activity per unit.

Prerequisites: Biology 340A and consent of instructor.

Supervision of one component of Preventive Dentistry Program. Maximum credit four units. Not applicable to biological sciences majors.

341. The Human Body (3) I, II

Prerequisite: Completion of the General Education requirement in Foundations II.A.2. Life Sciences.

Survey of human body with emphasis on intricacy of design and integration of various organ systems. Not open to nursing, exercise and nutritional sciences, or biological sciences majors, or to students with credit in any college level human physiology or anatomy course.

344. Advanced Human Anatomy (2)

One lecture and three hours of laboratory.

Prerequisite: Biology 212 and consent of instructor.

Advanced topics in human anatomy with emphasis toward dissection of human cadavers. Dissection techniques, pathology, and special training in prosection. Not applicable to biological sciences majors.

348. Health Professions Internship (1)

Prerequisites: 3.0 overall GPA, completion of lower division writing competency requirement, and consent of instructor.

Internship in a health care setting; term paper required. Maximum credit three units. Not applicable to biological sciences majors.

350. General Microbiology (4) I, II

Two lectures and six hours of laboratory.

Prerequisites: Biology 201A, 201B, and 215; Chemistry 231.

Actions and reactions of microorganisms in response to their environment, both natural and as changed by other organisms, including man. Also includes an introduction to pathogens.

352. Genetics and Evolution (3) I, II

Prerequisites: Biology 201A, 201B, and 215.

Principles of transmission genetics, population genetics, and evolution.

354. Ecology and the Environment (3) I, II

Prerequisites: Biology 201A, 201B, 215; and Mathematics 122

Fundamental concepts in population, community, and ecosystem ecology.

354L. Experimental Ecology (2)

One hour of discussion and three hours of laboratory.

Prerequisite: Credit or concurrent registration in Biology 354.

Methods of research in ecology; approaches to analysis of populations, communities, and ecosystems.

366. Biochemistry, Cell and Molecular Biology II (4)

Prerequisite: Chemistry 365.

Concepts of modern integrated molecular biology, cell biology, and biochemistry.

366L. Biochemistry, Cell and Molecular Biology Laboratory I (2)

Six hours of laboratory.

Prerequisite: Credit or concurrent registration in Biology 366.

Basic laboratory approaches in biochemistry, cell biology, and molecular biology.

436. Human Physiology Laboratory (2)

One lecture and three hours of laboratory.

Prerequisite: Credit or concurrent registration in Biology 336 or 590.

Human physiology and rationale of current week's laboratory and experimental outcomes of previous week's laboratory. Not open to students with credit in Biology 261.

440. Laboratory Techniques in Molecular Genetics (3)

Prerequisites: Biology 350 or 366L and consent of instructor. Recommended: Biology 549.

Laboratory methods in molecular genetics; experimental design, basic approaches to research problems in molecular genetics; students design and carry out projects under direction of instructor. Maximum combined credit six units for Biology 440 and 499.

450. Development of Modern Biology (3)

Prerequisites: Biology 201A and 201B.

History of development of modern biology stressing integration, organizing and understanding of modern topics or evolution genetics and developmental biology.

452. Science Concept Development and Integration (3)

Two lectures and three hours of activity.

Prerequisite: Senior standing, or participation in the science single subject credential program.

Development and integration of biological science content knowledge, introduction to learning theory, and transformation of knowledge. Designed for students preparing for the single subject teaching credential in life sciences.

460. Economic Botany (3)

Two lectures and three hours of laboratory.

Prerequisites: Biology 201A and 201B.

Plants of agricultural, economic, and historical importance. Topics include basic plant morphology, anatomy, and taxonomy, plant genetics, agricultural breeding and propagation techniques, vegetables and fruits, spices and herbs, beverage plants, woods and plant fibers.

461. Underwater Research Methods and Techniques (3)

Two lectures and three hours of laboratory.

Prerequisites: Biology 201B and Exercise and Nutritional Sciences 323 or Oceanography 306, and three upper division units in biology, Advanced Openwater or Scientific Scuba Diving Certification, diving skills proficiency evaluation, acceptable openwater diving equipment, medical examination, approval for scuba diving and waiver for scuba diving.

Preparation for scientific research underwater; scientific methods, techniques, operations and specialized equipment; scientific diver training and certification requirements; diving procedures and regulations; diving equipment; diving physiology hyperbaric conditions, fitness, practical diving skills, safety and emergency procedures.

467. Biochemistry, Cell and Molecular Biology III (4)

Prerequisite: Biology 366.

Advanced concepts of modern integrated cell biology, molecular biology and biochemistry.

474. Histology (4)

Two lectures and six hours of laboratory.

Prerequisite: Biology 201B. Recommended: Biology 212.

Descriptive microscopic anatomy of cells, tissues and organs of mammals with special emphasis on humans.

485. Principles of Immunology (3)

Prerequisites: Biology 201A, Chemistry 365, credit or concurrent registration in Biology 366.

Basic areas of immunology to include inflammation, generation of immune response, antibody production, lymphocyte development and function, hypersensitivities and AIDS, major histocompatibility complex and cytokines. Designed to give a basic background in the immune system.

490. Undergraduate Honors Research (3)

Prerequisites: Upper division standing with GPA of at least 3.20, four units of Biology 499, and approval of honors research program coordinator.

Experience in designing and carrying out independent research in a laboratory setting plus a written record of experimental design and results in the form of an honors research thesis to be presented at an undergraduate research forum and/or defended before a committee. Does not satisfy laboratory requirement in major. Maximum credit six units.

496. Experimental Topics (1-4)

Selected topics. May be repeated once with new content. See Class Schedule for specific content. Limit of nine units of any combination of 296, 496, 596 courses applicable to a bachelor's degree.

498. Laboratory Experience in Modern Industrial Technology (1-5) Cr/NC I, II

Up to 20 hours per week in academic year, 40 hours per week in summer sessions.

Prerequisites: Fifteen upper division units in biological sciences with grades of A or B and consent of instructor.

Practical laboratory experience in local industrial or SDSU campus laboratories emphasizing current technology. Maximum credit five units applicable to Recombinant DNA Technology certificate. Does not apply to biological sciences majors.

499. Special Study (1-3) I, II

Prerequisites: Upper division status in good standing and consent of instructor.

Individual research experience and interaction with researchers, on or off campus. Projects involve a total of approximately 45 hours of laboratory or fieldwork per unit and a research report. Hours are flexible and arranged between student and researcher. Maximum credit six units. Maximum six units applicable to the biology major for any combination of Biology 499, and Chemistry 499. Maximum three units applicable to the microbiology major for any combination of Biology 499 and Chemistry 499.

UPPER DIVISION COURSES (Also Acceptable for Advanced Degrees)

Writing Requirements: Completion of the English Placement Test and Writing Competency requirements is a prerequisite for all upper division biology courses numbered 350 and above.

507. Topics in Ecology (2-4)

Two or three lectures and 0 to 6 hours of laboratory.

Prerequisite: Biology 354 and as may be indicated in the Class Schedule.

Treatment of particular advanced aspects of ecology not covered in regular courses, including insect ecology, intertidal ecology, and ecology of the Colorado River Delta. See Class Schedule for specific content. Maximum credit six units.

508. Coevolution (3)

Prerequisites: Biology 352 and 354.

Coevolution in interspecific interactions, like herbivory, predation, parasitism, competition, pollination, and mimicry.

509. Evolutionary Biology (3)

Two lectures and two hours of activity.

Prerequisite: Biology 352.

Evolutionary biology including genetics of populations, speciation, systematic biology, adaptation, role of development in evolution, evolution of behavior, and comparative biology. Evolutionary biology as the central organizing principle of biology.

512. Evolution and Ecology of Marine Mammals (3)

Two lectures and three hours of laboratory.

Prerequisites: Biology 352 and 354.

Biology of marine mammals to include pinniped, cetacean and sirenian evolution, diet and foraging strategies, social organization, reproductive strategies, echolocation, diving physiology, and conservation.

514. Biology of the Algae (4)

Three lectures and three hours of laboratory.

Prerequisites: Biology 201B and six units of upper division course-work in the major.

Evolution, life histories, morphology, physiology, and ecology of micro and macro algae, with attention to both marine and freshwater taxa, and of sea-grasses.

515. Marine Invertebrate Biology (4)

Two lectures and six hours of laboratory.

Prerequisite: Biology 201B. Strongly recommended: Completion of three to six upper division units in the major.

Structure and function, ecology, behavior, physiology and phyletic relationships of marine invertebrate animals.

517. Marine Ecology (4)

Two lectures and six hours of laboratory.

Prerequisite: Biology 354.

Ecological concepts as applied to pelagic and benthic marine organisms and their environment. Field and laboratory experience in oceanographic techniques, particularly the coastal environment.

519. Aquaculture (3)

Prerequisite: Biology 201B. Strongly recommended: Completion of three to six upper division units in the major.

Principles and practices of the farming of aquatic organisms.

520. Ichthyology (4)

Three lectures and three hours of laboratory.

Prerequisite: Biology 201B. Strongly recommended: Completion of three to six upper division units in the major.

Identification, systematics, evolution, structure, physiology, behavior and ecology of fishes.

521. Advanced General Microbiology (2)

Prerequisites: Biology 350 or an introductory course in microbiology and consent of instructor.

Taxonomy, comparative physiology and ecology of representative microorganisms found in various natural environments.

521L. Advanced Microbiology Laboratory (3)

One lecture and six hours of laboratory.

Prerequisites: Biology 350, 366, 366L, and credit or concurrent registration in Biology 521 or 584. Strongly recommended: Credit or concurrent registration in an upper division writing course.

Procedures and methods for isolation, characterization and identification of prokaryotes from soil, water and humans; includes both pathogenic and non-pathogenic prokaryotes.

523. Herpetology (4)

Two lectures and six hours of laboratory.

Prerequisite: Biology 201B. Recommended: Biology 352.

Evolution, systematics, distribution, and ecology of amphibians and reptiles of the world.

524. Ornithology (4)

Two lectures, six hours of laboratory or field excursions, and a field project.

Prerequisite: Biology 201B. Strongly recommended: Completion of three to six upper division units in the major.

Study and identification of birds, especially those of the Pacific Coast and the San Diego region.

525. Mammalogy (4)

Two lectures and six hours of laboratory.

Prerequisite: Biology 201B. Strongly recommended: Completion of three to six upper division units in the major.

Evolution, systematics, distribution and ecology of mammals of the world.

526. Terrestrial Arthropod Biology (4)

Two lectures and six hours of laboratory.

Prerequisite: Biology 201B. Strongly recommended: Biology 352 and completion of three to six upper division units in the major.

Structure, function, behavior, ecology, evolution, and relationships of major groups of terrestrial arthropods, including insects, arachnids, and myriapods. Identification and natural history of southern California diversity.

527. Animal Behavior (4)

Three lectures and three hours of laboratory.

Prerequisites: Biology 215; Biology 201B or Psychology 211 and 260 for psychology majors.

Biological bases of animal behavior with emphasis on the ethological approach, including the evolution and adaptive significance of behavior.

530. Plant Systematics (4)

Two lectures and six hours of laboratory, field trips.

Prerequisite: Biology 201B. Strongly recommended: Completion of three to six upper division units in the major.

Plant description, identification, classification, and nomenclature with emphasis on evolutionary patterns, interdisciplinary data acquisition, and phylogenetic analysis.

531. Taxonomy of California Plants (4)

Two lectures and six hours of laboratory.

Prerequisite: Biology 201B. Strongly recommended: Completion of three to six upper division units in the major.

Fundamentals of plant taxonomy with emphasis on identification of plants native and naturalized to California. Plant collecting techniques. Field trips are required.

533. Plant Structure and Function (3)

Two lectures and three hours of laboratory.

Prerequisite: Biology 201B. Strongly recommended: Completion of three to six upper division units in the major.

Relationships between plant structure and function. Morphology and anatomy of vascular plants considering specific function of plant organs. Approaches to solve plant morphological problems. Techniques of plant anatomy.

535. Plant Ecology (4)

Three lectures and three hours of laboratory.

Prerequisite: Biology 201B. Strongly recommended: Completion of three to six upper division units in the major.

Plant adaptation and response to living and non-living environment including aspects of plant evolution, demography, ecophysiology community and ecosystem dynamics and soil-plant relationships. Terrestrial systems emphasized.

538. Environmental Policy and Regulations (3)

Prerequisite: Biology 354.

History of biological conservation and environmental laws; regulations governing biological resources; role of biologists; environmental impact analysis, operation of regulatory and resource agencies; biologists as expert witnesses; wetland protection and mitigation, state heritage programs, role of nongovernmental agencies.

540. Conservation Ecology (3)

Two lectures and three hours of laboratory.

Prerequisite: Biology 354.

Human impacts on ecosystems, the resultant endangerment and extinction of plant and animal species, and strategies for the protection and recovery of threatened forms.

541. Ecology of Fishes and Fisheries Biology (3)

Two lectures and three hours of laboratory.

Prerequisite: Biology 354. Recommended: Biology 520.

Ecology of fishes, including environmental constraints, habitats, feeding, behavior, growth, reproduction, biotic interactions, population dynamics and assemblage structure. Fisheries biology concepts, including stock recruitment models, climates and fisheries, density dependence and population regulation, and populations dynamics theory.

549. Microbial Genetics and Physiology (3)

Prerequisite: Biology 350 or 366.

Physiology of microbial growth, bacterial structure and function, genetics of bacteriophages and bacteria.

550. Eukaryotic and Prokaryotic Molecular Biology (4)

Prerequisites: Biology 352, 366, and Chemistry 365.

Gene structure, organization, and regulation in prokaryotes and eukaryotes. Mechanisms of RNA and protein synthesis. Dynamic aspects of the genome.

551. Recombinant DNA (3) I, II

Prerequisites: Biology 350, 366, 366L, Chemistry 365, and credit or concurrent registration in Biology 467 or 549.

Theory and practice of recombinant DNA techniques.

551L. Recombinant DNA Laboratory (2)

Six hours of laboratory.

Prerequisites: Biology 350, 366, 366L, Chemistry 365, and credit or concurrent registration in Biology 467 or 549.

A laboratory course in recombinant DNA techniques.

552. Advanced Cell and Molecular Biology Laboratory (3)

Nine hours of laboratory.

Prerequisite: Biology 366L. Credit in Chemistry 467L.

Laboratory experience for advanced undergraduates utilizing cell and molecular biological techniques. Independent research project guided by instructor.

554. Molecular Virology (3)

Prerequisites: Biology 366 and Chemistry 365. Credit or concurrent registration in Biology 467 or 549.

Molecular aspects of structure, genetics, and replication of viruses, virus-host interactions, pathogenesis of virus infections, diagnostic virology, and antiviral vaccines and drugs; emphasis on human pathogens.

555. Principles of Electron Microscopy (1)

Prerequisites: Biology 201B and Physics 180B.

Principles of scanning and transmission electron microscopy including theoretical basis of sample preparation.

556. Scanning Electron Microscopy Laboratory (2)

Six hours of laboratory.

Prerequisite: Credit or concurrent registration in Biology 555.

Biological specimen preparation and operation of scanning electron microscope.

557. Transmission Electron Microscopy Laboratory (3)

One lecture and six hours of laboratory.

Prerequisite: Credit or concurrent registration in Biology 555.

Biological sample preparation and operation of transmission electron microscope.

560. Animal Physiology (3)

Prerequisites: Biology 201A, 201B; Chemistry 365; Physics 180B, 182A, and 182B.

Physiology of vertebrate and invertebrate animals with emphasis on diversity of solutions to physiological problems and on functional integration of organ systems.

561. Radiation Biology (3)

Prerequisites: Biology 100 or 201A and 201B; Physics 180B, 182A, and 182B. Recommended: Biology 366.

Principles underlying radiological reactions of ionizing radiations. Effects of ionizing radiations at the biochemical, cell, organ, and organism levels.

561L. Radiation Biology Laboratory (2)

Six hours of laboratory.

Prerequisite: Credit or concurrent registration in Biology 561.

The laboratory determination of the effects of ionizing radiation on biological systems.

563. Plant Physiology (3)

Prerequisites: Biology 201B and Chemistry 365.

Activities of plants, including photosynthesis, ion transport, translocation, water relations, growth and development.

565. Human Genetics (3)

Prerequisites: Biology 352 and Chemistry 365. Recommended: Credit or concurrent registration in Biology 366.

Pedigree analysis, gene mapping, cytogenetic and molecular analysis of inherited disease and genetically controlled phenomena in humans.

569. Molecular Pharmacology (3)

Prerequisite: Biology 366.

Molecular mechanisms of drug action emphasizing pharmacokinetics, drug-receptor theory, signal transduction, physiological effects of drugs on nervous cardiovascular and endocrine systems. Includes discussion of molecular approaches to rational drug design, development, and testing in the pharmaceutical industry.

570. Neurobiology (3)

Prerequisite: Biology 366 or 590 or Psychology 260.

Structure and function of the nervous system to include cellular and molecular mechanisms underlying neuronal excitability and synaptic function, nervous system development, cellular and systems analysis of sensory, motor and higher brain functions. Emphasis on experimental approaches.

575. Molecular Basis of Heart Disease (3)

Prerequisite: Biology 366 or 590.

Current literature on the molecular basis of disordered physiology leading to heart disease.

577. Embryology (4)

Two lectures and six hours of laboratory.

Prerequisites: Biology 201A and 201B. Strongly recommended: Completion of three to six upper division units in the major.

Studies in comparative gametogenesis, morphogenesis, and reproductive physiology.

580. Cell Biology of the Blood (3)

Prerequisites: Biology 366, 366L, Chemistry 365. Recommended: Concurrent registration in Biology 467 and Chemistry 467L.

Basic processes of cell development, inflammation, acquired immune response, and regulation of these processes by cytokines.

584. Medical Microbiology (2)

Prerequisites: Biology 350 and 366.

Discussion of major bacterial and viral pathogens; molecular mechanisms of pathogenesis, microbial toxins and antimicrobial agents; immune response to microbial infections; biochemical and molecular diagnostics.

585. Cellular and Molecular Immunology (3)

Prerequisites: Biology 366. Recommended: Credit or concurrent registration in Biology 467 and Chemistry 467L.

Cellular and molecular aspects of the immune response. Genetics of immunoglobulins, major histocompatibility complex, lymphocyte development and their manifestations on immune responsiveness, lymphokines immunopathologies including AIDS, and contemporary immunological techniques. Not open to students with credit in Biology 485.

588. Parasitology (2)

Prerequisite: Biology 201B. Strongly recommended: Completion of three to six upper division units in the major.

Study of animal parasites with special reference to those of humans.

588L. Parasitology Laboratory (2)

Six hours of laboratory.

Prerequisite: Credit or concurrent registration in Biology 588.

Examination of animal parasites including identification of important human parasites; collection and preservation of local forms. (Formerly the laboratory portion of Biology 588.)

590. Physiology of Human Systems (4)

Three lectures and one hour of discussion.

Prerequisites: Chemistry 365, Physics 180B, 182B; or for the bioengineering emphasis: Physics 195, 196, 197. Recommended: Biology 366.

Human physiology presented at both cellular and organ system levels; neurophysiology, muscle physiology, cardiovascular physiology and respiration, kidney function, hormone function and reproduction. For students majoring in a natural science or pre-professional studies.

594. Biotechnology Research Rounds (2)

Prerequisites: Biology 366 and credit or concurrent registration in Biology 467.

Latest research methods in the biotechnology community. Speakers from local biotechnology companies and research institutes will discuss the power and limitations of current research methods being applied to develop new therapeutics. Evaluation of approaches, results, and utility of these technologies.

595. Computers in Biomedical Research (3)

Prerequisite: Biology 366 or 590. Recommended: Computer Science 107.

Application of micro- and minicomputers to tasks encountered by biomedical scientists in research laboratories (data acquisition and reduction, experiment control) and by physicians in medical care delivery (noninvasive imaging, clinical laboratory automation, patient file processing).

596. Special Topics in Biology (1-4)

Prerequisite: Consent of instructor.

Advanced selected topics in modern biology. May be repeated with new content. See Class Schedule for specific content. Limit of nine units of any combination of 296, 496, 596 courses applicable to a bachelor's degree. Maximum combined credit of six units of 596 and 696 applicable to a 30-unit master's degree. Additional units acceptable with the approval of the graduate adviser.

597A. Univariate Statistical Methods in Biology (3)

Two lectures and three hours of laboratory.

Prerequisite: Biology 350 or 352 or 354 or 366.

Application of univariate statistical techniques in biological sciences.

GRADUATE COURSES
Refer to Bulletin of the Graduate Division.

