

School of Life Sciences

Purpose and Focus

Biology is the study of life. The earth is filled with an enormous variety of living organisms; therefore, an understanding of the basic biological processes common to all organisms is essential to understanding the world. In recent decades, great strides have been made in understanding important biological processes, particularly those at the molecular, cellular, and ecosystem levels. An understanding of biological systems depends, in part, on the principles of physics and chemistry; thus a firm background in the physical sciences is also important in the study of biology. For many, an undergraduate major in biology serves as a basis for postgraduate study in the life sciences. School of Life Sciences graduates have gone on to advanced graduate study, leading to careers in college or university teaching, basic and applied research, and public health. Many have entered professional programs in medicine, veterinary medicine, and dentistry. Other graduates have gone directly into secondary (high school) science teaching, the biomedical industry, independent laboratory research, natural resources management, or environmental education.

Accreditation

Northwestern Commission on Colleges and Universities

Undergraduate Major

Biological Sciences

Degree Objectives/Learning Outcomes

The primary mission of the School of Life Sciences is to provide a rich, contemporary learning environment that ensures an integrated educational experience spanning the full spectrum of biology, with focused training available to advanced undergraduate students. Through these efforts, the School of Life Sciences will occupy central roles in creating scientific literacy among the diverse array of UNLV students and in addressing biological issues of local, regional, and global interest.

Students who graduate with a major in biology at UNLV will acquire:

1. Knowledge of the diversity and similarity of living organisms at organizational levels ranging from molecules to the community.
2. Knowledge of processes of inheritance and natural selection as they influence the development of populations and species.
3. Knowledge of scientific methods and the relationships among theory, experiment, analysis of data, and general knowledge.
4. The ability to articulate, in verbal and written form, knowledge of biology, biological methods, and biological issues in context.

Learning Outcome

Students who graduate with a major in biology will have fulfilled their personal expectations and will indicate they have been accepted to a graduate or professional school or an entry-level career position.

Areas of Concentration

Biological Sciences majors at the university have a choice of five areas of specialized study (concentrations) that prepare them for a variety of professional fields. In addition to attending graduate, medical, and other professional schools, Biological Sciences majors may move directly to governmental and private-sector careers in such fields as health care, laboratory sciences, environmental sciences, and teaching. **All concentrations provide the necessary background for application to graduate or professional postgraduate work, differing mainly in their emphasis on specialized career trajectories within the life sciences.**

Biology — Biotechnology

The Biotechnology Concentration provides strong preparation for careers in biotechnology, biomedical science research, and the pharmaceutical industry as well as for transition to graduate or other advanced educational programs.

Biology — Cell and Molecular Biology

The Cell and Molecular Biology concentration provides Biological Sciences majors with the intellectual tools essential for careers in biotechnology and biomedical science research as well as for transition to graduate Ph.D. programs in Biology, and in Cell and Molecular Biomedical research.

Biology — Comprehensive

The Comprehensive concentration provides the educational background necessary for a career in modern life science, including all requirements for admission to graduate school or related postgraduate study. The Biology — Comprehensive curriculum provides a solid foundation in fundamental areas of biology while permitting wide choice in course selection, allowing majors to explore and develop areas of molecular, physiological, ecological, and evolutionary biology.

Biology — Ecology and Evolutionary Biology

This concentration is recommended for those students who desire a strong foundation in evolution and the conceptual explanatory core of biology, as well as those whose interests are at the interface between organisms and their environments — that is, ecology. Ecology and Evolutionary Biology students are well-prepared for advanced graduate education in the Biological sciences and for careers in Environmental Biology research in teaching and in natural resources assessment and management.

Biology — Education

The Education concentration is designed for students seeking exceptionally strong backgrounds for professional teaching careers that include biology as a first teaching field. Students completing the biology — Education curriculum also enroll in course work to satisfy the Minor in Secondary Science Education in the UNLV College of Education.

Biology — Integrative Physiology

The Integrative Physiology concentration provides the biology major with the intellectual and technical tools essential for success in a broad array of life sciences careers including application to all the health care-related professional schools, graduate school

or related postgraduate study as well as biomedical science research. Integrative Physiology provides an in-depth examination of how animals and/or plants work from the molecular/cellular level of organization to a systems-level understanding (cardiac, vascular, temperature regulation etc.) and up to the integration of physiology with behavior and evolutionary processes. The integrative nature of this program provides the student with a solid foundation in fundamental areas of biology yet allows a wide choice in course selection ranging from molecular, physiological, ecological, and evolutionary biology.

Biology — Microbiology

The Microbiology concentration provides the biology major with the intellectual and technical skills required for success in the broad area of microbiology, which includes clinical, environmental, ecological, evolutionary, molecular, metabolic, and physiological perspectives of microbes, including aspects of virology and immunology. The skills obtained in this concentration provide training for an array of life sciences careers, including application to all the health care-related professional schools, appropriately related graduate schools, or related postgraduate study as well as biomedical science research. The Microbiology concentration focuses on how microbes function at a variety of levels of organization, from understanding the genetics of microorganisms, their gene regulation environmental interactions, metabolic regulation, and ecological interactions. Microbiology impacts all levels of biological organization, and as such, students majoring in Biology with a concentration in microbiology are provided with a solid foundation in the life sciences yet are exposed to an in-depth understanding of microbial processes.

Biology — Pre-Professional

The Preprofessional Biology concentration provides Biological Sciences majors with the intellectual tools essential for application to health care-related professional schools, including medical, dental, veterinary, optometric, and related programs.

Biology — Urban Horticulture

Urban horticulture is a degree concentration that combines a strong background in basic biology and the plant sciences with an important skill set for assessing, designing, and implementing horticultural environments in urban and suburban settings. Urban Horticulture graduates are in great demand as team members in the planning of new, progressive and humanized residential and commercial environments on behalf of both governmental agencies and private endeavors.

Early-Admit Fast-Track Program with UNLV — School of Dental Medicine

This program expedites the process of earning a doctor of dental medicine degree. Students admitted to the program complete three years of prerequisite course work at UNLV. Following completion of the second year, students take the DAT and apply to UNLV — School of Dental Medicine (UNLV-SDM) through the Associated American Dental School Application Service (AADSAS). Participation in this early admit program does not guarantee acceptance following completion of the second year of undergraduate study. Students who are admitted to UNLV-SDM matriculate following completion of the third year at UNLV. Course work completed at UNLV-SDM during the first year is transferred

to UNLV to complete the Bachelor of Science in biology — pre-professional concentration. The net result is reduction of the time required to earn the baccalaureate and DMD degrees from eight years to seven. To learn more about the specific details of this program, please contact the pre-health advisor.

Early Admit Fast-Track Program with Touro University — College of Osteopathic Medicine

This program expedites the process of earning an osteopathic medical degree. Students admitted to the program complete three years of prerequisite course work at UNLV. Following completion of the second year, students take the MCAT and apply to Touro University – College of Osteopathic Medicine (TU-COM) through the Association of American Colleges of Osteopathic Medicine Application Service (AACOMAS). Participation in this Early Admit Program does not guarantee acceptance following completion of the second year of undergraduate study. Students who are admitted to TU-COM matriculate following completion of the third year at UNLV. Course work completed at TU-COM during the first two years is transferred to UNLV to complete the Bachelor of Science in Biology — Pre-Professional Concentration. The net result is reduction of the time required to earn the baccalaureate and medical degrees from eight years to seven. To learn more about the specific details of this program please contact the pre-health advisor.

Early Admit Fast-Track Program with Touro University — Physician Assistant Studies Program

This program expedites the process of earning a Master's in Physician Assistant Studies. Students admitted to the program complete three years of prerequisite course work at UNLV. Following completion of the second year, students apply to Touro University — Physician Assistant Studies Program (TU-PASP) through the Central Application Service for Physician Assistants (CASPA). Participation in this Early Admit Program does not guarantee acceptance following completion of the second year of undergraduate study. Students who are admitted to TU-PASP matriculate following completion of the third year at UNLV. Course work completed at TU-PASP during the first two years is transferred to UNLV to complete the Bachelor of Science in Biology — Pre-Professional Concentration. The net result is reduction of the time required to earn the baccalaureate and physician assistant degrees from six to five. To learn more about the specific details of this program, please contact the pre-health advisor.

Minor Biological Sciences (24 credits)

The Biological Sciences Minor is appropriate for all students with interests in the life sciences and especially for those who seek careers that may be enhanced by a background in biology. These include, but are not limited to, biochemistry, chemistry, geology, psychology, anthropology, and sociology. To minor in Biological Sciences, students must complete the biological sciences core; BIOL 189, 196, 197; and 12 upper-division credits. BIOL 300 and BIOL 415 are recommended. No more than three credits of independent study (BIOL 492, 493, 494, 496,) may be applied toward the minor. A Biological Sciences Minor will be awarded only if the overall Biology GPA is 2.00 or above. At least nine credits must be earned at UNLV.

Admission to the Major

Minimum GPA: 2.50

Admission Policies: Prospective majors with GPAs of less than 2.50 but at least 2.30 may be admitted on probationary status. Students who enter on probation must meet with an advisor to establish a probationary course of study. Specific details pertaining to probationary status can be found in the College of Sciences listing of the *Undergraduate Catalog*.

Transfer Policies: Transfer students must have a minimum GPA of 2.50. All students are required to meet with an advisor to determine course work that can be used to satisfy degree requirements. Biology, chemistry, physics and math transfer courses will be accepted to fill specific degree requirements only with a grade of C or better.

Although rare, it is possible for superior pre-professional students to gain admission to a professional school upon completion of 94 units of undergraduate work. Such students may, under certain circumstances, be awarded a baccalaureate degree from UNLV upon successfully completing one year of full-time study with courses equivalent to the School of Life Sciences major at the professional school. To apply for a degree after one year of professional school, students must have completed 94 units at UNLV with a GPA of 3.50 and meet university and college graduation requirements. Any student contemplating such a program must obtain approval from the departmental chair and college dean in advance of departure from UNLV.

Community College Articulation

The School of Life Sciences has course articulation agreements with several community colleges both within and outside Nevada. For specific information about transfer of credits from two-year institutions, students should seek advising about specific courses of study from the department.

Department Policies

Academic Policies: In addition to the General Education Core requirements, all study courses must include a minimum of 39 credits in the Biological Sciences and satisfy the specific requirements of one of the five concentration areas offered by the department.

In accord with UNLV requirements, at least 40 credits must be earned in upper-division-level courses. This requirement may be satisfied by selecting courses within and outside the School of Life Sciences.

To graduate with a degree in the biological sciences, a GPA of at least 2.00 must be maintained for all courses in the major field (BIOL). All BIOL core courses taken (BIOL 189, 196, 197, 300, and 415) must be passed with a grade of C- or better to fulfill prerequisites for other upper-division courses and to apply to the B.S. degree in the Biological Sciences.

BIOL 100, 109, 113, 120, 122, 148, 208, 220, 223, and 224 are designed for nonbiology majors and do not fulfill the School of Life Sciences curricular requirements. Although these credits will apply to the general university total credit requirement; or might be required or advised for other programs or career tracks (e.g., primary or secondary teaching), they are not recommended for Biological Sciences majors and do not fulfill any requirements for the biology major. The faculty of the School of Life Sciences

urges all new majors in the department to enroll in and promptly complete fundamental course work, which will serve as a foundation for success in the study of the life sciences. *By the end of the second full year of study (or its equivalent)*, Biological Sciences Instructors will expect that Biological Sciences majors in all concentrations will have completed: ENG 101 and 102; MATH 127, 128 or MATH 181; CHEM 121 and 122; and PHYS 151/151L and 152/152L (or the equivalent from the PHYS 180 series). BIOL course content will reflect these expectations.

Advisement

All majors in the School of Life Sciences are required to meet with an advisor once a year at the College Advising Center located in White Hall. Students who fail to meet with an advisor will not be able to register for courses in the fall semesters.

Note:

Requirements for the major have been revised. The new requirements apply to biology majors in the class of fall 2004 and later. Students in prior classes follow the requirements that were in place when they entered the program. Students needing help in bridging gaps between old and new programs should contact the Biological Sciences Department office (WHI 101).

Degree Requirements

Biological Sciences

Biology — Biotechnology

- 1) English Composition 6 credits
ENG 101 and 102
- 2) English Literature 3 credits
ENG 231 or 232
- 3) Constitutions 4-6 credits
- 4) Mathematics
Filled by the major requirement MATH 181
- 5) Distribution Requirement
Life & Physical Sciences & Analytical Thinking (exempt)
Humanities and Fine Arts 9 credits
Social Science 9 credits
- 6) Multicultural (see notes)
International (see notes)
- 7) Degree Requirements:
Biology Core Requirements 20 credits
BIOL 189, 196, 197, 300, 415, SCI 101
Students with strong high school preparation in biology (honors or AP biology courses with lab or the equivalent) and who have achieved a score of 4 or better on the AP Biology exam or a score of 600 or better on the SAT II Biology E/M exam or a satisfactory score on the UNLV Biological Sciences Placement Exam may have the BIOL 189 lecture waived and the lab portion of BIOL 189 completed at UNLV (see the Advising Center before enrolling in classes). Students who have achieved a score of 5 on the AP Biology exam may have BIOL 189 and either BIOL 196 or BIOL 197 lectures waived and the appropriate lab completed at UNLV (see the Advising Center before enrolling in classes).

Other Required Courses 37 credits
 CHEM 121, 122, 241, 241L, 242, 242L, 474, 475, MATH
 181, STAT 391 or 491, PHYS 151, 152

Recommended Course: MATH 182

Biology-Biotechnology Requirements 20-24 credits
 A minimum of five courses are required. BIOL 251, BIOL
 405 and a minimum of two upper-division BIOL courses from
 lists B and D with at least one from list A, C or E. Other
 course work important for biotechnology careers, such as
 Quality Assurance/Quality Control may be petitioned to be
 substituted for UNLV courses.

List A: Ecology and Evolutionary Biology; BIOL 301, 302,
 305, 341, 412, 418, 427, 441, 444, 471, 480, 486,
 487, 490

List B: Cell and Molecular Biology; BIOL 304, 351, 405,
 409, 412, 414, 425, 445, 452, 453, 460, 464, 466,
 470, 473, 475, 481, 485, 489

List C: Anatomical and Morphological Biology; BIOL 348,
 426, 451, 465, 468

List D: Physiological Biology; BIOL 414, 417, 440, 442,
 445, 447, 448, 449, 452, 460, 475, 480

List E: Organismal Biology; BIOL 301, 302, 320, 422, 431,
 432, 433, 434, 437, 480, 486, 487

Electives 13 credits
 Total 124 credits

Notes:

1. Every student must complete a multicultural course and international course. Courses satisfying other requirements may simultaneously satisfy the multicultural and international requirements except one course cannot satisfy both the multicultural and the international requirements.
2. It is strongly recommended that students interested in biomedicine or attending graduate school take additional appropriate upper-division biology courses and research units to meet their elective credit requirements.
3. At least 40 credits must be earned at the upper-division level (300 and above).

Biology — Cell and Molecular Biology

- 1) English Composition 6 credits
 ENG 101 and 102
- 2) English Literature 3 credits
 ENG 231 or 232
- 3) Constitutions 4-6 credits
- 4) Mathematics
 Filled by the major requirement MATH 181
- 5) Distribution Requirement
 Life & Physical Sciences & Analytical Thinking (exempt)
 Humanities and Fine Arts 9 credits
 Social Science 9 credits
- 6) Multicultural(see notes)
 International(see notes)
- 7) Degree Requirements:
 Biology Core Requirements 20 credits
 BIOL 189, 196, 197, 300, 415, SCI 101

Students with strong high school preparation in biology (honors or AP biology courses with lab or the equivalent) and who have achieved a score of 4 or better on the AP Biology exam or a score of 600 or better on the SAT II Biology E/M exam or a satisfactory score on the UNLV Biological Sciences Placement Exam may have the BIOL 189 lecture waived and the lab portion of BIOL 189 completed at UNLV (see the Advising Center before enrolling in classes). Students who have achieved a score of 5 on the AP Biology exam may have BIOL 189 and either BIOL 196 or BIOL 197 lectures waived, and the appropriate lab completed at UNLV (see the Advising Center before enrolling in classes).

Required Courses 37 credits
 CHEM 121, 122, 241, 241L, 242, 242L, 474, 475,
 MATH 181, STAT 391 or 491, PHYS 151, 152

Other Recommended Courses: MATH 182

Biology-Cell and Molecular 20 credits
 A minimum of five courses are required.

Required Courses: BIOL 405, 425, and 445

Remaining credits selected from Lists A, B, C, D, E
 List A: Ecology and Evolutionary Biology: BIOL 301, 302,
 305, 341, 412, 418, 427, 441, 444, 471, 480, 486,
 487, 490

List B: Cell and Molecular Biology: BIOL 304, 351, 405,
 409, 412, 414, 425, 445, 452, 453, 460, 464, 466,
 470, 473, 475, 481, 485, 489

List C: Anatomical and Morphological Biology: BIOL 348,
 426, 451, 465, 468

List D: Physiological Biology: BIOL 414, 417, 440, 442,
 445, 447, 448, 449, 452, 460, 475, 480

List E: Organismal Biology: BIOL 301, 302, 320, 422, 431,
 432, 433, 434, 437, 480, 486, 487

Electives 19 credits
 Total 124 credits

Notes:

1. Every student must complete a multicultural course and an international course. Courses satisfying other requirements may simultaneously satisfy the multicultural and international requirements except one course cannot satisfy both the multicultural and the international requirements.
2. It is strongly recommended that students interested in biomedicine or attending graduate school take additional appropriate upper-division biology courses and research units to meet their elective credit requirements.
3. At least 40 credits must be earned at the upper-division level (300 and above).

Biological Sciences

Biology — Comprehensive

- 1) English Composition 6 credits
ENG 101 and 102
 - 2) English Literature 3 credits
ENG 231 or 232
 - 3) Constitutions 4-6 credits
 - 4) Mathematics
Filled by the major requirement MATH 181
 - 5) Distribution Requirement
Life & Physical Sciences & Analytical Thinking (exempt)
Humanities and Fine Arts 9 credits
Social Science 9 credits
 - 6) Multicultural (see notes)
International (see notes)
 - 7) Degree Requirements:
Biology Core Requirements 20 credits
BIOL 189, 196, 197, 300, 415, SCI 101
Students with strong high school preparation in biology (honors or AP biology courses with lab or the equivalent) and who have achieved a score of 4 or better on the AP Biology exam or a score of 600 or better on the SAT II Biology E/M exam or a satisfactory score on the UNLV Biological Sciences Placement Exam may have the BIOL 189 lecture waived and the lab portion of BIOL 189 completed at UNLV (see the Advising Center before enrolling in classes). Students who have achieved a score of 5 on the AP Biology exam may have BIOL 189 and either BIOL 196 or BIOL 197 lectures waived, and the appropriate lab completed at UNLV (see the Advising Center before enrolling in classes).
- Other Required Courses 34 credits
CHEM 121, 122, 241, 241L, 242, 242L, 474, MATH 181, STAT 391 or 491, PHYS 151, 152

Recommended Courses: CHEM 475, MATH 182

Biology-Comprehensive Requirements 20-24 credits
A minimum of five courses are required. A maximum of three courses from any one list (A, B, C, D or E) depending on the areas of interest, with the remaining credits selected from at least two other lists

List A: Ecology and Evolutionary Biology: BIOL 301, 302, 305, 341, 412, 418, 427, 441, 444, 471, 480, 486, 487, 490

List B: Cell and Molecular Biology: BIOL 304, 351, 405, 409, 412, 414, 425, 445, 452, 453, 460, 464, 466, 470, 473, 475, 481, 485, 489

List C: Anatomical and Morphological Biology: BIOL 348, 451, 426, 465, 468

List D: Physiological Biology: BIOL 414, 417, 440, 442, 445, 447, 448, 449, 452, 460, 475, 480

List E: Organismal Biology: BIOL 301, 302, 320, 422, 431, 432, 433, 434, 437, 480, 486, 487

- Electives 19 credits
Total 124 credits

Notes:

1. Every student must complete a multicultural course and an international course. Courses satisfying other requirements may simultaneously satisfy the multicultural and international requirements except one course cannot satisfy both the multicultural and the international requirements.
2. It is strongly recommended that students interested in biomedicine or attending graduate school take additional appropriate upper-division biology courses and research units to meet their elective credit requirements.
3. At least 40 credits must be earned at the upper-division level (300 and above).

Biology — Ecology and Evolutionary Biology

- 1) English Composition 6 credits
ENG 101 and 102
- 2) English Literature 3 credits
ENG 231 or 232
- 3) Constitutions 3-6 credits
- 4) Mathematics
Filled by the major requirement MATH 181
- 5) Distribution Requirement
Life & Physical Sciences & Analytical Thinking (exempt)
Humanities and Fine Arts 9 credits
Social Science 9 credits
- 6) Multicultural (see notes)
International (see notes)
- 7) Degree Requirements:
Biology Core Requirements 20 credits
BIOL 189, 196, 197, 300, 415, SCI 101
Students with strong high school preparation in biology (honors or AP biology courses with lab or the equivalent) and who have achieved a score of 4 or better on the AP Biology exam or a score of 600 or better on the SAT II Biology E/M exam or a satisfactory score on the UNLV Biological Sciences Placement Exam may have the BIOL 189 lecture waived and the lab portion of BIOL 189 completed at UNLV (see the Advising Center before enrolling in classes). Students who have achieved a score of 5 on the AP Biology exam may have BIOL 189 and either BIOL 196 or BIOL 197 lectures waived, and the appropriate lab completed at UNLV (see the Advising Center before enrolling in classes).

Other Required Courses 34 credits
CHEM 121, 122, 241, 241L, 242, 242L, 474, MATH 181, STAT 391 or 491, PHYS 151, 152

Recommended Courses: MATH 182, CHEM 475

Biology-Ecology and Evolutionary Biology
Requirements 24 credits

A minimum of six courses is required. BIOL 341, one course from List A, one from List E and one additional course from either A or E, and two courses from any two of Lists B, C and D. *BIOL 441 is strongly recommended for any EEB student with an ecological career focus.*

List A: Ecology and Evolutionary Biology: BIOL 301, 302, 305, 341, 412, 418, 427, 441, 444, 471, 486, 487, 490

List B: Cell and Molecular Biology: BIOL 304, 351, 405, 409, 412, 414, 425, 445, 452, 453, 460, 464, 466, 470, 473, 475, 481, 485, 489

List C: Anatomical and Morphological Biology: BIOL 348, 426, 451, 465, 468

List D: Physiological Biology: BIOL 414, 417, 440, 442, 445, 447, 448, 449, 452, 460, 475, 480

List E: Organismal Biology: BIOL 301, 302, 320, 422, 431, 432, 433, 434, 437, 480, 486, 487

Electives 13 credits
Total 124 credits

Notes:

1. Every student must complete a multicultural course and an international course. Courses satisfying other requirements may simultaneously satisfy the multicultural and international requirements except one course cannot satisfy both the multicultural and the international requirements.
2. It is strongly recommended that students interested in biomedicine or attending graduate school take additional appropriate upper-division biology courses and research units to meet their elective credit requirements.
3. At least 40 credits must be earned at the upper-division level (300 and above).

Biological Sciences

Biology — Education

- 1) English Composition 6 credits
ENG 101 and 102
- 2) English Literature 3 credits
ENG 231 or 232
- 3) Constitutions 4-6 credits
- 4) Mathematics
Filled by the major requirement MATH 181
- 5) Distribution Requirement
Life & Physical Sciences & Analytical Thinking (exempt)
Humanities and Fine Arts 9 credits
Social Science 9 credits
- 6) Multicultural(see notes)
International(see notes)
- 7) Degree Requirements:
Biology Core Requirements..... 20 credits
BIOL 189, 196, 197, 300, 415, SCI 101
Students with strong high school preparation in biology (honors or AP biology courses with lab or the equivalent) and who have achieved a score of 4 or better on the AP Biology exam or a score of 600 or better on the SAT II Biology E/M exam or a satisfactory score on the UNLV Biological Sciences Placement Examination may have the BIOL 189 lecture waived and the lab portion of BIOL 189 completed at UNLV (see the Advising Center before enrolling in classes). Students who have achieved a score of 5 on the AP Biology exam may have BIOL 189 and either BIOL 196 or BIOL 197 lectures waived and the appropriate lab completed at UNLV (see the Advising Center before enrolling in classes).

Other Required Courses 34 credits
CHEM 121, 122, 241, 241L, 242, 242L, 474, MATH 181, STAT 391 or 491, PHYS 151, 152

Recommended Courses: CHEM 475, MATH 182

Biology-Education Requirements 20-24 credits
A minimum of five courses are required, taken from Lists A, B, C, D, or E. One course must deal with Botany (BIOL 305, BIOL 422, BIOL 426, BIOL 442, BIOL 444). Students must meet with an Advisor in the Education Department in order to determine what requirements are for both a minor in Education and middle/high school certification.

List A: Ecology and Evolutionary Biology: BIOL 301, 302, 305, 341, 412, 418, 427, 441, 444, 471, 480, 486, 487, 490

List B: Cell and Molecular Biology: BIOL 304, 351, 405, 409, 412, 414, 425, 445, 452, 453, 460, 464, 466, 470, 473, 475, 481, 485, 489

List C: Anatomical and Morphological Biology: BIOL 348, 426, 451, 465, 468

List D: Physiological Biology: BIOL 414, 417, 440, 442, 445, 447, 448, 449, 452, 460, 475, 480

List E: Organismal Biology: BIOL 301, 302, 320, 422, 431, 432, 433, 434, 437, 480, 486, 487

Electives 16 credits
Total 124 credits

Notes:

1. Every student must complete a multicultural course and an international course. Courses satisfying other requirements may simultaneously satisfy the multicultural and international requirements except one course cannot satisfy both the multicultural and the international requirements.
2. It is strongly recommended that students interested in biomedicine or attending graduate school take additional appropriate upper-division biology courses and research units to meet their elective credit requirements.
3. At least 40 credits must be earned at the upper-division level (300 and above).

Biological Sciences

Biology — Integrative Physiology

- 1) English Composition 6 credits
ENG 101 and 102
- 2) English Literature 3 credits
ENG 231 or 232
- 3) Constitutions 4-6 credits
- 4) Mathematics
Filled by the major requirement MATH 181
- 5) Distribution Requirement
Life & Physical Sciences & Analytical Thinking (exempt)
Humanities and Fine Arts 9 credits
Social Science 9 credits
- 6) Multicultural(see notes)
International(see notes)
- 7) Degree Requirements:
Biology Core Requirements..... 20 credits
BIOL 189, 196, 197, 300, 415, SCI 101

Students with strong high school preparation in biology (honors or AP biology courses with lab or the equivalent) and who have achieved a score of 4 or better on the AP Biology exam or a score of 600 or better on the SAT II Biology E/M exam or a satisfactory score on the UNLV Biological Sciences Placement Exam may have the BIOL 189 lecture waived and the lab portion of BIOL 189 completed at UNLV (see the Advising Center before enrolling in classes). Students who have achieved a score of 5 on the AP Biology exam may have BIOL 189, and either BIOL 196 or BIOL 197 lectures waived, and the appropriate lab completed at UNLV (see Advising Center before enrolling in classes).

Required Courses 34 credits
 CHEM 121, 122, 241, 241L, 242, 242L, 474, MATH 181, STAT 391 or 491, PHYS 151, 152

Other Recommended Courses: CHEM 475, MATH 182

Biology-Integrative Physiology Requirements..... 20-24 credits
 A minimum of five courses are required.

Required Courses 6 credits
 BIOL 440 and 445

A maximum of three courses from list D, one course from list C, with the remaining credits selected from list A, B or E.

List A: Ecology and Evolutionary Biology: BIOL 301, 302, 305, 341, 412, 418, 427, 441, 444, 471, 480, 486, 487, 490

List B: Cell and Molecular Biology: BIOL 304, 351, 405, 409, 412, 414, 425, 445, 452, 453, 460, 464, 466, 470, 473, 475, 481, 485, 489

List C: Anatomical and Morphological Biology: BIOL 348, 426, 451, 465, 468

List D: Physiological Biology: BIOL 414, 417, 440, 442, 445, 447, 448, 449, 452, 460, 475, 480

List E: Organismal Biology: BIOL 301, 302, 320, 422, 431, 432, 433, 434, 437, 480, 486, 487

Electives 19 credits
 Total 124 credits

Notes:

1. Every student must complete a multicultural course and an international course. Courses satisfying other requirements may simultaneously satisfy the multicultural and international requirements except one course cannot satisfy both the multicultural and the international requirements.
2. It is strongly recommended that students interested in biomedicine or attending graduate school take additional appropriate upper-division biology courses and research units to meet their elective credit requirements.
3. At least 40 credits must be earned at the upper-division level (300 and above).

Biological Sciences

Biology — Microbiology

- 1) English Composition 6 credits
 ENG 101 and 102
- 2) English Literature 3 credits
 ENG 231 or 232
- 3) Constitutions 4-6 credits
- 4) Mathematics
 Filled by the major requirement MATH 181
- 5) Distribution Requirement
 Life & Physical Sciences & Analytical Thinking (exempt)
 Humanities and Fine Arts 9 credits
 Social Science 9 credits
- 6) Multicultural (see notes)
 International (see notes)
- 7) Degree Requirements:

Biology Core Requirements..... 20 credits
 BIOL 189, 196, 197, 300, 415, SCI 101

Students with strong high school preparation in biology (honors or AP biology courses with lab or the equivalent) and who have achieved a score of 4 or better on the AP Biology exam or a score of 600 or better on the SAT II Biology E/M exam or a satisfactory score on the UNLV Biological Sciences Placement Exam may have the BIOL 189 lecture waived and the lab portion of BIOL 189 completed at UNLV (see the Advising Center before enrolling in classes). Students who have achieved a score of 5 on the AP Biology exam may have BIOL 189, and either BIOL 196 or BIOL 197 lectures waived, and the appropriate lab completed at UNLV (see Advising Center before enrolling in classes).

Required Courses 34 credits
 CHEM 121, 122, 241, 241L, 242, 242L, 474, MATH 181, STAT 391 or 491, PHYS 151, 152

Other Recommended Courses: CHEM 475, MATH 182

Microbiology Concentration 28-32 credits
 Required course: BIOL 351

A minimum of three courses from list below:
 BIOL 405, 409, 418, 460, 464, 470, 485

Remaining credits (7-19 credits) selected from the following lists:

List A: Ecology and Evolutionary Biology: BIOL 301, 302, 305, 341, 412, 418, 427, 441, 444, 471, 480, 486, 487, 490

List B: Cell and Molecular Biology: BIOL 304, 351, 405, 409, 412, 414, 425, 445, 452, 453, 460, 464, 466, 470, 473, 475, 481, 485, 489

List C: Anatomical and Morphological Biology: BIOL 348, 426, 451, 465, 468

List D: Physiological Biology: BIOL 414, 417, 440, 442, 445, 447, 448, 449, 452, 460, 475, 480

List E: Organismal Biology: BIOL 301, 302, 320, 422, 431, 432, 433, 434, 437, 480, 486, 487

Electives 4-8 credits
 Total 124 credits

Notes:

1. Every student must complete a multicultural course and an international course. Courses satisfying other requirements may simultaneously satisfy the multicultural and international requirements except one course cannot satisfy both the multicultural and the international requirements.
2. It is strongly recommended that students interested in biomedicine or attending graduate school take additional appropriate upper-division biology courses and research units to meet their elective credit requirements.
3. At least 40 credits must be earned at the upper-division level (300 and above).

Biological Sciences

Biology — Pre-Professional

- 1) English Composition 6 credits
ENG 101 and 102
- 2) English Literature 3 credits
ENG 231 or 232
- 3) Constitutions 4-6 credits
- 4) Mathematics
Filled by the major requirement MATH 181
- 5) Distribution Requirement
Life & Physical Sciences & Analytical Thinking (exempt)
Humanities and Fine Arts 9 credits
Social Science 9 credits
- 6) Multicultural (see notes)
International (see notes)
- 7) Degree Requirements:
Biology Core Requirements 20 credits
BIOL 189, 196, 197, 300, 415, SCI 101
Students with strong high school preparation in biology (honors or AP biology courses with lab or the equivalent) and who have achieved a score of 4 or better on the AP Biology exam or a score of 600 or better on the SAT II Biology E/M exam or a satisfactory score on the UNLV Biological Sciences Placement Exam may have the BIOL 189 lecture waived and the lab portion of BIOL 189 completed at UNLV (see the Advising Center before enrolling in classes). Students who have achieved a score of 5 on the AP Biology exam may have BIOL 189 and either BIOL 196 or BIOL 197 lectures waived and the appropriate lab completed at UNLV (see the Advising Center before enrolling in classes).

Other Required Courses 37 credits
CHEM 121, 122, 241, 241L, 242, 242L, 474, 475, MATH 181, STAT 391 or 491, PHYS 151, 152

Recommended Course: MATH 182

Biology-Pre-Professional Requirements 20-24 credits
A minimum of five courses are required. BIOL 351 and a minimum of four upper-division BIOL courses with at least one each from B, C and D, and A or E.

List A: Ecology and Evolutionary Biology: BIOL 301, 302, 305, 341, 412, 418, 427, 441, 444, 471, 480, 486, 487, 490

List B: Cell and Molecular Biology: BIOL 304, 405, 409, 412, 414, 425, 445, 452, 453, 460, 464, 466, 470, 473, 475, 481, 485, 489

List C: Anatomical and Morphological Biology: BIOL 348, 426, 451, 465, 468

List D: Physiological Biology: BIOL 414, 417, 440, 442, 445, 447, 448, 449, 452, 460, 475, 480

List E: Organismal Biology: BIOL 301, 302, 320, 422, 431, 432, 433, 434, 437, 480, 486, 487

Electives 13 credits
Total 124 credits

Notes:

1. Every student must complete a multicultural course and an international course. Courses satisfying other requirements may simultaneously satisfy the multicultural and international requirements except one course cannot satisfy both the multicultural and the international requirements.
2. It is strongly recommended that students interested in biomedicine or attending graduate school take additional appropriate upper-division biology courses and research units to meet their elective credit requirements.
3. At least 40 credits must be earned at the upper-division level (300 and above).

Biological Sciences

Biology — Urban Horticulture

- 1) English Composition 6 credits
ENG 101 and 102
- 2) English Literature 3 credits
ENG 231 or 232
- 3) Constitutions 4-6 credits
- 4) Mathematics
Filled by the major requirement MATH 181
- 5) Distribution Requirement
Life & Physical Sciences & Analytical Thinking (exempt)
Humanities and Fine Arts 9 credits
Social Science 9 credits
- 6) Multicultural (see notes)
International (see notes)
- 7) Degree Requirements:
Biology Core Requirements 20 credits
BIOL 189, 196, 197, 300, 415, SCI 101

Students with strong high school preparation in biology (honors or AP biology courses with lab or the equivalent) and who have achieved a score of 4 or better on the AP Biology exam or a score of 600 or better on the SAT II Biology E/M exam or a satisfactory score on the UNLV Biological Sciences Placement Exam may have the BIOL 189 lecture waived and the lab portion of BIOL 189 completed at UNLV (see the Advising Center before enrolling in classes). Students who have achieved a score of 5 on the AP Biology exam may have BIOL 189, and either BIOL 196 or BIOL 197 lectures waived, and the appropriate lab completed at UNLV (see Advising Center before enrolling in classes).

Required Courses 34 credits
CHEM 121, 122, 241, 241L, 242, 242L, 474, MATH 181, STAT 391 or 491, PHYS 151, 152

Other Recommended Courses: CHEM 475, MATH 182

Biology-Urban Horticulture 24-28 credits
A minimum of eight courses are required.

Required Courses 13 credits
BIOL 220, 345, 426 and 442

A maximum of two courses from list A, one course from B, one course from list E.

List A: Ecology and Evolutionary Biology: BIOL 301, 302, 305, 341, 412, 418, 427, 441, 444, 471, 480, 486, 487, 490

List B: Cell and Molecular Biology: BIOL 304, 405, 409, 412, 414, 425, 445, 452, 453, 460, 464, 466, 470, 473, 475, 481, 485, 489

List E: Organismal Biology: BIOL 301, 302, 320, 422, 431, 432, 433, 434, 437, 480, 486, 487

Electives 14 credits
Total 124 credits

Notes:

1. Every student must complete a multicultural course and an international course. Courses satisfying other requirements may simultaneously satisfy the multicultural and international requirements except one course cannot satisfy both the multicultural and the international requirements.
2. It is strongly recommended that students interested in biomedicine or attending graduate school take additional appropriate upper-division biology courses and research units to meet their elective credit requirements.
3. At least 40 credits must be earned at the upper-division level (300 and above).

Biology

BIOL 100

General Biology for Non-Majors

Introduction to biology of the human species. For non-majors; emphasizing those aspects of structure, function, ecology, and evolution which provide a biological perspective for problems facing modern society. Three hours lecture and three hours laboratory. Satisfies the General Education Core requirement for a laboratory science course. 4 credits.

BIOL 103

Biology Laboratory

For transfer students only. Laboratory portion of either BIOL 100 or BIOL 189, for students who have had course work without a laboratory at a previous institution. Prerequisites: Credits for the lecture portion of either a majors or non-majors entry-level course and consent of instructor. 1 credit.

BIOL 121 (Formerly BIOL 109)

Human Nutrition

(Same as NUTR 121). Description of the nature and role of carbohydrates, lipids, proteins, water, vitamins, and minerals in the human body. Energy relations and various controversies in nutrition examined, as well as the relationships among nutrition, health, and disease. 3 credits.

BIOL 113

Life in the Ocean

Introduction to the environments and inhabitants of the sea. 3 credits.

BIOL 120

Plants and People

Introduction for non-biology majors to the social, cultural, and economic role of useful and harmful plants and plant products in modern society. Consideration given to the origin, history, and human value of selected plants, especially those used for food, medicine, and industrial raw materials, or religious purposes. 3 credits.

BIOL 122

Desert Plants

Study of typical desert plant communities, along with the identification of more common species. Additional topics include morphological and physiological adaptations to aridity; and the nature, origin, and occurrence of arid environments. Two hours lecture and three hours laboratory. Satisfies the General Education Core requirement for a laboratory science course. 3 credits.

BIOL 148

Natural History of the Desert Southwest

Introduction for biology non-majors to the desert environments of the American Southwest. Includes the study of climate, geology, plants, animals, and man in desert regions. Includes field trips. Three hours lecture and three hours laboratory. Satisfies the General Education Core requirement for a laboratory science course. 4 credits.

BIOL 189

Fundamentals of Life Science

Survey of contemporary biology; includes structure, function, interactions and evolutionary origins of living systems. For Biological Sciences majors and others who require biology as part of their professional career preparation. Satisfies General Education Core requirements for laboratory sciences. Aligned with State of Nevada life science content standards for K-8 certification. 4 credits.

BIOL 196

Principles of Modern Biology I

Structural and chemical nature of cells, complex organisms and cellular environments. Transmission and molecular genetics, cell communication, reproduction and energetics. For Biological Sciences majors and others pursuing advanced study in biology. Three hours lecture and three hours laboratory. Satisfies the General Education Core requirement for a laboratory science course. Prerequisite: BIOL 189 or equivalent. 4 credits.

BIOL 197

Principles of Modern Biology II

Whole-organism biology in an evolutionary context; biodiversity, structure, function and reproduction of prokaryotic and eukaryotic organisms. Evolutionary and ecological pattern and process. For Biological Sciences majors and others pursuing advanced study in biology. Three hours lecture and three hours laboratory. Satisfies the General Education Core requirement for a laboratory science course. Prerequisite: BIOL 189 or equivalent. 4 credits.

BIOL 208**Introduction to Human Genetics**

For non-majors. Aspects of human inheritance and evolution considered. Prerequisite: BIOL 100 or BIOL 189. 3 credits.

BIOL 220**Introduction to Ecological Principles**

Introduction for environmental science students to the major ecological principles at work in the environment. Focuses not only on these principles but also on understanding the processes that underlie them. Prerequisites: ENS 100 for Environmental Studies majors, and BIOL 197 for BIOL majors. 3 credits.

BIOL 223**Human Anatomy and Physiology I**

Review of the basic organization of human cells and tissues and the structure and function of the skeletal, muscular, nervous, and sensory systems. Three hours lecture and three hours laboratory. Prerequisite: BIOL 189. 4 credits.

BIOL 224**Human Anatomy and Physiology II**

Structure and function of the human digestive, circulatory, urogenital, and endocrine systems. Three hours lecture and three hours laboratory. Prerequisite: BIOL 189, BIOL 223. 4 credits.

BIOL 251**General Microbiology**

Survey of general microbiology including microbiological prokaryotic cell structure and function with an emphasis on microorganisms that associate with humans. Three hours lecture and three hours laboratory. Credit not allowed in both BIOL 251 and 351. Prerequisites: BIOL 189, CHEM 110 or CHEM 121. 4 credits.

BIOL 300**Principles of Genetics**

Study of the transmission of traits from one generation to the next, the structure and function of genes, and the variation of genes between and within populations. Three hours lecture and three hours laboratory. Prerequisites: BIOL 196, BIOL 197, CHEM 241 and CHEM 241L. 4 credits.

BIOL 301**Fossil Record**

History and evolution of life as recorded in the fossil record. Field trips required. Prerequisites: GEOL 102 or BIOL 191. 3 credits.

BIOL 302**Evolutionary Survey of Vascular Plants**

Evolutionary survey of vascular plants: their classification, appearance in geologic time, comparative life cycles and morphological characteristics. Three hours lecture and three hours laboratory. Prerequisite: BIOL 197. 4 credits.

BIOL 304**Molecular Genetics**

Comprehensive survey course designed to cover the basic principles that deal with the physical and chemical nature of genes. Specific topics include the structure/function of genes, genome organization, DNA replication and recombination, protein synthesis, regulation of gene expression, chromatin structure, epigenetic effects, and genetic engineering. Prerequisite: BIOL 196. 3 credits.

BIOL 305**Introduction to Conservation Biology**

Fundamental issues in conservation biology including biodiversity, invasive and endangered species, reserve design, and environmental legislation to provide a scientific examination of the biological underpinnings of conservation issues. Prerequisites: BIOL 197 or BIOL 220. 3 credits.

BIOL 320**Invertebrate Zoology**

Discussion of the taxonomy, morphology, and physiology of the phyla and classes of invertebrate animals, including some ecological and phylogenetic relationships. Two hours lecture and three hours laboratory. Prerequisite: BIOL 197. 4 credits.

BIOL 341**Principles of Ecology**

Fundamentals of ecology and levels of population, community, and ecosystem. Three hours lecture. Prerequisite: BIOL 197. 3 credits.

BIOL 345**Urban Horticulture**

New field of urban horticulture, which deals with how plants respond to urban stresses. Includes readings on and discussion of the following topics: plant sciences and development, horticultural practices, and stress physiology. Prerequisite: BIOL 189. 3 credits.

BIOL 348**Introduction to Human Anatomy**

Consideration of human anatomical systems - structure, composition, gross function, development and origins. Fundamental principles of anatomy including gross, microscopic, developmental and evolutionary aspects. Two 75 minute lectures per week. Prerequisite: BIOL 197 or equivalent. 3 credits.

BIOL 351**Microbiology**

Microbial systems provides in-depth coverage of prokaryotic cell structure, function, genetics, diversity, ecology, and pathogenesis, with an emphasis on microbial metabolism, bacterial genetics and molecular mechanisms. Three hours lecture and three hours laboratory. Credit not allowed in both BIOL 251 and 351. Prerequisites: BIOL 189, BIOL 196, BIOL 197, CHEM 121. 4 credits.

BIOL 405**Molecular Biology**

Introductory molecular biology. Study of genes and their activities at the molecular level, including transcription, translation, DNA replication, and recombination. Concepts of molecular biology presented along with experimental strategies and data that led to those concepts. Prerequisite: BIOL 300 or CHEM 474. 3 credits.

BIOL 409**Virology**

Systematic examination of animal, plant, and bacterial viruses including their structure and genome organization, their reproduction and assembly, and their effects on host organisms. Prerequisites: BIOL 351. 3 credits.

BIOL 412**Molecular Evolution**

Molecular evolution of genes and genomes. Origin of life from the prebiotic soup through the RNA world to current DNA replication systems. Determination of the universal tree of life by inferring molecular phylogenies of genes and proteins. Emphasis on evolution by duplication, recombination, and transposition. Prerequisites: BIOL 300, BIOL 405, BIOL 415. 3 credits.

BIOL 414**Endocrinology**

(Same as CHEM 478.) Survey of the structure and function of vertebrate endocrine systems, with emphasis on the biochemical basis of hormone action and the role of cell communication in endocrine physiology. Prerequisites: BIOL 196, CHEM 474 recommended. 3 credits.

BIOL 415**Evolution**

Evolutionary principles, designed to provide a synthesis of biological relationships essential for the professional biologist. Prerequisite: BIOL 300. 3 credits.

BIOL 417**Biochemical Adaptations**

Exploration of biochemical and molecular characteristics that appear to be adaptive for organisms in their respective environments. Three hour lecture. Prerequisites: BIOL 445. 3 credits.

BIOL 418**Microbial Ecology**

Study of microbes as individuals, populations, and communities in freshwater, marine, and terrestrial environments. Topics such as nutrient cycling, biodegradation, and biotechnology discussed from an ecological standpoint. Three hours lecture. Prerequisites: BIOL 351 or consent of instructor. 3 credits.

BIOL 422**Taxonomy of Vascular Plants**

Study of the evolutionary relationships of the principal orders, families and genera; systems of classification; collection and identification of local flora. Two hours lecture and six hours laboratory. Prerequisite: BIOL 197. 4 credits.

BIOL 425**Genomics**

Study of the sequencing, assembling and annotating of genomes. Examination of new approaches that integrate genetics, molecular biology, and computer sciences to answer biological questions in novel ways. Applications of genomics, proteomic and bioinformatic technologies in medical researches. Prerequisites: BIOL 300 and BIOL 405. 3 credits.

BIOL 426**Plant Anatomy**

Study of the basic structure of plant organs and tissues, particularly with regard to relationships between structure and function. Two hours lecture and four hours laboratory. Prerequisite: BIOL 197 or higher number BIOL course. 3 credits.

BIOL 427**Bryology**

Biology of mosses, including taxonomy, morphology, reproduction, speciation, desiccation tolerance, resource transfer, spore biology, and biology of the ecologically important soil crusts. Arid environments highlighted. Lab focuses on local identification and includes field trips. Prerequisite: BIOL 196 or higher number BIOL course. 3 credits.

BIOL 431**Ichthyology**

Study of biology of fishes, including morphology, physiology, ecology, and evolution. Emphasis on local fish, field work with state and federal agency biologists. Three hours lecture, three hours laboratory, some overnight or weekend field trips. Prerequisite: BIOL 197. 4 credits.

BIOL 432**Herpetology**

Systematics, ecology, and evolution of amphibians and reptiles. Three hours lecture and three hours laboratory. Prerequisite: BIOL 196, BIOL 197. 4 credits.

BIOL 433**Ornithology**

Principles of avian biology and evolution. Laboratory sessions involve bird identification and include field trips. Two hours lecture and six hours laboratory. Prerequisite: BIOL 197. 4 credits.

BIOL 434**Mammalogy**

Study of mammalian biology, evolution, and ecology, with attention to issues in mammal conservation biology. Three hours lecture and three hours laboratory with possible weekend and overnight field trips. Prerequisite: BIOL 197. 4 credits.

BIOL 437**Entomology**

Introduction to the principles of insect classification and biology. Three hours lecture and three hours laboratory. Prerequisite: BIOL 196, BIOL 197. 4 credits.

BIOL 440**Mammalian Physiology**

Principles of mammalian physiology, normal functioning of mammalian body as a whole, and interrelationships of organs and organ systems. Emphasis on physiological processes and their interrelationships. Corequisites: CHEM 242 and CHEM 242L. Prerequisites: BIOL 196, 197, CHEM 241 and CHEM 241L. 3 credits.

BIOL 441**Field Ecology**

Introduction to ecological research. Weekly field projects emphasize population biology, interactions among species, and ecosystem processes. Six hours of combined lecture and field or laboratory work. Prerequisite: BIOL 220 or BIOL 341 or consent of instructor. 3 credits.

BIOL 442**Principles of Plant Physiology with Laboratory**

Introduction to the basic physiological processes in plants: metabolism, nutrition, growth, and development. Three hours lecture and three hours laboratory. Prerequisites: BIOL 196, BIOL 197, CHEM 241 and CHEM 241L. 4 credits.

BIOL 444**Principles of Plant Ecology**

Introduction to the ecology of wild plants, particularly structure, ecology of populations, interactions of plants with their environment and other organisms, and survey of the major global vegetation types. Prerequisite: BIOL 341 or consent of instructor. 3 credits.

BIOL 445**Cell Physiology**

Cell physiology provides an understanding of the basic processes of eukaryotic cells and their relationship to cellular ultrastructure. Prerequisite: BIOL 196 or consent of instructor. 3 credits.

BIOL 447**Advanced Comparative Animal Physiology**

Comparative physiology provides a detailed understanding of the diverse array of physiological systems evolved to allow animals to function in various environments. The comparative approach is used to understand physiological adaptations to various environments and the evolution of physiological systems. Three hours lecture and three hours laboratory. Prerequisites: BIOL 196, BIOL 197, CHEM 241 and CHEM 241L. 3 credits.

BIOL 448**Mammalian Physiology Laboratory**

Practical experience with physiological techniques. Emphasis on the integration of tissue, organ, and organ system physiological functions. Corequisite: BIOL 440 or BIOL 447. 1 or 2 credits.

BIOL 449**Comparative Nutrition**

Explore the diversity and complexity of systems that have evolved to adequately support energy requiring processes for life. Topics range from the evolution of digestive systems in a wide array of organisms (single celled, plants and animals) to the development of, for example, simple, complex, and ruminant digestive systems. Methods of acquiring, processing and utilizing nutrients for growth, maintenance and metabolism, including performance are also discussed. Prerequisite: BIOL 196. 3 credits.

BIOL 451**Comparative Vertebrate Anatomy**

Introduction to comparative vertebrate zoology with emphasis on structure and evolution. Laboratory includes dissection of all major classes of vertebrates and study of gross and microscopic structures. Three hours lecture and six hours laboratory. Prerequisite: BIOL 197. 5 credits.

BIOL 452**Comparative Behavioral Endocrinology**

Explores the relationships between hormones, brain and behavior in invertebrate and vertebrate animals. Discussion of the effects of hormones on development and behavior, how behavior and the nervous system influence endocrine physiology and how hormones influence the timing of physiological and behavioral events. Prerequisite: BIOL 414 or BIOL 486. 3 credits.

BIOL 453**Immunology**

Study of the immune response, cell-mediated and humoral. Topics include the diversity of antibodies and antigen receptors, evolution of immunity, cell-cell interactions, importance of major histocompatibility complex immune regulation, and immunity to microorganisms. Prerequisites: BIOL 300 and BIOL 351. 3 credits.

BIOL 460**Microbial Physiology**

Exploration of the major aspects of microbial physiology, including structure and growth of bacteria, generation of ATP and intermediary metabolism, synthesis of macromolecules and cellular components, and coordination of intracellular activities. Three hours lecture. Prerequisites: BIOL 351, CHEM 241 and CHEM 241L. 3 credits.

BIOL 464**Bacterial Pathogenesis**

Addresses the molecular mechanisms by which bacterial pathogens cause disease. Basic principles of bacterial pathogenesis will be considered before a survey of bacterial pathogens and their specific virulence factors is conducted. Includes aspects of bacterial genetics, physiology, immunology, and the cell biology of host-parasite interactions. Prerequisite: BIOL 351. 3 credits.

BIOL 465**Vertebrate Embryology**

Development of vertebrates, with emphasis on amphibians, birds, and mammals. Considerations of gametogenesis, fertilization, cleavage, early morphogenesis, and organogenesis included. Two hours lecture and six hours laboratory. Prerequisite: BIOL 197. 4 credits.

BIOL 466**Developmental Biology**

Development biology from the perspective of evolutionary biology and embryology and genetics. Elucidation of general principles about the genetic basis of morphologic changes and regulatory mechanisms, the genetics toolkit for development of model species, and the regulation and function of these genes in the complex hierarchies that govern animal development. Prerequisites: BIOL 300 and BIOL 405 or CHEM 474. 3 credits

BIOL 468**Histology**

Microscopic structure and function of vertebrate tissues with emphasis on mammals. Two hours lecture and six hours laboratory. Prerequisites: BIOL 196, BIOL 197. 4 credits.

BIOL 470**Topics in Applied Microbiology**

Applications may include bioremediation, food, agriculture, pharmaceuticals, vaccine development, water treatment, or genetic engineering. Presentation and discussion of current literature. Topics published in the class schedule. Maximum of two different topics may be selected for a total of six credits. Prerequisites: BIOL 300 and BIOL 351. 3 credits.

BIOL 471**Aquatic Ecology**

Principles of aquatic ecology including physical, chemical and biotic attributes - and their interactions - relating to both freshwater and marine systems. Three hour lecture/discussion. Prerequisites: BIOL 341 and CHEM 122 or consent of instructor. 3 credits.

BIOL 473**Advanced Topics in Cell and Molecular Biology**

Discussion of current literature on a specific topic in cell and molecular biology. Topics published in the class schedule. May be repeated to a maximum of six credits. Prerequisites: BIOL 300 and consent of instructor. 3 credits.

BIOL 475**Neurobiology**

Introduction to the neurosciences, emphasizing cellular, molecular, and physiological aspects. Establishes a foundation of cellular neurobiology and moves on to selected topics in the organization, function, and development of neural systems. Prerequisites: BIOL 300. 3 credits.

BIOL 480**Introduction to Biological Modeling**

Introduction to the modeling of biological systems and processes through the use of computers. Prerequisites: BIOL 197. 3 credits.

BIOL 481**Advanced Cell Biology**

Advanced topics in cell and molecular biology, including membrane structure and function, cytoskeleton, signal transduction, and current research methods. Prerequisites: BIOL 196, CHEM 474. 3 credits.

BIOL 485**Microbial Genetics**

Examines genetics of prokaryotic microorganisms, including induction of mutations and selection of mutants, alternative processes of genetic exchange and gene mapping, and gene organization and regulation. Three hours lecture. Prerequisites: BIOL 300 and BIOL 351, 3 credits.

BIOL 486**Animal Behavior**

Evolutionary analysis of vertebrate and invertebrate behavior. Prerequisite: BIOL 197. 3 credits.

BIOL 487**Principles of Systematics**

Principles and applications of methods used to reconstruct history and biotic diversity among genes, species, and higher taxa. Considers several approaches to tree construction and significance of phylogenetic history within the context of evolution, biogeography, and conservation biology. Emphasis on molecular approaches to systematics. Prerequisite: BIOL 310 or consent of instructor. 3 credits.

BIOL 489**Developmental Genetics**

Topics in molecular genetics of developmental processes explored through current literature. May be repeated to a maximum of six credits. Prerequisites: BIOL 300, and BIOL 405 or CHEM 474. 3 credits.

BIOL 490**Biogeography**

Study of distributional patterns of plant and animal groups, including consideration of theories and principles, derived from a variety of disciplines, related to those patterns. Prerequisite: BIOL 197. 3 credits.

BIOL 492**Undergraduate Research**

Special problems in some field of the biological sciences for investigation and report. May be repeated to a maximum of eight credits. Prerequisites: Two years of biological sciences and consent of instructor. 1-3 credits.

BIOL 493

Undergraduate Seminar

Preparation and presentation of seminars on topics of current interest in biology. Topic changes by semester; see class schedule. May be repeated to a maximum of three credits. Prerequisites: Two years of biological sciences and consent of instructor. 1 credit.

BIOL 494

Biology Colloquium

Analysis and critique of topics as presented by speakers drawn from the national biological research community. May be repeated to a maximum of three credits. S/F grading only. Prerequisite: Two years of biological sciences. 1 credit.

BIOL 496

Advanced Topics in Modern Biology

Advanced study in a specialized area of biology. Topics selected and published in class schedule. Maximum of three different topics may be selected for a total of six credits. Prerequisites: BIOL 196, BIOL 197 and consent of instructor. 1-3 credits.

BIOL 498

Scientific Presentations

Seminar for undergraduate students conducting research projects on any biological discipline. Gives students advice and provides them with practical experience on giving oral and written presentations. Discussion of principles of good visual communication and demonstrations of good and poor selections. Prerequisites: BIOL 196, BIOL 197 and consent of instructor 1-2 credits.

BIOL 499

Instruction in Biological Sciences

Significant involvement in instruction of courses in biological sciences. May include laboratory preparation, instruction, and grading. May be repeated to a maximum of two credits. S/F grading only. Prerequisite: Consent of instructor. 1-2 credits.

Department of Chemistry

Purpose and Focus

The science of chemistry deals with the composition, analysis, structure, and properties of matter and the various transformations matter may undergo. Chemical processes are at the heart of many diverse systems that are of great interest to mankind, including biological functions, the natural and polluted environment, industrial processes, biotechnology, food and agriculture, mining technology, etc. The Bachelor of Arts degree is designed to allow a student sufficient flexibility to obtain expertise in a discipline other than chemistry so that chemical knowledge can be applied to another field. The Bachelor of Science degree is an accredited program that requires more chemistry, math, and physics than the Bachelor of Arts degree and is intended for students wishing to pursue a career in chemistry. The Bachelor of Science degree in Biochemistry is intended to provide a student with the theoretical and technical skills necessary for employment in industry or to pursue a graduate degree in biochemistry or a related field.

Degree Objectives/Learning Outcomes

Objectives of the Bachelor of Arts Degree in Chemistry:

1. Graduates shall be able to demonstrate technical competency in the performance of basic laboratory operations, including solution preparation and standardization, common synthetic procedures, standard qualitative and quantitative analysis procedures, and operation of standard laboratory equipment.
2. Graduates shall understand the concepts underlying the theoretical basis of chemistry, as well as areas of application of chemical principles.
3. Graduates shall be capable of critical analysis and, under supervision, shall be able to apply the scientific method to a chemical problem.
4. Graduates must be well versed in the language of chemistry, should be capable of accessing chemical information in its various forms, and should be capable of effectively communicating chemical knowledge in both written and oral forms.

Objectives of the Bachelor of Science Degree in Chemistry:

1. Graduates shall be able to demonstrate technical competency in the performance of basic laboratory operations, including solution preparation and standardization, common synthetic procedures, standard qualitative and quantitative analysis procedures, and operation of standard laboratory equipment.
2. Graduates shall have an in-depth understanding of the theoretical basis of chemistry, as well as areas of application of chemical principles.
3. Graduates shall be capable of critical analysis and shall have had experience in applying the scientific method to a chemical problem.
4. Graduates must be well versed in the language of chemistry and should be capable of effectively communicating chemical knowledge in both written and oral forms.