

UNLV Program Review Self Study

- Program Reviewed: School of Life Sciences
- Degree(s): Bachelor of Science in Biological Sciences
- Program Director: Dr. Frank van Breukelen
- Dean: Dr. Eric Chronister
- Date of Report: February 12, 2024

General Instructions

- Please complete the program review self-study using this template.
- If this review is covering several degree levels, please be sure to address each level in your responses to the questions.
- Send completed self-study electronically to: programreview@unlv.edu
- The Senior Vice Provost for Academic Affairs is committed to engaging programs in a clear and useful program review process. To facilitate continuous improvement, we welcome feedback from programs and departments, external or internal reviewers and any other constituents of the process.

I. Program Description

College/Program

- College or School: College of Sciences
- Unit: School of Life Sciences
- Web Address: <https://www.unlv.edu/lifesciences>
- Program(s) being reviewed: Bachelor of Science in Biological Sciences
- Degrees and their abbreviations: Bachelor of Science (BS) Biological Sciences

Primary Individual Completing This Worksheet

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- Date of self-study: March 22, 2024

Other Faculty Involved In Writing This Report:

- Names: Javier Rodríguez, Associate Director
Stephanie Samson, Administrative Assistant IV

II. Catalog

1. Please insert the current catalog description for the academic program.

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.

The Biological Sciences undergraduate degree program aims to diversely train its students, enabling graduates to pursue careers or advanced degrees in life and health sciences, research, education, industry, or governmental work. Based on their individual interests, students may select from the following concentrations: Biotechnology, Cell and Molecular Biology, Comprehensive Biology, Ecology and Evolutionary Biology, Education, Integrative Physiology, Microbiology, and Pre-Professional Studies. All biology undergraduate students must complete a minimum of 120 credit hours. Each concentration may require specific upper division courses; therefore the number of upper division electives may vary across concentrations.

Please see the UNLV College of Sciences, Biology department web page at www.unlv.edu/lifesciences for information about department programs, faculty and facilities. Degree worksheets and a 4-5 year plan for the major are available at www.unlv.edu/degree/bs-biological-sciences

Please see advising information at the UNLV College of Science Advising at www.unlv.edu/sciences/advising.

Accreditation

Institution - Northwest Commission on Colleges and Universities www.nwccu.org

Learning Outcomes

All students graduating with a Bachelor of Science in Biological Sciences should be able to:

1. Understand the nature of scientific knowledge.
 - Describe the differences between opinions, facts, and scientific theories.
 - Appropriately utilize the scientific method within the laboratory environment.
 - Apply their understanding of the scientific method to successfully design an experiment.
 - Critically analyze scientific content presented both orally and in writing.

2. Understand cell structures and functions.
 - Explain the similarities and differences between prokaryotic and eukaryotic cells.
 - Explain the similarities and differences between plant and animal cells.
 - Describe the structure and function(s) of common eukaryotic organelles (nucleus, ribosomes, rough and smooth endoplasmic reticulum, Golgi apparatus, vesicles, lysosomes, mitochondria, chloroplasts, peroxisomes, vacuoles, and cytoskeleton).
 - Diagram the structure of an animal cell membrane, including the phospholipid bilayer, cholesterol, proteins, and carbohydrates.
 - Explain the functions of the cell membrane, including passive and active transport and communication/information processing.

3. Understand the physical nature of genetic information.
 - Describe the structure of DNA.
 - Diagram the basic structure of a gene, including regulatory and coding sequences.
 - Explain how genetic information is used in reproduction, including the processes of mitosis and meiosis.
 - Explain how genetic information is utilized during transcription, translation, DNA replication, and cell division.
 - Explain how genetic information can be changed through processes of mutation.
 - Explain how epigenetic regulation of gene expression can occur.

4. Understand that all organisms are genetically related, have evolved, and are evolving.
 - Explain the relationship between genetic information, physical characteristics, and the environment.
 - Provide a timeline of major evolutionary events describing the emergence of the main forms of life (prokaryotes, eukaryotes, multicellular life, fungi, plants, insects, fish, amphibians, reptiles, birds, mammals).
 - Articulate the mechanisms of evolution including mutation, selection, and speciation.
 - Apply their understanding of evolutionary relationships to accurately interpret phylogenetic trees.
 - Explain experimental techniques used to investigate evolution.

5. Understand the metabolic complexity of cells and organisms.
 - Provide examples of diverse mechanisms used by cells/organisms to extract energy from the environment.
 - Explain the reactions of energy transformation that occur in mitochondria, chloroplasts, microbes, and multicellular organisms.
 - Provide examples of diverse mechanisms used by cells/organisms to synthesize biological molecules.
 - Explain how cells/organisms regulate the internal environment.

6. Understand the complex interplay of how organisms respond to and interact with each other and their environment.
 - Describe how interactions change as the scale of life transitions from cells to ecosystems.
 - Articulate the different patterns of population growth and explain the environmental factors that underlie each pattern.
 - Explain community structure and the various forms of biodiversity.
 - Provide examples of the types of interactions that can occur between community members, including competition, predation, parasitism, coexistence, mutualism, and commensalism.
 - Explain how communities can respond to disturbances.
 - Discuss the interactions that occur between organisms and the nonliving components of their environment, including the role of biogeochemical cycling.

7. Effectively communicate complex biological concepts, orally and in writing.
 - Effectively discuss individual biological concepts in short written format such as a two to four paragraph response.
 - Effectively articulate the relationships between many biological concepts in an extended written format such as an eight- to ten-page paper.
 - Effectively explain individual biological concepts in a ten to fifteen-minute oral presentation.
 - Effectively answer questions from the audience following an oral presentation.
 - Summarize key points from a peer-reviewed journal article in a written report or during a group discussion.

8. Fulfill their professional goals.

In addition to the outcomes listed above, concentration specific outcomes are as follows:

Cell and Molecular Biology

- Explain the interrelationship between chemistry and biology, including how physical and chemical laws influence the structure and function of intracellular components and macromolecules.

Ecology and Evolutionary Biology

- Articulate in detail the interactions organisms have with each other and with nonliving components of the environment and how organisms and environments change over time.

Integrative Physiology

- Explain how cells and organisms acquire and process nutrients, transform energy, and maintain homeostasis in a variable environment to survive and reproduce.

Microbiology

- Explain the diversity and similarity of microbes, including their physiology, mechanisms of pathogenesis and host defenses, and unique ecology.

Pre-professional

- Become competitive candidates for admission into professional schools.

Admission Policies

Minimum GPA Requirement: 2.50

Prospective biology majors with a GPA less than 2.50, but at least 2.0, may be admitted on probationary status. A student placed on probation must meet with an advisor to design and agree upon a probationary course of study based on the student's previous progress and on established degree program requirements. This course of study must include at least 15 credits that apply toward a degree in the major, with a majority of the credits coming from courses in the college, unless all requirements within the college have been completed by the student. The advisor will place a memorandum outlining the course of study in the student's file. Students are expected to complete the probationary course of study within two consecutive semesters and one summer. Students who complete the probationary course of study within the allotted time with a cumulative GPA (for the course of study only) of at least 2.00 will be removed from probation.

Biological Sciences Major

Course requirements

Biological Sciences majors must complete a set of required 100-level science, math, and composition classes with a satisfactory grade before they can enroll in more advanced 300- and 400-level biology classes. In the first two semesters the typical student will complete the seven biology, chemistry, math, and composition courses listed below with a C or better (C- is not sufficient) as a prerequisite for enrollment in any upper division biology course. These courses, which satisfy university and science major requirements (22 credits), are typically taken in the freshman year:

- Biology 190A, Biology 190L, and Biology 191A, Biology 191L
- Chemistry 121A, 121L and Chemistry 122A, 122L
- Mathematics 181 or Mathematics 127 or Mathematics 128
- English 102 or English 114 or Honors 100

With satisfactory completion of these classes ("C" or better in each class), students will be able to enroll in 300- and 400-level biology classes, subject to any additional prerequisites listed in the course catalog.

If a student does not earn a “C” or better the first time they take a required course, it is expected that they will repeat the course one time and utilize available resources to improve their academic performance. Continuation as a biology major requires a C or better (C- is not sufficient) in each course (or equivalent transferred from another institution).

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 School Director 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 cumulative GPA of at least 2.00 must be maintained for all courses in the major field (Biology). All Biology core courses taken (Biology 190A/190L, 191A/191L, 300 or 304, 351, 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 Biological Sciences.

Biology 100, 104, 109, 113, 189, 120, 121, 122, 148, 208, 220 are designed for non-biology 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 urge 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: English 101 and 102; Mathematics 127, 128 or Mathematics 181; Chemistry 121A and Chemistry 121L and Chemistry 122A and Chemistry 122L; and Physics 151A/151L and 152A/152L (or the equivalent from the Physics 180 series). Biology 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 Paul McDermott Physical Education Building.

Biology Degree Requirements - Total: 120 Credits

General Education Requirements - Subtotal: 32-42 Credits

First-Year Seminar - Credits: 2-3

- (see note 1 below)

English Composition - Credits: 6

- English 101 - Composition I
- English 102 - Composition II

Second - Year Seminar - Credits: 3

Constitutions - Credits: 3-6

Mathematics

- Mathematics 181 - Calculus I - Fulfilled by the major requirement

Distribution Requirement - Credits: 18

Please see Distribution Requirements for more information.

- Humanities and Fine Arts: 9 Credits
 - Two courses 3 credits each from two different humanities areas, 6 credits
 - One course in fine arts, 3 credits
- Social Science: 9 Credits
 - One course each from three different fields.
- Life and Physical Sciences and Analytical Thinking:
 - Automatically satisfied by Major requirements

Multicultural and International - Credits: 0-6

(see note 2 below)

- Multicultural, one 3 credit course required
- International, one 3 credit course required

These courses may overlap with general education and major requirements.

A single course may not meet the multicultural and international requirements simultaneously. For the list of approved multicultural and international courses, go to: <https://www.unlv.edu/facultysenate/student-resources>

Milestone Experience

- Biology 351 - Microbiology - Fulfilled by the major requirement

Culminating Experience

- Biology 415 - Evolution - Fulfilled by the major requirement

Cell and Molecular Biology Concentration

Major Requirement - BS in Biological Sciences - Cell and Molecular Biology Concentration -Subtotal: 78 Credits (see notes 1-6 below)

Biology Core Requirements - Credits: 20

- Biology 190A - Introduction to Cell and Molecular Biology
- Biology 190L - Introduction to Cell and Molecular Biology Laboratory
- Biology 191A - Introduction to Organismal Biology
- Biology 191L - Introduction to Organismal Biology Laboratory
- Biology 300 - Principles of Genetics or Biology 304 - Molecular Genetics
- Biology 351 - Microbiology
- Biology 415 - Evolution

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 5 on the AP Biology exam may have either Biology 190A or Biology 191A lectures waived, and the appropriate lab completed at UNLV (consult the Advising Center before enrolling in classes).

Other Required Courses - Credits: 34

- Chemistry 121A - General Chemistry I
- Chemistry 121L - General Chemistry Laboratory I
- Chemistry 122A - General Chemistry II
- Chemistry 122L - General Chemistry Laboratory II
- Chemistry 241 - Organic Chemistry I
- Chemistry 241L - Organic Chemistry for Life Sciences Lab I
- Chemistry 242 - Organic Chemistry II
- Chemistry 242L - Organic Chemistry for Life Sciences Laboratory II
- Chemistry 474 - Biochemistry I
- Mathematics 181 - Calculus I
- Statistics 391 - Applied Statistics for Biological Sciences or
Statistics 491 - Statistics for Scientists I
- Physics 151A - General Physics I

- Physics 151L - General Physics I Lab
- Physics 152A - General Physics II
- Physics 152L - General Physics II Lab

Recommended Courses

- Mathematics 182 - Calculus II

Cell and Molecular Biology Concentration - Credits: 24

- Chemistry 475 - Biochemistry II
- A minimum of four courses from list below:
 - Biology 405 - Molecular Biology
 - Biology 409 - Virology
 - Biology 425 - Genomics
 - Biology 445 - Cell Physiology
 - Biology 453 - Immunology
 - Biology 460 - Microbial Physiology
 - Biology 464 - Bacterial Pathogenesis
 - Biology 466 - Developmental Biology
 - Biology 470 - Topics in Applied Microbiology
 - Biology 478 - Genetics and Cell Biology of Cancer
- Remaining credits (to total of 24) selected from course focus lists A-C with a minimum of one course from each list A-C.

List A: Focus on Cell Structure and Function

- Biology 360 - Introduction to Biomathematics I
- Biology 361 - Introduction to Biomathematics II
- Biology 405 - Molecular Biology
- Biology 409 - Virology
- Biology 425 - Genomics
- Biology 436 - Biometry
- Biology 443 - Molecular Biotechnology
- Biology 445 - Cell Physiology
- Biology 458 - Stem Cells and Regeneration Biology
- Biology 460 - Microbial Physiology
- Biology 464 - Bacterial Pathogenesis
- Biology 466 - Developmental Biology
- Biology 469 - RNA Biology
- Biology 470 - Topics in Applied Microbiology
- Biology 473 - Advanced Topics in Cell and Molecular Biology
- Biology 478 - Genetics and Cell Biology of Cancer
- Biology 480 - Introduction to Biological Modeling
- Biology 485 - Microbial Genetics

List B: Focus on Organismal Structure and Function

- Biology 347 - Human Anatomy Lab

- Biology 348 - Introduction to Human Anatomy
- Biology 349 - Human Physiology Foundations
- Biology 360 - Introduction to Biomathematics I
- Biology 414 - Endocrinology
- Biology 417 - Biochemical Adaptations
- Biology 426 - Plant Anatomy
- Biology 436 - Biometry
- Biology 440 - Mammalian Physiology
- Biology 442 - Principles of Plant Physiology with Laboratory
- Biology 447 - Advanced Comparative Animal Physiology
- Biology 451 - Comparative Vertebrate Anatomy
- Biology 453 - Immunology
- Biology 455 - Comparative Vertebrate Anatomy and Biomechanics
- Biology 463 - Genetics of Human Disease
- Biology 468 - Histology
- Biology 475 - Neurobiology
- Biology 480 - Introduction to Biological Modeling

List C: Focus on Biological Diversity

- Biology 301 - Fossil Record
- Biology 305 - Introduction to Conservation Biology
- Biology 320 - Invertebrate Zoology
- Biology 341 - Principles of Ecology
- Biology 360 - Introduction to Biomathematics I
- Biology 403 - Restoration Ecology
- Biology 412 - Molecular Evolution
- Biology 413 - Introduction to Scientific Writing
- Biology 418 - Microbial Ecology
- Biology 427 - Bryology
- Biology 432 - Herpetology
- Biology 434 - Mammalogy
- Biology 435 - Forest Ecology
- Biology 436 - Biometry
- Biology 437 - Entomology
- Biology 438 - Soil Plant Water Relations in Arid Environments
- Biology 441 - Field Ecology
- Biology 444 - Principles of Plant Ecology
- Biology 461 - Prokaryotic Diversity
- Biology 480 - Introduction to Biological Modeling
- Biology 486 - Animal Behavior
- Biology 487 - Principles of Systematics
- Biology 490 - Biogeography

General Electives - Credits: 6-9

Notes

1. It is strongly recommended that students take Science 101 to satisfy the First Year Seminar requirement.
2. 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.
3. 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.
4. Up to 4 credits of Biology 492 may be used toward concentration total of 24 credits.
5. Up to 2 credits total of Biology 494 and/or Biology 499 may be used as electives to satisfy the 120 credit total.
6. At least 40 credits must be earned at the upper-division level (300 and above).

Total Credits: 120

Ecology and Evolutionary Biology Concentration

Major Requirements - BS in Biological Sciences - Ecology and Evolutionary Biology Concentration - Subtotal: 78 Credits (see note 1-6 below)

Biology Core Requirements - Credits: 20

- Biology 190A - Introduction to Cell and Molecular Biology
- Biology 190L - Introduction to Cell and Molecular Biology Laboratory
- Biology 191A - Introduction to Organismal Biology
- Biology 191L - Introduction to Organismal Biology Laboratory
- Biology 300 - Principles of Genetics (or) Biology 304 - Molecular Genetics
- Biology 351 - Microbiology
- Biology 415 - Evolution

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 5 on the AP Biology exam may have either Biology 190A or Biology 191A lectures waived, and the appropriate lab completed at UNLV (consult the College of Sciences Advising Center before enrolling in classes).

Other Required Courses - Credits: 34

- Chemistry 121A - General Chemistry I
- Chemistry 121L - General Chemistry Laboratory I

- Chemistry 122A - General Chemistry II
- Chemistry 122L - General Chemistry Laboratory II
- Chemistry 241 - Organic Chemistry I
- Chemistry 241L - Organic Chemistry for Life Sciences Lab I
- Chemistry 242 - Organic Chemistry II
- Chemistry 242L - Organic Chemistry for Life Sciences Laboratory II
- Chemistry 474 - Biochemistry I
- Mathematics 181 - Calculus I
- Statistics 391 - Applied Statistics for Biological Sciences or
Statistics 491 - Statistics for Scientists I
- Physics 151A - General Physics I
- Physics 151L - General Physics I Lab
- Physics 152A - General Physics II
- Physics 152L - General Physics II Lab

Recommended Courses

- Mathematics 182 - Calculus II
- Chemistry 475 - Biochemistry II

Biology - Ecology and Evolutionary Biology Requirements - Credits: 24

- Biology 341 - Principles of Ecology
- A minimum of three courses from list below:
 - Biology 301 - Fossil Record
 - Biology 305 - Introduction to Conservation Biology
 - Biology 320 - Invertebrate Zoology
 - Biology 412 - Molecular Evolution
 - Biology 418 - Microbial Ecology
 - Biology 427 - Bryology
 - Biology 432 - Herpetology
 - Biology 434 - Mammalogy
 - Biology 438 - Soil Plant Water Relations in Arid Environments
 - Biology 441 - Field Ecology
 - Biology 444 - Principles of Plant Ecology
 - Biology 486 - Animal Behavior
 - Biology 487 - Principles of Systematics
 - Biology 490 - Biogeography
- Remaining credits (to total of 24) selected from course focus lists A-C.
Overall minimum of one course from each list A-C

List A: Focus on Cell Structure and Function

- Biology 405 - Molecular Biology
- Biology 409 - Virology
- Biology 425 - Genomics
- Biology 445 - Cell Physiology
- Biology 460 - Microbial Physiology

- Biology 464 - Bacterial Pathogenesis
- Biology 466 - Developmental Biology
- Biology 470 - Topics in Applied Microbiology
- Biology 478 - Genetics and Cell Biology of Cancer
- Biology 473 - Advanced Topics in Cell and Molecular Biology
- Biology 485 - Microbial Genetics

List B: Focus on Organismal Structure and Function

- Biology 348 - Introduction to Human Anatomy
- Biology 414 - Endocrinology
- Biology 417 - Biochemical Adaptations
- Biology 426 - Plant Anatomy
- Biology 440 - Mammalian Physiology
- Biology 442 - Principles of Plant Physiology with Laboratory
- Biology 447 - Advanced Comparative Animal Physiology
- Biology 451 - Comparative Vertebrate Anatomy
- Biology 453 - Immunology
- Biology 455 - Comparative Vertebrate Anatomy and Biomechanics
- Biology 468 - Histology

List C: Focus on Biological Diversity

- Biology 301 - Fossil Record
- Biology 305 - Introduction to Conservation Biology
- Biology 320 - Invertebrate Zoology
- Biology 341 - Principles of Ecology
- Biology 412 - Molecular Evolution
- Biology 418 - Microbial Ecology
- Biology 427 - Bryology
- Biology 432 - Herpetology
- Biology 434 - Mammalogy
- Biology 438 - Soil Plant Water Relations in Arid Environments
- Biology 441 - Field Ecology
- Biology 444 - Principles of Plant Ecology
- Biology 486 - Animal Behavior
- Biology 487 - Principles of Systematics
- Biology 490 - Biogeography

General Electives - Credits: 6-9

Notes:

1. It is strongly recommended that students take Science 101 to satisfy the First Year Seminar requirement.
2. 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.

3. 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.
4. Up to 4 credits of Biology 492 may be used toward concentration total of 24 credits.
5. Up to 2 credits total of Biology 494 and/or Biology 499 may be used as electives to satisfy the 120 credit total.
6. At least 40 credits must be earned at the upper-division level (300 and above).

Total Credits: 120

Integrative Physiology Concentration

Major Requirements - BS in Biological Sciences - Integrative Physiology Concentration - Subtotal: 78 Credits (see note 1-6 below)

Biology Core Requirements - Credits: 20

- Biology 190A - Introduction to Cell and Molecular Biology
- Biology 190L - Introduction to Cell and Molecular Biology Laboratory
- Biology 191A - Introduction to Organismal Biology
- Biology 191L - Introduction to Organismal Biology Laboratory
- Biology 300 - Principles of Genetics (or) Biology 304 - Molecular Genetics
- Biology 351 - Microbiology
- Biology 415 - Evolution

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 5 on the AP Biology exam may have either Biology 190A or Biology 191A lectures waived, and the appropriate lab completed at UNLV (consult the College of Sciences Advising Center before enrolling in classes).

Other Required Courses - Credits: 34

- Chemistry 121A - General Chemistry I
- Chemistry 121L - General Chemistry Laboratory I
- Chemistry 122A - General Chemistry II
- Chemistry 122L - General Chemistry Laboratory II
- Chemistry 241 - Organic Chemistry I
- Chemistry 241L - Organic Chemistry for Life Sciences Lab I
- Chemistry 242 - Organic Chemistry II
- Chemistry 242L - Organic Chemistry for Life Sciences Laboratory II

- Chemistry 474 - Biochemistry I
- Mathematics 181 - Calculus I
- Statistics 391 - Applied Statistics for Biological Sciences or
Statistics 491 - Statistics for Scientists I
- Physics 151A - General Physics I
- Physics 151L - General Physics I Lab
- Physics 152A - General Physics II
- Physics 152L - General Physics II Lab

Recommended Courses

- Chemistry 475 - Biochemistry II
- Mathematics 182 - Calculus II

Integrative Physiology Requirements Credits: 24

- Biology 445 - Cell Physiology
- A minimum of two from the following:
 - Biology 440 - Mammalian Physiology
 - Biology 442 - Principles of Plant Physiology with Laboratory
 - Biology 447 - Advanced Comparative Animal Physiology
- Remaining credits (to total of 24) selected from course focus lists A-C.
Overall minimum of one course from each list A-C.

List A: Focus on Cell Structure and Function

- Biology 405 - Molecular Biology
- Biology 409 - Virology
- Biology 425 - Genomics
- Biology 445 - Cell Physiology
- Biology 460 - Microbial Physiology
- Biology 464 - Bacterial Pathogenesis
- Biology 466 - Developmental Biology
- Biology 470 - Topics in Applied Microbiology
- Biology 473 - Advanced Topics in Cell and Molecular Biology
- Biology 478 - Genetics and Cell Biology of Cancer
- Biology 485 - Microbial Genetics

List B: Focus on Organismal Structure and Function

- Biology 348 - Introduction to Human Anatomy
- Biology 414 - Endocrinology
- Biology 417 - Biochemical Adaptations
- Biology 426 - Plant Anatomy
- Biology 440 - Mammalian Physiology
- Biology 442 - Principles of Plant Physiology with Laboratory
- Biology 447 - Advanced Comparative Animal Physiology
- Biology 451 - Comparative Vertebrate Anatomy
- Biology 453 - Immunology

- Biology 455 - Comparative Vertebrate Anatomy and Biomechanics
- Biology 468 - Histology

List C: Focus on Biological Diversity

- Biology 301 - Fossil Record
- Biology 305 - Introduction to Conservation Biology
- Biology 320 - Invertebrate Zoology
- Biology 341 - Principles of Ecology
- Biology 412 - Molecular Evolution
- Biology 418 - Microbial Ecology
- Biology 427 - Bryology
- Biology 432 - Herpetology
- Biology 434 - Mammalogy
- Biology 438 - Soil Plant Water Relations in Arid Environments
- Biology 441 - Field Ecology
- Biology 444 - Principles of Plant Ecology
- Biology 486 - Animal Behavior
- Biology 487 - Principles of Systematics
- Biology 490 - Biogeography

General Electives - Credits: 6-9

Notes:

1. It is strongly recommended that students take Science 101 to satisfy the First Year Seminar requirement.
2. 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.
3. 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.
4. Up to 4 credits of Biology 492 may be used toward concentration total of 24 credits.
5. Up to 2 credits total of Biology 494 and/or Biology 499 may be used as electives to satisfy the 120 credit total.
6. At least 40 credits must be earned at the upper-division level (300 and above).

Total Credits: 120

Microbiology Concentration

**Major Requirements - BS in Biological Sciences - Microbiology
Concentration - Subtotal: 78 Credits (see notes 1-6 below)**

Biology Core Requirements - Credits: 20

- Biology 190A - Introduction to Cell and Molecular Biology
- Biology 190L - Introduction to Cell and Molecular Biology Laboratory
- Biology 191A - Introduction to Organismal Biology
- Biology 191L - Introduction to Organismal Biology Laboratory
- Biology 300 - Principles of Genetics (or) Biology 304 - Molecular Genetics
- Biology 351 - Microbiology
- Biology 415 - Evolution

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 5 on the AP Biology exam may have either Biology 190A or Biology 191A lectures waived, and the appropriate lab completed at UNLV (consult the College of Sciences Advising Center before enrolling in classes).

Other Required Courses - Credits: 34

- Chemistry 121A - General Chemistry I
- Chemistry 121L - General Chemistry Laboratory I
- Chemistry 122A - General Chemistry II
- Chemistry 122L - General Chemistry Laboratory II
- Chemistry 241 - Organic Chemistry I
- Chemistry 241L - Organic Chemistry for Life Sciences Lab I
- Chemistry 242 - Organic Chemistry II
- Chemistry 242L - Organic Chemistry for Life Sciences Laboratory II
- Chemistry 474 - Biochemistry I
- Mathematics 181 - Calculus I
- Statistics 391 - Applied Statistics for Biological Sciences or
Statistics 491 - Statistics for Scientists I
- Physics 151A - General Physics I
- Physics 151L - General Physics I Lab
- Physics 152A - General Physics II
- Physics 152L - General Physics II Lab

Recommended Courses

- Chemistry 475 - Biochemistry II
- Mathematics 182 - Calculus II

Microbiology Concentration - Credits: 24

- A minimum of three courses from list below:
 - Biology 405 - Molecular Biology

- Biology 409 - Virology
 - Biology 418 - Microbial Ecology
 - Biology 453 - Immunology
 - Biology 460 - Microbial Physiology
 - Biology 464 - Bacterial Pathogenesis
 - Biology 470 - Topics in Applied Microbiology
 - Biology 485 - Microbial Genetics
- Remaining credits (to total of 24) selected from course focus lists A-C.
Overall minimum of one course from each list A-C

List A: Focus on Cell Structure and Function

- Biology 405 - Molecular Biology
- Biology 409 - Virology
- Biology 425 - Genomics
- Biology 445 - Cell Physiology
- Biology 460 - Microbial Physiology
- Biology 464 - Bacterial Pathogenesis
- Biology 466 - Developmental Biology
- Biology 470 - Topics in Applied Microbiology
- Biology 473 - Advanced Topics in Cell and Molecular Biology
- Biology 478 - Genetics and Cell Biology of Cancer
- Biology 485 - Microbial Genetics

List B: Focus on Organismal Structure and Function

- Biology 348 - Introduction to Human Anatomy
- Biology 414 - Endocrinology
- Biology 417 - Biochemical Adaptations
- Biology 426 - Plant Anatomy
- Biology 440 - Mammalian Physiology
- Biology 442 - Principles of Plant Physiology with Laboratory
- Biology 447 - Advanced Comparative Animal Physiology
- Biology 451 - Comparative Vertebrate Anatomy
- Biology 453 - Immunology
- Biology 455 - Comparative Vertebrate Anatomy and Biomechanics
- Biology 468 - Histology

List C: Focus on Biological Diversity

- Biology 301 - Fossil Record
- Biology 305 - Introduction to Conservation Biology
- Biology 320 - Invertebrate Zoology
- Biology 341 - Principles of Ecology
- Biology 412 - Molecular Evolution
- Biology 418 - Microbial Ecology
- Biology 427 - Bryology

- Biology 438 - Soil Plant Water Relations in Arid Environments
- Biology 432 - Herpetology
- Biology 434 - Mammalogy
- Biology 441 - Field Ecology
- Biology 444 - Principles of Plant Ecology
- Biology 486 - Animal Behavior
- Biology 487 - Principles of Systematics

General Electives - Credits: 6-9

Notes:

1. It is strongly recommended that students take Science 101 to satisfy the First Year Seminar requirement.
2. 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.
3. 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.
4. Up to 4 credits of Biology 492 may be used toward concentration total of 24 credits.
5. Up to 2 credits total of Biology 494 and/or Biology 499 may be used as electives to satisfy the 120 credit total.
6. At least 40 credits must be earned at the upper-division level (300 and above).

Total Credits: 120

Pre-Professional Concentration

Major Requirement - BS in Pre-Professional Concentration - Subtotal: 76 credits (see notes 1-7 below)

Biology Core Requirements - Credits: 20

- Biology 190A - Introduction to Cell and Molecular Biology
- Biology 190L - Introduction to Cell and Molecular Biology Laboratory
- Biology 191A - Introduction to Organismal Biology
- Biology 191L - Introduction to Organismal Biology Laboratory
- Biology 300 - Principles of Genetics (or) Biology 304 - Molecular Genetics
- Biology 351 - Microbiology
- Biology 415 - Evolution

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 5 on the AP Biology exam may have either Biology 190A or Biology 191A lectures waived, and the appropriate lab completed at UNLV (consult the College of Sciences Advising Center before enrolling in classes).

Other Required Courses - Credits: 36

- Chemistry 121A - General Chemistry I
- Chemistry 121L - General Chemistry Laboratory I
- Chemistry 122A - General Chemistry II
- Chemistry 122L - General Chemistry Laboratory II
- Chemistry 241 - Organic Chemistry I
- Chemistry 241L - Organic Chemistry for Life Sciences Lab I
- Chemistry 242 - Organic Chemistry II
- Chemistry 242L - Organic Chemistry for Life Sciences Laboratory II
- Chemistry 474 - Biochemistry I
- Chemistry 475 - Biochemistry II
- Mathematics 181 - Calculus I
- Statistics 391 - Applied Statistics for Biological Sciences or Statistics 491 - Statistics for Scientists I
- Physics 151A - General Physics I
- Physics 151L - General Physics I Lab
- Physics 152A - General Physics II
- Physics 152L - General Physics II Lab

Recommended Courses

- Mathematics 182 - Calculus II

Pre-Professional Requirements - Credits: 20

- A minimum of six courses from focus course lists A, B, C (total of 20 credits)
Select from course focus lists A - C.
Overall minimum of one course from each list A - C

List A: Focus on Cell Structure and Function

- Biology 405 - Molecular Biology
- Biology 409 - Virology
- Biology 425 - Genomics
- Biology 445 - Cell Physiology
- Biology 460 - Microbial Physiology
- Biology 464 - Bacterial Pathogenesis
- Biology 466 - Developmental Biology
- Biology 470 - Topics in Applied Microbiology
- Biology 473 - Advanced Topics in Cell and Molecular Biology
- Biology 478 - Genetics and Cell Biology of Cancer

List B: Focus on Organismal Structure and Function

- Biology 348 - Introduction to Human Anatomy
- Biology 414 - Endocrinology
- Biology 417 - Biochemical Adaptations
- Biology 426 - Plant Anatomy
- Biology 440 - Mammalian Physiology
- Biology 442 - Principles of Plant Physiology with Laboratory
- Biology 447 - Advanced Comparative Animal Physiology
- Biology 451 - Comparative Vertebrate Anatomy
- Biology 455 - Comparative Vertebrate Anatomy and Biomechanics
- Biology 468 - Histology

List C: Focus on Biological Diversity

- Biology 301 - Fossil Record
- Biology 305 - Introduction to Conservation Biology
- Biology 320 - Invertebrate Zoology
- Biology 341 - Principles of Ecology
- Biology 412 - Molecular Evolution
- Biology 418 - Microbial Ecology
- Biology 427 - Bryology
- Biology 432 - Herpetology
- Biology 434 - Mammalogy
- Biology 438 - Soil Plant Water Relations in Arid Environments
- Biology 441 - Field Ecology
- Biology 444 - Principles of Plant Ecology
- Biology 486 - Animal Behavior
- Biology 487 - Principles of Systematics
- Biology 490 - Biogeography

General Electives - Credits: 2-12

Notes:

1. It is strongly recommended that students take Science 101 to satisfy the First Year Seminar requirement.
2. 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.
3. 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.
4. Up to 2 credits total of Biology 492, Biology 494, Biology 496 and/or Biology 499 may be used to satisfy concentration of 20 credits.
5. An additional 2 credits of Biology 492, Biology 494, Biology 496, and/or Biology 499 may be used as electives to satisfy the 120 credit total.
6. At least 40 credits must be earned at the upper-division level (300 and above).
7. Biology 351, Biology 415 are milestone courses for the BS Biological Sciences.

Total Credits: 120

2. Has the catalog description/program undergone substantial change(s) since the last program review? If yes, please describe the substantive changes.

- The above description of the BS Biological Sciences that appears in the university's undergraduate catalog remains accurate.
- Life Sciences faculty implement periodic changes to their academic offerings to enhance the educational experience of their students. Below we list examples of these improvements.
- In the past seven years Life Sciences faculty developed three Course-based Undergraduate Research Experiences (CUREs) to give second-year students and seniors authentic experience with the scientific process during their academic careers.
 - Biology 207 - Phage Discovery (4 credits) uses bacteriophage biology as a model system to introduce Biology majors to the process of research, and to facilitate development of communication and collaboration skills and employment of quantitative reasoning. Students are tasked with isolating a phage from the environment and applying various microbiology and

molecular biology techniques to characterize the phage during the semester. Students are required to maintain their data in a digital lab notebook, report their results at group meetings, summarize their data in graphical format, and deliver a summative oral presentation of their research to the class at the end of the term. In addition, students actively participate in group discussions of a collection of primary research articles and of two assigned novels, *The Immortal Life of Henrietta Lacks* (2010), by Rebecca Skloot, and *The Perfect Predator* (2019), by Steffanie Strathdee and Thomas Patterson.

- Biology 217 - Bacteriophage Genomics (3 credits) introduces students to bacteriophage genomics and genome annotation. Students are provided with the genome data obtained from the Biology 207 - Phage Discovery course and asked to annotate the phage genomes according to established standards of review. Students maintain and collaborate on a shared Google Sheet system that houses their research annotations. The final versions of these files are submitted in the appropriate format to the Sea Phages Consortium (and then to Genbank), with the end goal of publication in a peer-reviewed journal. Techniques covered include gene identification, start codon identification, and putative function assignment, and incorporate a variety of online open source tools (i.e. BLAST, DNA Master, GeneMark). In addition, students actively participate in group discussions of two assigned novels, *The Gene: An Intimate History* (2017) by Siddhartha Mukherjee, and *A Crack in Creation: Gene Editing and the Unthinkable Power to Control Evolution* (2018), by Jennifer Doudna and Samuel Sternberg.

Biology 207 and 217 were redesigned after their initial offering to satisfy the university's Second-Year Seminar requirement. The Second-Year Seminar, a component of the General Education Distribution Requirement, is a 3 credit course that explores issues relevant to contemporary global society through reading original literature from antiquity to the present day. Students learn about these issues within their larger contexts, which include aspects of literature, history, politics, economics, philosophy, and scientific discovery.

- Biology 401R - Undergraduate Research: Design to Data (4 credits) is the most recently developed Course-Based Undergraduate Research Experience, and was first offered in Spring 2023. In this intensive upper division course, students acquire a firm conceptual understanding of many fundamental research techniques, which they are required to learn to apply correctly.
- Development and first offering of the hybrid Biology 189L - Fundamentals of Life Science Lab (1 credit) in Fall 2019. New instructional materials were developed during Spring 2019 and evaluated for accessibility in the summer. Course design was grounded in learning science research, and the course was developed in collaboration with an Instructional Designer. All hands-on lab activities and experiments were maintained for the hybrid sections, but the presentation of background content (the "introductory lecture") was moved online.

- Several upper-division courses were developed (or offered after a long hiatus) to expand the number of topics students can learn more about. These new courses include:

- Biology 347 - Human Anatomy Lab (1 credit)
- Biology 348 - Introduction to Human Anatomy (3 credits)
- Biology 349 - Human Physiology Foundations (3 credits)

(The School previously offered Biology 223 - Human Anatomy and Physiology I (4 credits) and Biology 224 - Human Anatomy and Physiology II (4 credits), but these courses were designed primarily for School of Nursing majors, and were transferred to the Department of Kinesiology and Nutrition Sciences, in the School of Integrated Health Sciences. Subsequently, Life Sciences faculty developed Biology 347, Biology 348, and Biology 349 for Biology majors specifically.)

- Biology 421G - Conservation Genetics (3 credits) draws from concepts and methods in ecological and evolutionary genetics to examine the conservation and restoration of rare, threatened, and endangered species.
 - Biology 424 - Climate Change Physiology (3 credits) introduces students to recent findings regarding how animals are affected by global climate change.
 - Biology 436 - Biometry (3 credits) covers experimental design and statistical analyses of large biological datasets.
 - Biology 459 - Genetics of Human Disease (3 credits) discusses the genetic basis of non-infectious diseases.
 - Biology 467 - Geomicrobiology (3 credits) discusses microbial communities and their local physical environments.
 - Biology 474C - Climate Change Ecology (3 credits) is focused on a crucial contemporary topic of broad interest.
 - Biology 478P - Biopharmacology (3 credits) covers drug development, pharmacological actions and functions of basic drug classes, drug metabolism, and side effects.
- Life Sciences faculty implemented a Graduate Reception, an engagement and community outreach event where graduating students attend a campus reception in December or May to celebrate their academic achievement with their families and School faculty.

III. Relationships

3. What relationship does this program have to other programs or institutions in the NSHE system (e.g. articulation, transfers, partnerships)?

- The Nevada System of Higher Education (NSHE) uses common course numbering, and thus any transfer courses between NSHE's academic institutions (College of Southern Nevada, Great Basin College, Nevada State University, Truckee Meadows Community College, Western Nevada College, University of Nevada, Las Vegas, University of Nevada, Reno) should be "straight" transfers, that is, transfers that don't require articulation. UNLV's Office of the Registrar maintains all transfer credit articulation history, and can be accessed using the Transfer Evaluation System (TES, <https://www.unlv.edu/registrar/advisor-info/undergraduate-transfer-credit>).
- There are no other active partnerships or relationships between the BS Biological Sciences and NSHE institutions.

4. Describe the relationship between this program and other UNLV programs. How does this program serve or interact with other areas of the institution (e.g. collaborations, partnerships, affiliated faculty, general education)?

- The Nevada Institute of Personalized Medicine (NIPM) is the only established Center of Excellence for Personalized Medicine in Nevada that is endorsed by the National Institutes of Health. NIPM is housed within UNLV's College of Sciences, and it endeavors to accelerate the adoption of advanced genomics for Nevada's healthcare systems.
- Two School of Life Sciences Assistant Professors, Prasun Guha and Qian Liu, have dual appointments at NIPM (51% Full Time Equivalent, FTE) and at the School (49% FTE), and 3 other School faculty (Nora Caberoy, Mira Han, Brian Hedlund) are affiliated with NIPM.
- Adjunct Faculty, School of Life Sciences
 - Jingchun Chen, Nevada Institute of Personalized Medicine
 - Duane Moser, Desert Research Institute, Las Vegas
 - Aude Picard, College of Sciences
 - James Raymond, School of Life Sciences
 - Henry Sun, Desert Research Institute, Las Vegas
 - The 3 Course-based Undergraduate Research Experiences (CUREs) courses are associated with national efforts.
- Biology 207 - Phage Discovery and Biology 217 - Bacteriophage Genomics satisfy the university's Second-Year Seminar requirement for all UNLV undergraduate degree programs, and participate in the Howard Hughes Medical Institute's Science

Education Alliance-Phage Hunters Advancing Genomics and Evolutionary Science (SEA-PHAGES) program.

- Biology 401 - Undergraduate Research: Design to Data is part of the University of California, Davis Design to Data (D2D) program.
- The laboratories associated with microbiology for non-majors (Biology 251 - General Microbiology) and majors (Biology 351 - Microbiology) participate in the Small World Initiative (SWI), an innovative program that encourages students to pursue careers in science while addressing a worldwide health threat – superbugs and the diminishing supply of effective antibiotics. SWI includes more than 330 undergraduate institutions and high schools across 45 US states, the District of Columbia, Puerto Rico, and 15 countries.
- Any Biology class may be used to satisfy the university's General Education Life and Physical Sciences Courses (6-7 credits) Distribution Requirement.

IV. Faculty Information and Productivity

5. Evaluate trends in the following areas

- a. Composition of full-time faculty (as of Fall 2023)
 - i. Number of Faculty
 - ii. Rank
 - iii. Ethnicity/Race
 - iv. Gender
 - v. Percent of faculty with terminal degree
- b. Scholarship (Gathered by Department)
 - i. Publications/Creative Activities
 - ii. Grant Applications/Grant Funding Awarded
 - iii. Other
- c. Teaching/Service (Gathered by Department)
 - i. Innovative teaching practices
 - ii. Teaching or Service Awards
 - iii. Faculty/Student Collaborations
 - iv. Community Engagement Activities

Composition of Full-time Faculty

- Assistant Professors (6) – Darrin Brager, Matthew Meiselman, Ranjani Murali, Drew Peltier, Matthew Petrie, Mo Weng (Peltier arrived on campus in early January 2024, and Murali is scheduled to arrive in March 2024).

- Dual Appointment Assistant Professors (2) – Prasun Guha and Qian Liu. Guha and Liu have a 49% FTE appointment at the School (both have a 51% FTE at the Nevada Institute of Personalized Medicine, College of Sciences), only teach biology courses periodically, and are non-voting members of the School.
- Associate Professors (10) – Scott Abella, Andrew Andres, Nora Caberoy, Mira Han, Allyson Hindle, David Lee, Nicole Pietrasiak, Paul Schulte, Ai-Sun (Kelly) Tseng, Boo Shan Tseng.
- Professors (12) – Dale Devitt, Allen Gibbs, Brian Hedlund, Donald Price, Eduardo Robleto, Javier Rodríguez, Martin Schiller, Jeffery Qingxi Shen, Elizabeth Stacy, Daniel Thompson, Frank van Breukelen, Helen Wing.
- Andrew Andres (Executive Associate Dean, College of Sciences) and Martin Schiller (Executive Director, Nevada Institute of Personalized Medicine, College of Sciences) serve in full-time administrative positions outside the School, do not teach biology courses, and currently are non-voting members of the School.
- “Faculty in Residence” is the term used by the university to refer to non-tenure-track, teaching-intensive, and essential faculty employed by the university.
- Assistant Professor in Residence (1) – Joseph Nika.
- Associate Professors in Residence (5) – Jef Jaeger, Sean Neiswenter, Kathryn Rafferty, Christy Strong, Jenifer Utz.
- Professor in Residence (1) – Kurt Regner (retired at the end of December 2023).
- Total: 30 ladder-rank faculty (20 males, 10 females); 7 faculty in residence (4 males, 3 females)
- White, 26 (70%); Asian, 9 (24%); Hispanic, 2 (5%)
- Visiting Professor (1) - Wendy Trzyna (White female)
- Visiting Assistant Professors (this is effectively a Lecturer position) (2) – David Choate, Michael Treat (2 White males).
- All (100%) School faculty (ladder-rank faculty, Faculty in Residence, Lecturers) hold a doctoral degree.
- Since 2014, 10 faculty have left the School (8 retirements, 1 accepted a senior leadership position at another institution, 1 tenure denial).
- Since 2014, 18 faculty have joined the School (3 Faculty in Residence, 15 ladder-rank faculty, including 2 who only have a 49% FTE appointment in the School).

- Of the 15 ladder-rank faculty, 12 were hired as Assistant Professors, and 3 were hired with tenure (2 Associate Professors, 1 Professor).
- The 4 Assistant Professors hired since 2014 who applied for tenure and promotion earned this distinction. A fifth tenure and promotion dossier is currently under evaluation; the application was unanimously supported by the School, the College of Sciences, and the Faculty Senate.
- The 3 Assistant Professors in Residence hired since 2014 who applied for promotion to Associate Professor in Residence earned this distinction.
- The number of female ladder-rank faculty (10) and faculty in residence (3) in the School has increased since 2014, but the School has not hired any member of an underrepresented group during this period.
- The standard teaching load of ladder-rank faculty is 1-1, although these faculty additionally participate in formal graduate seminars in the Fall and/or Spring semesters. Faculty in Residence teach 3, often large-enrollment courses per semester.
- Due to the low number of full-time faculty, the School relies on Visiting Assistant Professors to offer some required (e.g. Biology 189 - Fundamentals of Life Science, Biology 191A - Introduction to Organismal Biology, Biology 251A - General Microbiology) or popular (e.g. Biology 414 - Endocrinology, Biology 486 - Animal Behavior) courses.
- The School also relies on part-time instructors to teach the laboratory component of Biology courses or some upper division courses (e.g. Biology 320 - Invertebrate Zoology, Biology 468 - Histology). Indeed, 32 (Fall 2020), 29 (Fall 2021), and 36 (Fall 2022) part-time instructors taught Biology courses in past semesters.

Scholarship

- Life Sciences faculty work in a wide variety of fields, including the major research areas of:
 - Bacterial pathogenesis
 - Biogeography
 - Biological education
 - Biomechanics
 - Cellular and molecular biology
 - Climate change
 - Computational biology, including bioinformatics
 - Conservation biology
 - Ecology (including microbial and bacteriophage ecology, fire ecology, restoration ecology, and ecosystem ecology)
 - Evolutionary biology
 - Microbial genetics

- Microbial, cell, animal, and plant physiology
 - Neurobiology
 - Plant anatomy
 - Urban water conservation
- Since 2013, 24 Life Sciences faculty have collectively published 459 peer-reviewed book chapters and articles, most of them in prestigious journals (e.g. Current Biology, Nature Biotechnology, Nature Communications, Nature Conservation, Nature Metabolism, Proceedings of the National Academy of Sciences of the United States of America, Science) or in renowned journals in their respective disciplines. Many of these publications have graduate (187, 41%) or undergraduate (76, 17%) student coauthors.
- Some faculty have been recognized for their research accomplishments:
 - UNLV Top Tier Award (Allen Gibbs, 2019)
The UNLV Top Tier Award honors employees for outstanding contributions to UNLV and its mission to be a Top Tier University.
 - American Society for Microbiology Peggie Cotter Award for Early Career Branch Members (Boo Tseng, 2020)
 - Keynote Speaker, UNLV Virtual Undergraduate Research Symposium (Kathryn Rafferty, 2020)
 - Plenary speaker, Conference of the Indian Society of Evolutionary Biologists (Allen Gibbs, 2023)
 - UNLV Barrick Scholar Award (Boo Tseng, 2023)
The Barrick Scholar Awards are designed to recognize faculty members who have established a record of distinguished research or have demonstrated excellence in the area of creative activity.
- The h-index (or Hirsch index) is a measure used to indicate the impact and scholarly productivity of a researcher based on how often his/her publications have been cited. The collective h-index of Life Sciences faculty is higher than that of Biology faculty from 4 of the 6 peer institutions chosen by UNLV for comparison.

Institution	Biological Sciences h-index 2018-2022
University of New Mexico, Albuquerque	22
University of Hawaii, Manoa	19
University of Nevada, Las Vegas	13
University of North Texas, Denton	12
University of Texas, San Antonio	9
University of Texas, Arlington	8
Portland State University, Oregon	6

- Since 2013, Life Sciences faculty have played leading or important roles in securing ca. \$116,540,000 in *total* extramural funding to support research and educational activities, including major research instrumentation grants, supplemental awards, and in-kind awards. (Note: Not all these funds were awarded to UNLV or to the School of Life Sciences, or provided facilities and administrative costs.) This remarkable amount includes a \$20 million National Science Foundation's Established Program to Stimulate Competitive Research (EPSCoR) award (2013-2017), a recent \$32 million award through the Southern Nevada Public Land Management Act to build the Children's Science and Nature Park in North Las Vegas, and a recent \$5 million grant from the U.S. Department of Agriculture's Forest Service to remedy tree canopy inequities in the Las Vegas Valley (see page 33).

This extramural funding comes from federal, state, private, and international organizations, including the National Institutes of Health, National Science Foundation, National Aeronautics and Space Administration, U.S. Bureau of Land Management, the U.S. Departments of Agriculture (Forest Service, Natural Resources Conservation Service), Education, Energy, Defense, and Interior (Fish & Wildlife Service), U.S. Geologic Survey, National Park Service, Nevada Department of Wildlife, Nevada Division of Forestry, Department of Air Quality Management, Clark County, Nevada, the Cystic Fibrosis Foundation, Glen Canyon Natural History Association, Human Frontier Science Program, Troesh Center for Entrepreneurship and Innovation Research Grants, Tesla Motors, Inc., and Valley Electric Association, Inc., Pahrump, Nevada.

- Data provided by UNLV's Office of Sponsored Programs (Division of Research) show that from 2018 to 2022, Life Sciences faculty secured robust amounts of competitive extramural awards from federal and state agencies totaling \$2.8 M (2018), \$2.3 M (2019), \$3.6 M (2020), \$4.1 M (2021), and \$3.7 M (2022) to support research and educational activities.

Teaching / Service

- Life Sciences faculty completely redesigned Biology 189 - Fundamentals of Life Science (an important service course), and Biology 190 - Introduction to Cell and Molecular Biology, and Biology 191 - Introduction to Organismal Biology (the 2 introductory core courses) to improve the educational experience for students. These efforts were supported by grants from the National Science Foundation (see page 40 for details).
- Life Sciences faculty developed 3 Course-based Undergraduate Research Experiences (CUREs): Biology 207 - Phage Discovery, Biology 217 - Bacteriophage Genomics, and Biology 401R - Undergraduate Research: Design to Data (see pages 22-23 for a description of each course).
- Biology 251L - General Microbiology Laboratory was redesigned to become a CUREs course.

- Biology 360 - Introduction to Biomathematics I and Biology 480 - Introduction to Biological Modeling make extensive use of computer software or computer programming, novel activities (aside from statistics) for an undergraduate biology course at the School.
- Life Sciences faculty added a weekly 1-hour Discussion session to Biology 415 - Evolution, a core course for Biology majors. This expansion required the development of 15 weeks of novel curriculum to enhance comprehension and help students develop their analytical skills.
- Biology 418 - Microbial Ecology was partially “flipped.” The instructor assigns homework every 4-5 lectures, and there is a student-led discussion of each assignment before they are turned in.
- Biology 492 - Undergraduate Research. Since 2013, Life Sciences faculty have collectively provided research opportunities and mentoring to hundreds of undergraduate students. Students conducted projects in the laboratory and/or at field sites, sometimes as part of their Honor Theses or Summer Research Experiences. Some of these students presented their findings at scientific conferences.

Mentoring activities by Life Sciences faculty often extend to academic performance and professional development.

- Since 2007 Kurt Regner has been the Principal Investigator for 5 National Science Foundation Research Experience for Undergraduates (REU) Sites at UNLV: A Broad View of Environment Microbiology (March 2007 - May 2014) and Mechanisms of Evolution (May 2014 - February 2026). The total funding for all REU grants and supplements (2007-2026) is \$2,038,233.

These combined summer programs have supported 158 undergraduates from diverse ethnic and socioeconomic backgrounds, 5 high school teachers, and 3 post-baccalaureate and 4 visiting scholars. (The current grant has 2 years remaining and will support 20 additional students, for a grand total of 178 undergraduates supported.) The REU program serves as a bridge for UNLV undergraduates wishing to enter a graduate program, and 12 former REU participants are either currently enrolled in, or completed an UNLV College of Sciences graduate program. Two former REU participants are NSF Graduate Fellowship Program recipients. There are 50 accepted publications with a former REU participant as a co-author.

- Kathryn Rafferty organizes the Life Sciences Career Panel (2022, 2023), and is collaborating with the Department of English to develop a Science Writing Minor.
- Since 2013, various Life Sciences faculty have been recognized for their educational and service accomplishments, including:

- UNLV College of Sciences Distinguished Teaching Award (Jenifer Utz, 2016)
 - UNLV College of Sciences Distinguished Teaching Award (Jef Jaeger, 2018)
 - UNLV Academic Assessment Award (Jenifer Utz, 2018)
 - UNLV College of Sciences Distinguished Service Award (Helen Wing, 2019)
 - Outstanding Undergraduate Research Mentor, UNLV Office of Undergraduate Research (Kathryn Rafferty, 2019, 2020)
 - UNLV Foundation Distinguished Teaching Award (Kathryn Rafferty, 2021)
 - Consolidated Students of the University of Nevada, Las Vegas Faculty Achievement Award (Boo Tseng, 2021)
 - UNLV Foundation Distinguished Teaching Award (Jenifer Utz, 2021)
 - Outstanding Mentor Award, UNLV Graduate and Professional Student Association (Elizabeth Stacy, 2022)
 - UNLV Academic Success Center Faculty Award (Jenifer Utz, 2022)
- Several Life Sciences faculty are recognized as experts in their respective fields of study, and accordingly have served on review panels and/or study sections at, or as ad hoc reviewers of proposals submitted to, for instance, the National Institutes of Health, National Science Foundation, U.S. Departments of Agriculture, Defense, and Energy, U.S. Geologic Service, Cystic Fibrosis Foundation, Center for the Synthesis and Analysis of Biodiversity of the French Foundation for Research on Biodiversity, National Research Institute for Agriculture, Food and Environment's AgreenSkills Postdoc Fellowship Program (France), and Rannís - The Icelandic Centre for Research.
 - Life Sciences faculty have served or serve as Editors, Associate Editors, or on Editorial Boards of numerous journals, including American Journal of Physiology-R, Animal Biotelemetry, Bergey's Manual of Systematics of Archaea and Bacteria, Differentiation, Ecological Restoration, Extremophiles, Forest Ecology and Management, Frontiers in Cell Death, Frontiers in Ecology and Evolution, Frontiers in Microbiology, Geobiology, Genes, Journal of Bacteriology, Journal of Comparative Physiology B, Journal of Phycology, Microbiome, and Phycologia.

Additionally, faculty routinely review manuscripts submitted to prestigious journals in their respective areas of interest, and collectively have reviewed ca. one thousand manuscripts since 2013.

- Life Sciences faculty organize sessions or workshops at regional, national, and international symposia, or organize entire conferences. Examples include International Workshop on Trends in Microbiology and Microbial Biotechnology, North America Forest Ecology Workshop, American Physiology Summit, Bergey's International Society for Microbial Systematics, California/Nevada Amphibian Population Task Force, International Workshop on Geo-Omics of Archaea, Mount Charleston (Nevada) Symposium, Relict Leopard Frog Conservation Team, Society for Marine Mammalogy, Tenth International Conference on Thermophiles Research, Wind River Conference on Prokaryotic Biology.

In addition to delivering presentations at scientific conferences, multiple Life Sciences faculty give invited talks at universities across the country.

Community Engagement

- Allen Gibbs, Christy Strong, and Matthew Petrie lead Science Café Las Vegas, an organization geared towards bringing science discussions to the public of Southern Nevada. Local scientists give ca. 15 minute presentations to the public at an off campus venue, followed by a roundtable discussion of the topic. Science Café Las Vegas is supported by the UNLV School of Life Sciences and the College of Sciences, and is held the first Wednesday of every month, 6:30 - 8:00 p.m.
- Mira Han offered (2019-2023) the 2-week UNLV Summer Code Camp for middle school girls from Clark County School District. Students were exposed to various applications of computation, with female role models and developed a game that simulates the evolutionary process of natural selection.
- Brian Hedlund and Jenifer Utz organized a week-long workshop on ecohydrology and tectonics in Big Pine, California for high-school teachers from the Las Vegas Valley. Hedlund also organized a community discussion about groundwater resource management in Tecopa, California. Both events were supported by grants from the National Science Foundation.
- Allen Gibbs served as Faculty Advisor of UNLV SMILES (Strategic & Meaningful, Interactive Literacy Engagement Series: Engage with your K-5th Grade Child with Digital Literacy) from 2017 to 2019.
- Dale Devitt is the Director of the Center for Urban Water Conservation in North Las Vegas. The Center is open to the public 6 days per week, and community engagement involves direct participation of Master Gardeners who maintain the experimental fruit orchard, sell fruit to the public, and present monthly talks on a wide range of horticultural topics.

A recent \$5 million grant from the U.S. Department of Agriculture's Forest Service will allow UNLV and community partners to engage and educate residents of Clark County about the importance of trees in cities and plant thousands of drought-tolerant trees in southern Nevada. Another goal of the project, which starts in January 2024, is workforce development. Project leaders will certify arborists in training and connect them with employers as work is done to find more nature-based solutions to climate change; much of this workforce development will take place at the Center.

- Life Sciences faculty give presentations to, or organize workshops for elementary, middle, and high school students in the Las Vegas Valley, and/or deliver public talks to the southern Nevada community. Further, faculty are regularly interviewed by

various local, national, and international news media and scientific outlets to discuss their research and/or broader topics.

- Life Sciences faculty have served and continue to serve as judges in various competitions, including the Second Joint Congress on Evolutionary Biology, Undergraduate & Graduate Research Talks at the Arizona and Southern Nevada Branch Meeting of the American Society for Microbiology, UNLVs’ Rebel Grad Slam 3-Minute Thesis Competition, and the Beal Bank USA Southern Nevada Regional Science & Engineering Fair, organized annually by UNLV’s College of Sciences. Students from public and private elementary, middle, and high schools participate in the fair.

V. Student Success

6. Reflect on student success metrics provided.

a. Which metrics are points of strength for the program?

- Approximately two thirds of the 2017-2021 cohorts of BS Biological Sciences majors remained in their degree program (860, 66.4%) and in the College of Sciences (875, 67.5%), whereas 86% (1,109) remained at the university. In contrast, the university retention rate of the total 2017-2021 student cohorts was 77.9% (16,072).
- The 2017-2021 cohorts of BS Biological Sciences majors who are minority students remained in their degree program (67%) and at the university (86%) at rates comparable to those of non-minority students (BS Biological Sciences, 65%; university, 84%).
- The 2017-2021 cohorts of BS Biological Sciences majors who are Pell grant recipients remained in the College of Sciences (68%) and at the university (85%) at similar rates as non-Pell recipients (College of Sciences, 67%; university, 87%).
- The number of BS Biological Sciences degrees earned in the 2021-2022 academic year increased 11.8% (26 degrees), in comparison to the academic year 2017-2018.

Academic Year	BS Biological Sciences Degree(s)
2017-2018	220
2018-2019	244
2019-2020	210
2020-2021	270
2021-2022	246

- The number of BS Biological Sciences degrees earned by minority students in the 2021-2022 academic year increased 15.8% (23 degrees), in comparison to the academic year 2017-2018, whereas the number of BS Biological Sciences degrees earned by non-minority students increased 4.1% (3 degrees).

Academic Year	BS Biological Sciences degrees earned by Minority students	BS Biological Sciences degrees earned by Non-minority students
2017-2018	146	73
2018-2019	166	78
2019-2020	154	55
2020-2021	211	59
2021-2022	169	76

- For the 5 cohorts of BS Biological Sciences majors from 2012 to 2016, the average 6-year graduation rate from UNLV was 50%, compared to 45.3% for all student cohorts.
- Data from UNLV's Pre-professional Advising Center for Fall 2022 indicate that Biology majors account for 35% of students in Pre-Professional health programs.

Program	No. Biology majors (% students in program)	Total no. students
Pre-Medicine	474 (39.1%)	1,211
Pre-Dental Medicine	116 (43.9%)	264
Pre-Physician Assistant	84 (35.9%)	234
Pre-Physical Therapy	3 (1.8%)	167
Pre-Pharmacy	35 (31.5%)	111
Pre-Veterinary Medicine	43 (51.2%)	84
Pre-Occupational Therapy	1 (1.3%)	76
All	770 (35.3%)	2,179

- More significantly, from 2019 to 2022 more than half of Biology majors were accepted into their desired health professional program.

Professional School	No. Biology applicants (% accepted)	Accepted
Medicine	115 (43.6%)	264
Osteopathic medicine	67 (54.9%)	122
Dental Medicine	69 (67%)	103
Physician Assistant	37 (51.4%)	72
Physical Therapy	4 (36.4%)	11
Pharmacy	67 (82.7%)	81
Veterinary Medicine	9 (52.9%)	17
Optometry	13 (76.5%)	17
Totals	381 (55.5%)	687

- Since at least Fall 2018, most students at UNLV's Honors College are College of Sciences majors, and a large fraction of those students are Biology majors, many of which receive scholarships to complete their degree.

- The 2022 Senior Exit Survey was completed by 171 BS Biological Sciences graduating students, a 70% response rate. Most respondents strongly agreed that the courses in their major were academically challenging (134, 78%), and that they acquired knowledge and skills important for their professional careers (89, 52%). Most students (98, 57%) were strongly or somewhat satisfied with course availability.
- Enrollment and diversity comparisons between Biology majors and the general UNLV undergraduate student population for Fall 2022 are shown below.

Group	Biology majors	Undergraduate UNLV population
Enrollment	1,347	25,373
% Pell grant recipients	39% (529)	39% (9,815)
% Minority	77% (1,031)	73% (18,591)
% Male	36.8% (497)	43% (11,017)
% 25 years old or older	16% (209)	18% (4,557)

b. Are there areas of concern for the program?

- The BS Biological Sciences is the largest undergraduate degree program in the College of Sciences, and thus enrollment trends in the program have a strong influence in the College.

Term	Enrollment in Life Sciences (% College of Sciences students who are Biology majors)	Enrollment in College of Sciences
Fall 2018	1,743 (69.9%)	2,492
Fall 2019	1,654 (68.5%)	2,415
Fall 2020	1,705 (67.9%)	2,511
Fall 2021	1,541 (65.7%)	2,345
Fall 2022	1,347 (64.3%)	2,094
Fall 2023	1,288 (64.8%)	1,988

- Using Fall 2018 as a benchmark, a 5% (89 students) decrease in Life Sciences enrollment occurred in Fall 2019, followed by larger decreases in Fall 2021 (202 students, 11.6%), Fall 2022 (396 students, 22.7%), and Fall 2023 (455 students, 33.8%). Enrollment in Life Sciences decreased 12.6% (194 students) from Fall 2021 to Fall 2022, and 4.4% (59 students) from Fall 2022 to Fall 2023. This downward trend forced the cancellation of scheduled lecture and laboratory sections in the past year.
- Enrollment decline of first-year students in Life Sciences was steep (46%) in Fall 2020, probably reflecting the effects of the COVID-19 pandemic. Sophomores declined 32% in Fall 2021, whereas juniors declined 15%.

- From Fall 2018 to Fall 2023 enrollment in the College of Sciences decreased by 20% (504 students), compared to 26% (455 students) for Life Sciences. In Fall 2023 enrollment in the College of Sciences is 1,988, the first sub-2,000 count for at least a decade. In contrast, the UNLV undergraduate student population was relatively stable from 2018 to 2022.
- Nationwide, more and more high school graduates are opting out of higher education in part because of a strong labor market. In fact, with the exception of UNLV, enrollments are down at every academic institution of the Nevada System of Higher Education (College of Southern Nevada, Great Basin College, Nevada State University, Truckee Meadows Community College, Western Nevada College, University of Nevada, Reno), and UNLV has invested significant resources to recruit students, and replaced large numbers of non-resident students with Nevada undergraduates, which negatively impacts tuition revenues.
- Life Sciences faculty do not participate in recruitment activities, and UNLV's upper administration may be able to provide explanations for the continuing decline in enrollment in the School, which is a very concerning situation for the unit and the university.
- Concomitant with the decrease in total enrollment in Life Sciences, the number of BS Biological Sciences majors who are minority students decreased 19.4% (248) from 2018 (1,279) to 2022 (1,031), whereas the number of non-minority students decreased 31.9% (147) over the same period (2018, 461; 2022, 314). For comparison, from 2018 to 2022, the UNLV undergraduate minority student population increased 12%, and the non-minority population declined 21.8%.
- Additionally, the number of BS Biological Sciences majors who are Pell grant recipients decreased 14.8% (92) from 2018 (621) to 2022 (529), whereas that of non-Pell grant recipients decreased 27.1% (304) over the same period (2018, 1,122; 2022, 818). During the same interval, the number of Pell grant recipients at UNLV increased 15%, and that of non-Pell recipients decreased 27%.
- The 2022 Senior Exit Survey was completed by 171 BS Biological Sciences graduating students. Less than 40% of the respondents strongly agreed that they developed effective job-seeking skills (52, 30%), or were strongly satisfied with the quality of instruction (30, 18%), quality of program of study (40, 23%), quality of academic advising by faculty (61, 36%), faculty interest in students (35, 20%), diversity of faculty and staff (60, 35%), development of effective job-seeking skills (52, 30%), or their overall academic experience (43, 25%).

To some extent, the dissatisfaction reflected in the Exit Survey may have been caused by the abrupt transition to remote instruction forced by the COVID-19 pandemic in March 2020, which lasted through Spring 2021. The vast majority of Life Sciences faculty had never taught online or enjoyed this modality, and many students stated that they did not like remote learning.

c. Describe changes or improvements you would like to see in student success metrics.

- School faculty have considered using the Major Field Test (MFT) in Biology from the Educational Testing Service (ETS) to evaluate program effectiveness and student performance. Major Field Tests are comprehensive undergraduate outcomes assessments designed to measure the critical knowledge and understanding obtained by students in an academic major. The MFT in Biology consists of 150 multiple-choice questions, some of which are based on descriptions of laboratory and field situations, diagrams or experimental results. Some of the questions within each of the major areas (cell biology, molecular biology and genetics, organismal biology, population biology, evolution, and ecology) are designed to test analytical skills.
- Paper tests could be administered at the end of a semester to students enrolled in the required major course Biology 415 - Evolution. Evolution functions as the Culminating Experience for the BS Biological Science and is often the final core biology course that students complete before graduation. The MFT in Biology could be administered every other semester or every third semester. It is possible to receive a custom report to compare UNLV students to test takers at 10 peer institutions. Such a report would provide objective and reliable data about the educational experience of Biology majors and how it compares to aspirational peers. Significant challenges to implement MFT in Biology are ensuring that a representative number of students complete the exam and the cost of ca. \$38 per exam.

VI. Assessment

7. The program has an assessment index score of 0. Identify areas to improve/enhance the assessment score (if applicable).

- The 2023 Assessment Report received an academic index score of 9/14. The Office of Assessment stated: “The report includes a list of all learning outcomes and identifies the learning outcomes assessed, along with faculty review of data and potential areas for improvement. To continue progress, the [School] can reduce the reliance on grades as a metric and shift to deconstructed components of learning using rubric-based scoring. This approach provides a more nuanced view of student progress in specific areas yielding the capacity for more targeted improvements.”

The BS Biological Sciences has 8 Student Learning Outcomes:

1. Understand the nature of scientific knowledge.
2. Understand cell structures and functions.
3. Understand the physical nature of genetic information.
4. Understand that all organisms are genetically related, have evolved, and are evolving.
5. Understand the metabolic complexity of cells and organisms.
6. Understand the complex interplay of how organisms respond to and interact with each other and their environment.
7. Effectively communicate complex biological concepts, orally and in writing.
8. Fulfill students’ professional goals.

- The recently adopted weekly reports in 2 core Biology laboratory courses (Biology 190L - Introduction to Cell and Molecular Biology Laboratory and Biology 191L - Introduction to Organismal Biology Laboratory) have substantive short essay answer components that allow assessment of the learning outcomes of these introductory courses. Combining marks with “+” and “-” symbols, in the 2022-2023 Academic Year more than 76% of students earned a grade of “C” or better in Biology 190L, and more than 33% earned an “A” in each of the three terms (Fall 2022, Spring 2023, Summer 2023). Similarly, more than 87% of students earned a grade of “C” or better in Biology 191L, and more than 21% earned an “A” in each academic term. (For Biology majors, the minimum passing grade for Biology courses is “C”.) The grade distribution for both courses is better than expected from a Gaussian distribution, which suggests that student performance exceeded expectations.
- Biology 300 - Principles of Genetics is a core course that many students find particularly challenging. The School should develop an assessment strategy for this course, to learn what aspects of the class need to be improved.
- Biology 351 - Microbiology is a required major course that satisfies the university’s Milestone Experience requirement. The goals of the Milestone Experience are to orient students to the expected learning outcomes of their major field(s) and to reinforce the University Undergraduate Learning Outcomes (UULOs). Students in Microbiology must submit to the course’s learning management system (WebCampus-Canvas) a recorded 10-13.5 minute oral presentation on their bacterial isolates using computer-generated slides. This assignment allows assessment of the learning outcomes of this upper division course. Combining marks with “+” and “-” symbols, in the 2022-2023 Academic Year more than 95% of students earned a grade of “C” or better in the assignment, and more than 78% earned an “A” in each of the three terms (Fall 2022, Spring 2023, Summer 2023). These grade distributions are better than expected from a Gaussian distribution and suggest that student performance exceeded expectations.
- Biology 415 - Evolution is a required major course that satisfies the university’s Culminating Experience requirement. The goals of the Culminating Experience are a final review, consolidation, and assessment of the UULOs, as well as the learning outcomes of the student’s major(s), which prepare students to transition to the workplace or the next phase of their academic career. Typically, Evolution is the last Biology course students complete before graduation, and students in the class must submit a written project report on the topic of genetic drift. The project report entails analysis and interpretation of data that each student generated in simulations of genetic drift and natural selection. Combining marks with “+” and “-” symbols, in Fall 2022 95% of students earned a grade of “C” or better in the assignment, and 75% earned an “A”. This grade distribution is better than expected from a Gaussian distribution, and suggests that student performance exceeded expectations.

- To complement the data for Evolution, the Assessment Committee will request from the Provost's Office data for the Learning Outcome Survey for graduating seniors, to assess the Culminating Experience for the BS Biological Sciences.
- The final components of the assessment of the BS Biological Sciences will entail analysis of the demographics of Biology majors, in addition to the 4-, 5-, and 6-year graduation rates.

8. Describe how assessment findings have been used to identify gaps or weaknesses in student learning. What changes were made to address these issues?

- Life Sciences faculty are committed to improving the quality of our educational offerings, particularly in the introductory courses. Faculty received grants from the National Science Foundation to support these efforts. A grant from the Improving Undergraduate STEM Education program supported redevelopment of Biology 189 - Fundamentals of Life Science (an important service course, see page 45), and 2 grants from the Scholarships in STEM program supported redevelopment of Biology 190 - Introduction to Cell and Molecular Biology, and of Biology 191 - Introduction to Organismal Biology, the 2 introductory core courses. The 3 courses were redesigned based on collaboration between Life Sciences faculty, educational psychologists, learning designers, and learning technologists; all three courses were completely rebuilt. The courses now include materials that are aligned with multimedia learning and cognitive load principles, and that provide learning objectives for each chapter, opportunities for self-testing, spaced study, active learning during each lecture, and robust formative assessment resources to students.
- In Fall 2019, Life Sciences faculty added a weekly 1-hour Discussion session to Biology 415 - Evolution, a core course for Biology majors. These sessions are led by Graduate Teaching Assistants and are designed to enhance students' comprehension of fundamental concepts by engaging in analyses of evolutionary problems, use of evolutionary logic in bioinformatics, discussions of selected evolutionary research literature, and individual and/or group projects. Concomitant with this change, the credit value of the course increased from 3 to 4.
- As mentioned, the BS Biological Sciences does not have a current Assessment Plan. The 4 Life Sciences faculty serving in the Assessment Committee are new to this task, and they are working to remediate this lapse.

VII. Curriculum

9. Are there a lot of prerequisites or corequisites that are no longer vital/or may prevent student progress? Are any of the required courses on the high-fail rate list (data provided by Academic Effectiveness)?

- The BS Biological Sciences requires 120 credits, including 44 credits of Biology courses (20 credits of core courses and 24 credits of additional courses).
- The 5 lecture and 2 laboratory core courses are:
 - Biology 190A - Introduction to Cell and Molecular Biology (3 credits)
 - Biology 190L - Introduction to Cell and Molecular Biology Laboratory (1 credit)
 - Biology 191A - Introduction to Organismal Biology (3 credits)
 - Biology 191L - Introduction to Organismal Biology Laboratory (1 credit)
 - Biology 300 - Principles of Genetics (4 credits) or Biology 304 - Molecular Genetics (4 credits)
 - Biology 351 - Microbiology (4 credits)
 - Biology 415 - Evolution (4 credits)
- Based on their individual interests, Biology majors may select from the following 5 concentrations:
 - i.) Cell and Molecular Biology
 - ii.) Ecology and Evolutionary Biology
 - iii.) Integrative Physiology
 - iv.) Microbiology
 - v.) Pre-Professional Studies

Each concentration requires specific upper division courses; therefore the number of upper division Biology electives varies slightly across concentrations.

- Students in the Cell and Molecular Biology concentration are required to take Chemistry 475 - Biochemistry II (3 credits) and a minimum of 4 courses from the following list:
 - Biology 405 - Molecular Biology (3 credits)
 - Biology 409 - Virology (3 credits)
 - Biology 425 - Genomics (3 credits)
 - Biology 445 - Cell Physiology (3 credits)
 - Biology 453 - Immunology (3 credits)
 - Biology 460 - Microbial Physiology (3 credits)
 - Biology 464 - Bacterial Pathogenesis (3 credits)
 - Biology 466 - Developmental Biology (3 credits)
 - Biology 470 - Topics in Applied Microbiology (3 credits)
 - Biology 478 - Genetics and Cell Biology of Cancer (3 credits)
- Students in the Ecology and Evolutionary Biology concentration are required to take Biology 341 - Principles of Ecology (3 credits) and a minimum of 3 courses from the following list:
 - Biology 301 - Fossil Record (3 credits)
 - Biology 305 - Introduction to Conservation Biology (3 credits)
 - Biology 320 - Invertebrate Zoology (4 credits)
 - Biology 412 - Molecular Evolution (3 credits)

- Biology 418 - Microbial Ecology (3 credits)
 - Biology 427 - Bryology (3 credits)
 - Biology 432 - Herpetology (4 credits)
 - Biology 434 - Mammalogy (4 credits)
 - Biology 438 - Soil Plant Water Relations in Arid Environments (3 credits)
 - Biology 441 - Field Ecology (3 credits)
 - Biology 444 - Principles of Plant Ecology (3 credits)
 - Biology 486 - Animal Behavior (3 credits)
 - Biology 487 - Principles of Systematics (3 credits)
 - Biology 490 - Biogeography (3 credits)
- Students in the **Integrative Physiology concentration** are required to take Biology 445 - Cell Physiology (3 credits) and 2 of the following 3 courses:
 - Biology 440 - Mammalian Physiology (3 credits)
 - Biology 442 - Principles of Plant Physiology with Laboratory (4 credits)
 - Biology 447 - Advanced Comparative Animal Physiology (3 credits)
- Students in the **Microbiology concentration** are required to take a minimum of 3 courses from the following list:
 - Biology 405 - Molecular Biology (3 credits)
 - Biology 409 - Virology (3 credits)
 - Biology 418 - Microbial Ecology (3 credits)
 - Biology 453 - Immunology (3 credits)
 - Biology 460 - Microbial Physiology (3 credits)
 - Biology 464 - Bacterial Pathogenesis (3 credits)
 - Biology 470 - Topics in Applied Microbiology (3 credits)
 - Biology 485 - Microbial Genetics (3 credits)
- Students in the **Cell and Molecular Biology, Ecology and Evolutionary Biology, Integrative Physiology, and Microbiology concentrations** complete the required 24 credits in upper division Biology courses by taking at least 1 course from each of 3 lists of Biology courses: List A: Cell Structure and Function, List B: Organismal Structure and Function, List C: Biological Diversity (see pages 43-44 for the composition of each list).

These students can use:

- Up to 4 credits of Biology 492 - Undergraduate Research (1-3 credits) to fulfill the requirement of 24 credits of additional Biology courses.
- Up to 2 credits of Biology 494 - Biology Colloquium (1 credit) and/or Biology 499 - Instruction in Biological Sciences (1-2 credits) to fulfill the 120 credits degree program requirement.

- List A: Cell Structure and Function includes the following courses:
 - Biology 405 - Molecular Biology (3 credits)
 - Biology 409 - Virology (3 credits)
 - Biology 425 - Genomics (3 credits)
 - Biology 445 - Cell Physiology (3 credits)
 - Biology 453 - Immunology (3 credits)
 - Biology 460 - Microbial Physiology (3 credits)
 - Biology 464 - Bacterial Pathogenesis (3 credits)
 - Biology 466 - Developmental Biology (3 credits)
 - Biology 470 - Topics in Applied Microbiology (3 credits)
 - Biology 473 - Advanced Topics in Cell and Molecular Biology (3 credits)
 - Biology 478 - Genetics and Cell Biology of Cancer (3 credits)
 - Biology 485 - Microbial Genetics (3 credits)

- List B: Organismal Structure and Function includes the following courses:
 - Biology 347 - Human Anatomy Lab (1 credit)
 - Biology 348 - Introduction to Human Anatomy (3 credits)
 - Biology 349 - Human Physiology Foundations (3 credits)
 - Biology 414 - Endocrinology (3 credits)
 - Biology 417 - Biochemical Adaptations (3 credits)
 - Biology 426 - Plant Anatomy (3 credits)
 - Biology 436 - Biometry (3 credits)
 - Biology 440 - Mammalian Physiology (3 credits)
 - Biology 442 - Principles of Plant Physiology with Laboratory (4 credits)
 - Biology 447 - Advanced Comparative Animal Physiology (3 credits)
 - Biology 451 - Comparative Vertebrate Anatomy (2 credits)
 - Biology 453 - Immunology (3 credits)
 - Biology 455 - Comparative Vertebrate Anatomy and Biomechanics (3 credits)
 - Biology 460 - Microbial Physiology (3 credits)
 - Biology 463 - Genetics of Human Disease (3 credits)
 - Biology 468 - Histology (4 credits)
 - Biology 475 - Neurobiology (3 credits)
 - Biology 480 - Introduction to Biological Modeling (3 credits)

- List C: Biological Diversity includes the following courses:
 - Biology 301 - Fossil Record (3 credits)
 - Biology 305 - Introduction to Conservation Biology (3 credits)
 - Biology 320 - Invertebrate Zoology (4 credits)
 - Biology 341 - Principles of Ecology (3 credits)
 - Biology 403 - Restoration Ecology (3 credits)
 - Biology 412 - Molecular Evolution (3 credits)
 - Biology 418 - Microbial Ecology (3 credits)

- Biology 421G - Conservation Genetics (3 credits)
 - Biology 427 - Bryology (3 credits)
 - Biology 431 - Ichthyology (4 credits)
 - Biology 432 - Herpetology (4 credits)
 - Biology 433 - Ornithology (4 credits)
 - Biology 434 - Mammalogy (4 credits)
 - Biology 435 - Forest Ecology (3 credits)
 - Biology 437 - Entomology (4 credits)
 - Biology 438 - Soil Plant Water Relations in Arid Environments (3 credits)
 - Biology 441 - Field Ecology (3 credits)
 - Biology 444 - Principles of Plant Ecology (3 credits)
 - Biology 474C - Climate Change Ecology (3 credits)
 - Biology 486 - Animal Behavior (3 credits)
 - Biology 487 - Principles of Systematics (3 credits)
 - Biology 490 - Biogeography (3 credits)
- Students in the **Pre-Professional concentration** are required to take a minimum of 6 courses from List A: Cell Structure and Function, List B: Organismal Structure and Function, and List C: Biological Diversity, with at least 1 course from each List. These students only need to complete 20 credits of additional Biology courses, instead of the required 24 credits for the other 4 concentrations.

Students in this concentration can use up to 2 credits of Biology 494 - Biology Colloquium and/or Biology 499 - Instruction in Biological Sciences to fulfill the 120 credits degree program requirement.

- For Biology majors, the minimum passing grade for Biology courses is “C”.
- Students are allowed 3 attempts to pass a Biology course, including earned grades, withdrawals, and audits. School permission is required for the second and third attempts. The School instituted this policy to give priority to students trying to enroll in a course for the first time, because some students who had already earned a passing grade in a course were retaking the course to try to earn a higher grade and because some students apparently operate under the assumption that because they can retake courses, trying to do well the first time is not particularly important.
- Regarding academic challenges for graduation, as it is often the case for Biology degrees, Chemistry 241/242 - Organic Chemistry I/II (8 credits) remain the largest coursework obstacle for students to complete the BS Biological Sciences.

Several students find Biology 300 - Principles of Genetics (4 credits) and/or Biology 415 - Evolution (4 credits) challenging, but with some guidance most earn a passing grade (“C” or higher) for these courses.

- The School offers courses required by other degree programs, particularly degrees offered by the Division of Health Sciences (composed of the School of Integrated Health

Sciences, the School of Nursing, and the School of Public Health), or courses that can be used to satisfy requirements of other degrees. For instance:

- Biology 100 - General Biology for Non-majors (4 credits)
Majors of Colleges/Schools other than the College of Sciences can take Biology 100 to satisfy the General Education Distribution Requirement of a science course with a laboratory.
- Biology 104 - Introduction to Human Ecology (3 credits)
This course satisfies the General Education Life and Physical Sciences Distribution Requirement for non-College of Sciences majors, and historically has been offered for students participating in Study Abroad programs, which are administered by the Office of International Programs.
- Biology 189 - Fundamentals of Life Science (4 credits)
Required for BS Comprehensive Medical Imaging, BS Kinesiology, BS Public Health, BS Nursing, BS Nutrition Science. The course can also be used to satisfy the Life and Physical Sciences requirement of the BA Anthropology, BS Applied Health Sciences, BA Psychology, and BA Secondary Education, for example.
- Biology 251 - General Microbiology (4 credits)
Required for BS Applied Health Sciences, BS Health Physics - Pre-Professional Concentration, BS Nursing, BS Nutrition Science, BS Nutrition Science (Dietetics and Pre-Professional Concentrations). The course is also taken by students who want to pursue careers in Occupational Therapy and Physical Therapy.

The Department of Psychology designated 4 biology courses as electives for its Neuroscience Minor:

- Biology 300 - Principles of Genetics (4 credits)
- Biology 304 - Molecular Genetics (4 credits)
- Biology 445 - Cell Physiology (3 credits)
- Biology 475 - Neurobiology (3 credits)

As stated, Biology 190A - Introduction to Cell and Molecular Biology (3 credits) and Biology 190L - Introduction to Cell and Molecular Biology Laboratory (1 credit) are required courses for Biology majors, and these 2 courses can also be used to satisfy the Life and Physical Sciences requirement of the BA Psychology.

- The School has a four-member Curriculum Coordination Committee that periodically reviews the program, and Life Sciences faculty feel that current prerequisite courses are appropriate and provide students with the knowledge necessary to succeed in more advanced courses.
- The School offers few online courses, except for the forced transition to predominantly online teaching due to the COVID-19 pandemic (March 2020 - Spring 2021).

- The university characterizes a course as “High Fail Rate” if 20% or more of the students earn a “D” or “F” or withdraw or receive an Incomplete (DFWIC-). The list below shows Biology courses designated as High Fail Rate from Fall 2021 to Spring 2023.

Course	%DFWIC Fall 2021	%DFWIC Spring 2022	%DFWIC Fall 2022	%DFWIC Spring 2023
Biology 100 General Biology for Non-majors (4 credits)	24.9% (n = 60)	29.3% (n = 73)	29.8% (n = 77)	26.1% (n = 61)
Biology 189 Fundamentals of Life Science (4 credits)	44.2% (n = 287)	49.7% (n = 309)		
Biology 189A (A=Lecture, 3 credits)			45.7% (n = 395)	48.9% (n = 245)
Biology 189L (L=Laboratory, 1 credit)			21.8% (n = 190)	22% (n = 91)
Biology 190A Introduction to Cell and Molecular Biology (3 credits)	37.2% (n = 175)	58.1% (n = 229)	46.7% (n = 255)	54.4% (n = 212)
Biology 190L Introduction to Cell and Molecular Biology Lab (1 credit)		28.4% (n = 101)	26% (n = 127)	24.6% (n = 86)
Biology 191A Introduction to Organismal Biology (Lecture, 3 credits)			24.9% (n = 44)	
Biology 251 General Microbiology (4 credits)	26.2% (n = 71)	34.8% (n = 80)	27.4% (n = 69)	
Biology 251A (Lecture, 3 credits)				27.6% (n = 55)
Biology 300 Principles of Genetics (4 credits)	38.5% (n = 57)	42.9% (n = 72)	27.5% (n = 57)	21.1% (n = 40)
Biology 341 Principles of Ecology (3 credits)				23% (n = 23)
Biology 348 Introduction to Human Anatomy (3 credits)		23.8% (n = 45)		
Biology 349 Human Physiology Foundations (3 credits)		22.2% (n = 10)		
Biology 351 Microbiology (4 credits)	24.8% (n = 29)			
Biology 405 Molecular Biology (3 credits)			32.1% (n = 9)	
Biology 409 Virology (3 credits)			25% (n = 10)	
Biology 414 Endocrinology (3 credits)	46.2% (n = 12)	24.2% (n = 8)		33.3% (n = 12)
Biology 434 Mammalogy (4 credits)	27.3% (n = 9)			
Biology 436 Biometry (3 credits)				27.3% (n = 3)
Biology 445 Cell Physiology (3 credits)	27.1% (n = 23)		25.2% (n = 29)	44.9% (n = 40)
Biology 453 Immunology (3 credits)	28.2% (n = 20)	35.2% (n = 32)	25.8% (n = 24)	22.7% (n = 22)
Biology 464 Bacterial Pathogenesis (3 credits)	49.1% (n = 28)		44.4% (n = 32)	
Biology 466 Developmental Biology (3 credits)			40% (n = 8)	
Biology 475 Neurobiology (3 credits)		21.9% (n = 16)		
Biology 480 Introduction to Biological Modeling (3 credits)		30.9% (n = 12)		25.6% (n = 10)
Biology 490 Biogeography (3 credits)			21.2% (n = 7)	

- The list consists mostly of entry level (100-level) courses for non-majors (Biology 100, 189) or for majors (Biology 190, 191), or upper division (300- and 400-level) major courses. UNLV is an access institution, and lower division biology courses taken by first-year students often have relatively high fail rates, in part because many students have not yet developed the study skills necessary to succeed in STEM disciplines. Upper division courses are synthetic in nature and taught at a high level, and thus some students find them challenging, particularly when the courses emphasize cellular and molecular concepts (e.g. cell physiology, endocrinology, immunology).
- Biology 251 - General Microbiology is required by some programs offered by the School of Integrated Health Sciences, including BS Health Physics - Pre-Professional Concentration and BS Nutrition Science (Dietetics, Pre-Professional, and Sports Nutrition Concentrations), and notably, by the BS Nursing, offered by the School of Nursing. Various factors may contribute to the high fail rate in General Microbiology. First, Biology 189 - Fundamentals of Life Science is a prerequisite for General Microbiology, but the grade for Biology 189 is not used in the calculation for admission into the Nursing program. Consequently, students who earn a “C” or “D” in Biology 189 can enroll in General Microbiology, where they tend to underperform. Second, the prerequisite Chemistry 108 - Introduction to Chemistry may not be adequate preparation for General Microbiology. Third, General Microbiology is not supported by the Academic Success Center (ACS), and thus Supplemental Instructors are not available to offer weekly tutoring sessions (labs), to the detriment of students with underdeveloped study skills or who are passive learners. Fourth, a large percentage of students are non-traditional, older individuals who are transitioning from other careers into Nursing. These individuals are typically employed full time and seemingly find it difficult to devote the necessary time to prepare for quizzes and examinations, and this demographic tends to struggle significantly in the course. A final factor is mainly associated with traditional, younger students. Many of these students appear to have the mentality that because the Pre-Nursing program allows 2 attempts to pass pre-major courses, the first attempt is largely inconsequential. These students do not seem to understand or accept that having to retake any pre-major course significantly compromises the probability of being accepted into the Nursing program.
- Biology 300 - Principles of Genetics. The School of Life Sciences offers few 200-level courses, and the transition from an introductory (100-level) course to an upper division course that requires mathematical skills is challenging for many students. On the other hand, faculty who teach Principles of Genetics indicate that (i) the course would benefit from revised learning objectives that deemphasize memorization; (ii) the course attempts to cover too much material; (iii) the current textbook may not be the best choice; and (iv) the discussion sections can be more effective. In summary, Principles of Genetics should be assessed, with the goal of making it a better educational experience for students.

10. (Undergraduate only) Does your program have a course to meet the culminating experience requirement? Which course? Describe how the course meets the culminating experience requirement.

- As previously stated, Biology 415 - Evolution (4 credits) is a required major course that satisfies the university's Culminating Experience requirement. All students in Evolution must submit a written Project Report on the topic of genetic drift. The Project Report entails analysis and interpretation of data that each student generated in simulations of genetic drift and natural selection, culminating with a discussion of the interaction of these two evolutionary mechanisms. The Project Report is worth 13 points out of the 80 points (16.25%) associated with the Discussion component of the course, and 3.25% of the final grade for the course.

11. (Undergraduate only) Does your program have a course that meets the milestone experience requirement? Which course is the milestone course, and how does it meet the requirements?

- As previously stated, Biology 351 - Microbiology (4 credits) is a required major course that satisfies the university's Milestone Experience requirement. All students in Microbiology must submit to the course's learning management system (WebCampus-Canvas) a recorded 10-13.5 minute oral presentation on their bacterial isolates using computer-generated slides. This assessment represents 5.45% of the final grade for the course.

12. Are all required courses offered on a regular schedule? Please identify required courses and describe the teaching schedule. Does the mix of course sections, days, times, modalities meet student needs?

- As previously stated, the 5 lecture and 2 laboratory core courses of the BS Biological Sciences are:

- Biology 190A - Introduction to Cell and Molecular Biology (3 credits)
- Biology 190L - Introduction to Cell and Molecular Biology Laboratory (1 credit)
- Biology 191A - Introduction to Organismal Biology (3 credits)
- Biology 191L - Introduction to Organismal Biology Laboratory (1 credit)
- Biology 300 - Principles of Genetics (4 credits) or Biology 304 - Molecular Genetics (4 credits)
- Biology 351 - Microbiology (4 credits)
- Biology 415 - Evolution (4 credits)

All core Biology courses are offered every semester, and demand is monitored closely to try to serve all students who need to enroll in them.

Courses from each of the 3 lists (List A - Cell Structure and Function, List B - Organismal Structure and Function, List C - Biological Diversity) are offered every semester. Nevertheless, not every course in the catalog is taught regularly, because current faculty do not have expertise in that particular area (e.g. Biology 427 - Bryology, Biology 431 - Ichthyology).

- Months before the start of a particular semester Life Sciences faculty indicate their teaching preferences for that term. The Director, Associate Director, a member of the Curriculum Coordination Committee, and Front Office staff meet to evaluate all requests and finalize the teaching schedule to meet student needs.

The School informally divides the week into 4 “teaching periods” (Monday-Wednesday morning and afternoon, Tuesday-Thursday morning and afternoon), and to the extent possible schedules sections of large major and non-major courses in different periods, to provide enrollment options for students. Laboratories and discussion sections of these courses are also scheduled in different teaching periods, including Friday morning and afternoon. Single sections of upper division courses (virtually all at the 400-level) are similarly divided between Monday-Wednesday and Tuesday-Thursday.

Various required courses for majors and non-majors (e.g. Biology 189 - Fundamentals of Life Science, Biology 190 - Introduction to Cell and Molecular Biology, Biology 191 - Introduction to Organismal Biology, Biology 251 - General Microbiology, Biology 300 - Principles of Genetics, Biology 351 - Microbiology) and a few upper division courses are offered in the Summer Session.

- Occasionally, demand for Biology 445 - Cell Physiology exceeded capacity, and the School now offers a 120 seat section that satisfies demand.

- The Department of Psychology designated Biology 475 - Neurobiology as an elective course for the Department's Neuroscience Minor, and course capacity (ca. 45 seats) does not satisfy demand because Biology majors also take the course. To address this issue, Life Sciences will offer a 150 seat section of Neurobiology in Spring 2024.
- The School teaches all its courses in-person, with the exception of 1 or 2 sections of Biology 100 - General Biology for Non-majors (4 credits) and the hybrid Biology 189L - Fundamentals of Life Science Lab (1 credit), which combines online background content (the "introductory lecture") with hands-on lab activities.

13. How many courses are low yield? Are these low yield courses necessary for degree paths or electives? How much faculty resources are required to maintain these courses? Is there a way to increase yield for these courses?

- The "fill ratio" of in-person Biology courses was 78% for Fall 2022 and Fall 2023 (as of 16 August).
- The university considers a course "Low Yield" if it enrolls less than 15 students within a term. The list below shows the 19 Biology courses designated as Low Yield from Fall 2021 to Spring 2023.

Term	Course	Enrollment
Fall 2022	Biology 103 - Biology Laboratory	8
Spring 2023	Biology 103	5
Fall 2021	Biology 111 - Water, People and the Environment	14
Fall 2021	Biology 207 - Phage Discovery	13
Fall 2022	Biology 360 - Introduction to Biomathematics I	9
Fall 2021	Biology 421G - Conservation Genetics	13
Spring 2022	Biology 425 - Genomics	4
Spring 2023	Biology 425	10
Fall 2022	Biology 426 - Plant Anatomy	12
Spring 2023	Biology 436 - Biometry	11
Fall 2021	Biology 442 - Principles of Plant Physiology with Laboratory	12
Fall 2021	Biology 451 - Comparative Vertebrate Anatomy	6
Fall 2022	Biology 451	8
Fall 2021	Biology 455 - Comparative Vertebrate Anatomy and Biomechanics	7
Fall 2022	Biology 455	7
Fall 2022	Biology 481 - Advanced Cell Biology	8
Fall 2021	Biology 492 - Undergraduate Research	7
Spring 2022	Biology 492	6
Fall 2022	Biology 492	10

- Low-enrollment sections of Biology 103 - Biology Laboratory serve students whose schedules do not allow them to enroll in other sections. Indeed, the Registrar's Office sometimes asks the School to create sections to accommodate a small number of students.
- Biology 207 - Phage Discovery is a relatively new sophomore course that provides students authentic research experiences, and consequently it is designed to serve a smaller number of students.
- Some courses are only offered occasionally (e.g. Biology 111 - Water, People and the Environment, Biology 360 - Introduction to Biomathematics I, Biology 426 - Plant Anatomy, Biology 436 - Biometry, Biology 442 - Principles of Plant Physiology with Laboratory, Biology 481 - Advanced Cell Biology), or cover topics of interest to a smaller number of students (e.g. Biology 425 - Genomics, Biology 455 - Comparative Vertebrate Anatomy and Biomechanics). Life Sciences faculty believe that it is important to serve majors with specialized interests, irrespective of whether some courses may be under enrolled.
- Biology 421G - Conservation Genetics was offered for the first time in Fall 2021, and thus it is not surprising that enrollment was less than 15 students.
- Actual participation in Biology 492 - Undergraduate Research is often higher than the official enrollment indicates, because students conducting research stop enrolling in the course after they complete the maximum of 4 credits that can be applied towards the BS Biological Sciences.

14. Is the program planning curriculum changes in the next few years? If yes, please describe these changes.

- No extensive curricular changes are planned.
It is sometimes the case that when new faculty join the School they develop new courses (e.g. Biology 403 - Restoration Ecology, Biology 421G - Conservation Genetics, Biology 474C - Climate Change Ecology) in their areas of expertise (see page 24 for additional new courses). The School's Curriculum Coordination Committee assists faculty to get courses approved by the university's Faculty Senate's Undergraduate Curriculum Committee.

VIII. Post-Graduation Outcomes

15. What does the data documenting student outcomes suggest about the current structure of the program in preparing students to enter the workforce or pursue additional education opportunities?

- Data provided by the Nevada System of Higher Education (NSHE) indicate that from 2016 to 2021, most BS Biological Sciences graduates were employed in Nevada in the 4 quarters after graduation, and that their average starting salary was ca. \$21,600 until 2020, when this salary increased to ca. \$27,500. (Due to the manner in which NSHE collects data, these figures include BS Biochemistry graduates, which total ca. 20 students annually.)

Cohort	% BS Biological Sciences graduates employed in Nevada in the 4 quarters after graduation	Average annual salary
2016 - 2017	77% (n = 178)	\$20,836
2017 - 2018	75% (n = 173)	\$20,912
2018 - 2019	66% (n = 172)	\$22,992
2019 - 2020	63% (n = 212)	\$21,532
2020 - 2021	77% (n = 225)	\$27,548

- These data suggest that many BS Biological Sciences students can find employment in Nevada shortly after graduation, albeit at low salaries.
- For the past 3 years, 250 BS Biological Sciences majors on average have graduated every year. The university did not provide data on how many of these graduates enter graduate schools to pursue a master's or doctoral degree or professional schools (e.g. dental medicine, law, medicine).
- There are various careers for biologists who want to combine their scientific training with interests in other fields, including forensic science, politics and policy, business and industry, economics, mathematics, science writing and communication, art (scientific illustration).

16. Identify the skills students acquire through their program of study. How do these skills map onto workforce needs?

- Students who graduate with a BS Biological Sciences should be able to understand the nature of scientific knowledge, cell structures and functions, the physical nature of genetic information, the metabolic complexity of cells and organisms, that all organisms are genetically related, have evolved, and are evolving, the complex interplay of how organisms respond to, and interact with each other and their environment, interpret visual representations of data, and effectively communicate complex biological concepts, orally and in writing. This diverse training provides essential skills for biology graduates to pursue careers or advanced degrees in life and health sciences, research, K-12 and postsecondary education, industry, or governmental work.
- Students who have participated in Biology 401R - Undergraduate Research: Design to Data have secured internships with the National Aeronautics and Space Administration, the Southern Nevada Water Authority, and the Las Vegas Metro Forensics Department, for example. Sometimes these internships led to permanent employment.

17. What is the demand trajectory and employment opportunities in this area over the next 3-5 years? Identify the most important local employers for program graduates.

- According to the U.S. Department of Labor, in 2020 Nevada ranked 37th in the U.S. with 320 positions for biological scientists. Projections indicate that in Nevada these jobs will experience a modest net gain by 2030, and that ca. 30 positions will be available annually.

Projected employment for biological scientists, all other in the United States.

Region	Year - Employment	% change	Projected annual job openings*
Nevada (37th in the U.S.)	2020 - 320 2030 - 360	+ 13%	30
United States	2022 - 60,400 2032 - 62,700	+ 4%	4,700

*Projected annual job openings refers to the average annual job openings due to growth and net replacement.

- In 2022, the median annual salary for biological scientists in Nevada was ca. \$68,000, which ranked 41st in the U.S.

Region	2022 yearly wages
Nevada (41st in the U.S.)	10% - \$44,720 Median - \$68,410 90% - \$97,880
United States	10% - \$ 50,730 Median - \$ 87,300 90% - \$155,570

Source for both tables: CareerOneStop website, <https://www.careeronestop.org/>, sponsored by the U.S. Department of Labor.

- Specific data provided by Lightcast, a labor market analytics company, show occupations that individuals with an undergraduate degree in biology are employed at in the U.S., as well as the average annual job openings and projected 5-year growth in those professions. The nature of the positions indicate that Biology graduates can perform a broad array of jobs. For example, by taking a few courses in healthcare administration, Biology graduates can secure positions as Medical and Health Services Managers.

Occupation	2023 jobs	Annual openings	Growth (2023-2028)
Postsecondary Teachers	8,682	929	7.91%
Medical Assistants	8,470	1,477	13.41%
Secondary School Teachers, except Special and Career/Technical Education	6,082	504	6.35%
Software Developers	5,602	735	28.29%
Medical and Health Services Managers	4,475	542	18.37%
Computer Occupations, All Other	4,444	417	9.77%
Clinical Laboratory Technologists and Technicians	2,449	234	11.31%
Veterinary Assistants, and Laboratory Animal Caretakers	1,311	302	12.97%
Industrial Production Managers	1,282	132	13.42%
Engineers, All Other	1,218	104	9.20%
Data Scientists	994	130	25.96%
Veterinarians	889	55	13.50%
Architectural and Engineering Managers	792	83	14.77%
Veterinary Technologists and Technicians	747	106	18.47%
Environmental Scientists and Specialists, including Health	731	77	5.61%
Forest and Conservation Technicians	602	79	1.16%
Biological Technicians	539	81	7.24%

Occupation	2023 jobs	Annual openings	Growth (2023-2028)
Life, Physical, and Social Science Technicians, All Other	482	69	7.05%

- Data provided by UNLV’s Office of Career Services and Workforce Development list the top employers for BS Biological Sciences applicants in Nevada. Many of these entities are associated with healthcare, an area of primary interest for many or most Biology graduates, but other companies operate in different fields, an example of the new directions in biological careers alluded to earlier. (It should be noted that the data provided only include a small percentage of BS Biological Science graduates.)

Employer	Employer industry	Applicant count
Grifols	Pharmaceuticals	33
Scribe America	Healthcare	17
Absolute Dental	Healthcare	10
Aya Healthcare	Healthcare	10
Spring Mountain Vision	Healthcare	9
Life Pursuits Solutions	Other industries	6
Nevada Donor Network, Inc.	Healthcare	6
Phamatech, Inc.	Biotech and life sciences	5
UnitedHealth Group	Healthcare	5
Barton Associates	Staffing and recruiting	4
Bureau of Reclamation	Government	4
Credit One Bank	Financial services	4
Vitalant	Healthcare	4
BoardPackager	Internet and software	3
HELP of Southern Nevada	Non-profit - Other	3
JT4	Defense	3
Life Extension	Healthcare	3

- The Office of Career Services and Workforce Development also listed the top companies and organizations that have hosted Biology interns. Again, some of these organizations are not directly associated with the life sciences, and internships can lead to permanent employment.

Employer	Employer industry	Applicant count
Office of Economic Development, UNLV	Higher education	14
Serenity Health	Healthcare	12
Credit One Bank	Financial services	11
LA Laser Center, LLC	Healthcare	9

Employer	Employer industry	Applicant count
ClinCapture, Inc.	Internet & software	7
Dr. Esther Tan & Dr. Trang Tran Optometry	Healthcare	6
Tortoise Group	Animal and wildlife	6
ASM Global - Allegiant Stadium	Sports and leisure	5
Nevada National Security Sites	Government	5
Nevada Energy	Utilities and renewable energy	4
Olami	Non-profit - Other	4
Arrow International, Inc.	Manufacturing	3
Easy Event Planning LLC	Internet and software	3
IGT	Internet and software	3
Light & Wonder	Electronic and computer hardware	3
Love Yourself Foundation	Other industries	3
RECORD	Internet and software	3

- Handshake is an online recruiting platform for higher education students and alumni. Handshake partners with universities and employers to streamline and simplify the recruiting process for internships and jobs. The company claims that “Handshake is the number one site for college students to find jobs.”

Data provided by the Office of Career Services and Workforce Development show that <40% of Biology majors have logged into Handshake in 2023, and that smaller numbers have made coaching appointments at the office or applied for internships or jobs through the platform.

Handshake actions	First year	Second year	Juniors	Seniors
Logged into system this year	76/239 (32%)	98/252 (39%)	104/304 (34%)	222/639 (35%)
Coaching appointments	10	12	7	14
Internship applicants	7	9	22	47
Full-time job applicants	3	6	12	26

18. Are there skills/areas of study that can be added or enhanced to meet evolving workforce needs?

- Biologists continue to explicitly incorporate mathematics into the life sciences. If the School is allowed to hire faculty with the relevant expertise, program faculty plan to develop a course or set of courses where students can acquire or develop computational programming skills, including Geographic Information Systems (GIS),

R (an integrated suite of software facilities for data manipulation, calculation, and graphical display), and Python coding.

IX. Budget and Resources

19. What are the primary funding sources for this program?

- The School of Life Sciences normally receives \$170,000 per year in State funds. This allocation decreased from \$340,000 in 2011, a drastic reduction that led to an increased reliance on student laboratory fees to maintain the quality of educational offerings. This Fiscal Year (July 2023 - June 2024), the School's State funding was cut an additional 50%, to \$85,000, to accommodate cost-of-living salary increases for UNLV employees.
- Student laboratory fees are typically ca. \$100,000 per year. The use of these fees is highly restricted by the Board of Regents, which limits carryover balances across fiscal years and strategic spending. These severe restrictions impede the program's ability to invest in high-dollar instrumentation to better serve Biology students.
- The School receives ca. \$100,000 per year from endowments and gifts, and ca. \$20,000 annually from facilities and administrative costs ("indirect cost" recovery). Summer teaching returns amount to ca. \$60,000 per year.

20. Describe how revenue is allocated to support program activities.

- Operations is a major cost for the School. The majority of School funds are expended supporting the teaching mission of the unit. An additional significant expenditure is startup packages for new faculty. The School is responsible for 25% of startup packages that, in recent history, have been in the \$600,000 range.

21. Is the current revenue allocation sufficient to support the program? If additional resources are necessary, please describe the changes that are necessary.

- No. The School of Life Sciences relies on internally generated funds to support our programs. The School needs a greater share of the College of Sciences funding allocation from the Provost's Office because the program has approximately 65% of the College majors and have extensive infrastructure needs for both teaching and research.
- A recent change that benefits the School is a greater allocation of Summer Session (teaching) returns. This distribution was increased to 70% for Summer 2023, which corresponded to \$174,671, and is scheduled to increase to 75% for Summer 2024.

22. Discuss strengths or concerns in the following areas:

- a. Library resources
 - Like many universities, UNLV must prioritize some journal subscriptions over others. A particularly worrisome trend is the high cost of open access publications. In many other institutions, these costs are supplemented by the university, whereas at UNLV the senior investigator is responsible for all costs.
- b. Equipment
 - Much of the shared equipment in the School is aging and requires replacement; however, funds are not available to do these replacements proactively. The UNLV Office of Information Technology has supported efforts to replace antiquated audiovisual equipment in teaching laboratories with newer, albeit used equipment. Nevertheless, a concerted effort to place *new* equipment in the School's teaching laboratories is warranted. All UNLV students pay a Student Technology Fee (\$8 per credit), and these funds should be allocated to meet the School's needs for new audiovisual equipment.
- c. Space
 - A modern Biology building is needed to support Life Sciences faculty. Juanita Greer White Life Sciences (3 floors, 82,120 gross square feet, opened in 1976) was constructed at a time when research was not emphasized at UNLV, and thus the outdated research and teaching laboratories in White Hall diminish the educational experience of Biology undergraduates. In addition, the Science Teaching Labs (STL) building (1 floor, 8,064 gross square feet, opened in 2007), where various teaching laboratories are held, is in such a state of disrepair that an employee fell through a portion of the floor that had water damage. STL requires either tremendous reconditioning or demolition and reconstruction.
- d. Other nonacademic sources
 - The School would greatly benefit from having named Endowed Chairs.
 - The relationship between the School of Life Sciences and the UNLV Foundation (the not-for-profit corporation responsible for raising and managing private donations to UNLV) should be more affable and transparent.

X. Summative Evaluation

23. Summarize the areas of excellence and/or strengths of this program.

- Life Sciences faculty are engaged scholars. Students consider the vast majority of faculty to be effective instructors and give them high marks in anonymous course teaching evaluations. Faculty are productive members of the scientific community, publishing in prestigious journals in their respective areas of expertise and securing extra mural funding to support not only their research programs, but also pedagogical initiatives. Even the Faculty in Residence, which only have teaching responsibilities, voluntarily perform research, publish in peer-reviewed journals, secure extramural funding from federal and state agencies and actively participate in service activities. Indeed, the School's Faculty in Residence are among the best on campus, yet remain tremendously under compensated for their invaluable educational and research contributions to the university.
- Life Sciences faculty implement periodic changes to their academic offerings to enhance the educational experience of their students. For instance, faculty developed 3 Course-based Undergraduate Research Experiences (CUREs) to give second-year students and seniors authentic experience with the scientific process during their academic careers. Additionally, faculty redesigned foundational courses and the Culminating Experience course (Biology 415 - Evolution) to promote active learning and help students develop their analytical skills.
- Life Sciences faculty provide opportunities for motivated undergraduate students to join their laboratory groups and gain hands-on experience in a broad array of research projects. Many of these students gain acceptance into professional or graduate school.

24. Identify opportunities to improve this program.

- The School's allocation of State funds should be increased towards the \$340,000 total from 2011, as the intent of student laboratory fees was *not* to replace programmatic funding, but to augment that funding to maintain and enhance the educational experience of Biology students.
- Increased faculty recruitment is required to allow the School to teach important courses, such as Biology 320 - Invertebrate Zoology, Biology 431 - Ichthyology, Biology 433 - Ornithology, Biology 437 - Entomology, and Biology 466 - Developmental Biology, and to develop other relevant courses, including Desert Biology of Plants and Animals, Geographic Information Systems (GIS) for Biologists, Limnology, Marine Biology, Metabolism, Plant Systematics, Protein Biology, Reproductive Biology, and Wildlife Biology. Currently, none of these courses can be offered.

- Collaborate with the Office of Career Services and Workforce Development to educate BS Biological Sciences majors about the broad career opportunities for Biology graduates and to encourage them to use Handshake, the online recruiting platform for higher education students. Handshake partners with universities and employers to streamline and simplify the recruiting process for internships and jobs and has an active contract with UNLV.
- The university should conduct a comprehensive review of the salary structure of all Life Sciences faculty and staff, as compared to other Research 1 institutions, and make the necessary compensatory adjustments.

25. Based on this analysis, what are the top three priorities/needs for this program in the future?

- The downward trend in enrollment in Life Sciences since Fall 2018 is an area of deep concern. As mentioned, using Fall 2018 as a benchmark, a 5% (89 students) decrease in Life Sciences enrollment occurred in Fall 2019, followed by larger decreases in Fall 2021 (202 students, 11.6%), Fall 2022 (396 students, 22.7%), and Fall 2023 (455 students, 33.8%). Enrollment in Life Sciences decreased 12.6% (194 students) from Fall 2021 to Fall 2022, and 4.4% (59 students) from Fall 2022 to Fall 2023. School faculty are interested in learning how they can partner with the Office of Undergraduate Admissions to help increase the number of Biology majors.
- Life Sciences faculty should revise the Assessment Plan for the BS Biological Sciences, and should develop an assessment strategy for Biology 300 - Principles of Genetics, to learn what aspects of this core course need to be improved.
- Update the composition of the 3 lists of Biology courses (List A: Cell Structure and Function, List B: Organismal Structure and Function, List C: Biological Diversity) to include all recently developed courses and thus eliminate confusion during transcript audits of Biology majors, as well as to ensure that university websites present the most up to date information about requirements and courses for the BS Biological Sciences.