

Submission date: January 31, 2020

Program/s in this review: BA and BS in Biological Sciences (BA/BS BIOS)

Specialized accrediting agency (if applicable): Not applicable

Campuses where the program is delivered: Anchorage

Members of the program review committee:

- Khrys Duddleston, Professor and Director of Biological Sciences, Anchorage Campus
- Cindy Trussell, Associate Professor of Biological Sciences, Kodiak Campus

1. Centrality of Program Mission and Supporting Role (700 words or less)

Relevancy of the programs

Biological Sciences programs (BA/BS BIOS) are by definition the study of life, and thus carry inherent relevance to society. Medicine, ecology and the environment, climate and the origins of humans as a species all hinge upon underlying biological principles. Biological Sciences graduates serve diverse roles in Alaska and outside including work as state and federal agency scientists, teachers, industry professionals, and health professionals.

Any role the program plays in supporting other academic programs

For the review period, the Department of Biological Sciences taught 136,673 credit hours outside of the BA/BS BIOS. Many BIOL courses are GERs, and/or are required for programs across the university including, but not limited to, Chemistry, Geography and Environmental Studies (College of Arts and Sciences); Health Science, Nursing, Social Work, Dental Assisting, Dental Hygiene, Medical Assisting, Physical Education, (College of Health); Occupational Health and Safety and other programs (Community and Technical College); Honors College; and Civil Engineering (School of Engineering).

Any partnerships with outside agencies, businesses, or organizations

BA/BS BIOS students participate in internships with state and federal agencies and local consulting firms (ADF&G; Minnesota DNR; US Dept of Int; USFWS; AK Marine Conservation Council; LGL among others) that often lead to permanent employment. Students (BIOS and NSCI) may enroll in BIOL A495a to earn credit for their internships (BIOL A495a); however, many students do not do so, and thus records of their internships have been sparse over the years. We average 2 to 3 BIOL A495a enrollees per summer.

Any specific workforce development and employment opportunities relevant to the program

Graduates obtain employment with institutions such as native corporations, school districts, environmental and wildlife positions in local, state and federal agencies, private, state and federal public health agencies and programs, medical and dental clinics, hospitals, veterinary clinics, university research labs (in AK and outside). Student internships often lead to permanent employment. Biological sciences programs support pre-health programs at UAA, including WWAMI and Nursing, Doctor of Pharmacy, Physician Assistant, and the MS in Biological Sciences. Biological Sciences is a liberal arts program that develops and reinforces critical thinking skills valued both within the sciences and in other industries and professions.

Any sources of extramural support and funding for the program

Research is integral to the BA/BS BIOS program, and extramurally funded faculty research programs provide opportunities for undergraduates to engage in undergraduate research, the highest impact practice (HIP) in the sciences. Students frequently enroll in BIOL A498 to earn credit for undergraduate research (201101-201901 = 420 students; 1,101 SCH produced); however, extramural grants regularly include funds to hire undergraduates as research assistants. The latter is especially important as it increases opportunities for students who must work while completing their degree and would otherwise not been able to benefit from this HIP. Biological Sciences faculty garner extramural funds that support new and continuing original and collaborative research, as well as facilities and provide major equipment. Faculty obtain funds from agencies such as the NSF, NIH, DOD, private foundations and other sources. From FY2013 - FY2018, extramural grants

totaled ~\$21M (this is likely an underestimation, as it refers to CAS Biology research org code 12099 only), with an average of 7-12 active grants per year (average FY budget ~\$1.8M). Currently, research faculty are managing ~\$9.2M in active awards (~\$5.8M DC; ~\$3.1M ICR). As noted above, these grants include funding to support research, as well as to pay students as research assistants in faculty laboratories.

Any high demand job designation for the program

BA/BS BIOS degrees prepare students for high demand job areas including Education and Health professions. In fact, the "[Alaska Occupations by Employment Outlook](#)" from the Alaska Department of Labor of the top 10 jobs, 9 of them are in the health professions. In addition to BS BIOS degree holders filling diverse positions in the state, the program supports students in other units serving high demand areas including the College of Health and in Engineering. It is worth noting that the AK Department of Labor does not list UAA as a potential location for training [Zoologists and Wildlife Biologists](#), which is an unfortunate oversight that needs correcting.

2. Program Demand (including service to other programs), Efficiency, and Productivity (7 year trend; 1400 words or less)

Seven-year degree and/or certificate trend:

The number of undergraduate degrees awarded has remained stable from 2013-2019, beginning with 38 and ending with 34 majors, and averaging 39.57 ± 5.26 majors over this period.

Credits Per Degree (Average Credits Earned):

The number of credits per degree has remained relatively stable from 2013-2019, beginning with 148.9 and ending with 119.8, and averaging 133.4 ± 8.95 credits over this period.

Seven-year majors or program enrollment trend

The number of majors from 2013-2019 declined from 521 to 398. This drop of ~ 23% is similar to the percent decline seen in CAS over the same time period. Interestingly, the number of Natural Sciences majors (also a Dept. of Biological Sciences Degree program) increased during this time.

Course pass rates:

The percentage of majors that pass the 100-299 level course averages 67% for the review period, beginning at 52% in AY13 and increasing to 79% in AY19. An average 91.5% of all majors passed their 300-499 courses over the review period, beginning at 85% in AY13 and remaining little changed until AY19 when they increased to 93%.

Students who withdrew or received Ds and Fs for this period remained steady, averaging 27% for all 100-299 level courses, and 7% for all 300-499 level majors courses; the overall average was 17%.

Internal demand:

59% of all BIOL SCH are taken by BS/BA majors. At the upper-division level, nearly 85% of SCH are taken by BS/BA biological sciences majors, compared to 55% at the lower division level. Comparing this with all other CAS degrees 14% are taken are within their major for both upper and lower-division courses. These results are surprising.

Seven-year Student Credit Hour (SCH) production trend:

As is expected given enrollment trends, 7-yr SCH has declined over the review period. Overall, this program produced 11% of total SCH reported for the College of Arts & Sciences in 2013, increasing to 14% in 2019. Thus, despite a general decrease in majors, our SCH production trend as a percentage of CAS is increasing.

Enrollment/Full-Time Equivalent Faculty (FTEF)

Overall, enrollments to FTEF have remained relatively stable but have declined, beginning at 556.5 Enroll/FTEF in AY13, ending at 486.5 Enroll/FETF in AY19, and averaging 509.4 ± 44.4 Enroll/FTEF for the review period. The highest levels were

in AY13 and AY15, which could have been associated with our move into a new building, scheduling that accommodated high demand classes, and employment of term laboratory coordinators. These lab coordinators worked with faculty of record instructors to enhance course content, delivery, and student support. Lower numbers in AY 2017-19 likely reflect the loss of full-time faculty to generate enrollment.

SCH/FTEF: Student credit hours per Full-Time Equivalent Faculty (FTEF) - A measure of faculty workload.

Based on program review data, the department is currently delivering more SCH per FTEF than all other programs in the College of Arts and Sciences.

Average class size:

Class size has remained nearly unchanged for the review period, beginning at 26.7 in AY13 and ending in AY19 at 27.6 ($\bar{x} = 27.9 \pm 1.31$). Compared to class sizes for Arts & Sciences, there are no significant differences in class sizes between Biological Sciences versus Arts & Sciences. Indeed, the campus has a limited provision of 3 large classrooms (>100 seats) of which only one (RH 101) was intentionally designed as a lecture hall; the other 2 were not (ARTS 150, the "Wendy"). Clearly, rooms having limited surface areas will constrain academic class sizes for the foreseeable future. However, there is a major benefit to students in that their faculty: student ratio remains favorable.

Tuition Revenue/SCH:

The department has seen a 20.88% increase in tuition revenue per student credit hour. When the numbers were first recorded in AY 15 our Tuition Revenue/SCH was 178.6 it has increased each year to 215.9 in AY 19.

External Demand

The majority (77%) of UAA Award students in the biological sciences pursue additional education. Interestingly, they overwhelmingly choose a University of Alaska school. Of the 409 2nd enrollments represented in this UAA Post Award data, 63% chose an Alaskan University.

3. Program Quality, Improvement and Student Success (1500 words or less)

Specialized accreditation process and status

Not Applicable

Currency of the curriculum AND Innovative program design

In 2011, The AAAS released its report/call to action "*Vision and Change*". This report developed over 5 years in collaboration with the US National Science Foundation's (the NSF) Directorates for Education and Human Resources, the Howard Hughes Medical Institute and the National Institutes of Health (NIH), outlined their vision and recommendations for the undergraduate teaching of the biological sciences. The full report is available online at visionandchange.org.

Vision and Change urged universities to:

- Fundamentally redesign their curricula to focus on core competencies (skills required to succeed in biology) and core concepts (concepts common to all levels of biological organization); and
- Fundamentally change their teaching approach to integrate research and teaching and maximize the use of student leaders and experiential learning techniques.

We revised our curriculum following this call and it was implemented in 2014. Key features of this new curriculum include:

- Replacing the traditional two-semester introductory biology course with an intensive single-semester course (BIOL 108) that uses a student-lead learning approach to teach students core skills and a modular approach

that enables them to apply these skills and to learn core biological concepts within a suite of biological contexts (e.g. genetics, physiology, ecology).

- Replacing the 200-level traditional lecture plus lab course offerings with:
 - Theory-based “lecture” courses (BIOL 242, 252, 271 & 288) in which students apply those core concepts to major subject areas: cell biology, genetics, ecology and evolution.
 - Two experiential learning courses in which students deepen their knowledge of those sub-disciplines through a hands-on student-led learning approach and acquire the practical skills that they need to succeed as researchers: BIOL 243 (Experiential Learning in Cell biology and Genetics), BIOL 273 (Experiential Learning in Ecology and Evolution)
- Eliminating prescribed upper division requirements and enabling students to choose upper division selectives from subject areas (Genetics, Cellular and Molecular Biology; Ecology and Evolution; Diversity and Organismal Biology; Physiology) ensures students are exposed to the breadth of the biological sciences while being free to choose courses that are of the most interest to them.
- Eliminating long pre-requisite chains for upper division courses.
 - BIOL 108 is the only biological prerequisite for all of the 200-level offerings.
 - The most relevant 200-level offering is the prerequisite for all of our 300-level and most of our 400-level offerings.
 - A single 300-level offering is the prerequisite for the remaining 400-level courses.
- Implementation of an ePortfolio to collect valuable assessment artifacts over the course of study (ongoing).
- Incorporating an external standardized exit test into the 400-level seminar series to facilitate internal assessment of our degree programs.

Availability and indications of quality of distance offerings

UAA Biological Sciences continues to increase distance offerings of undergraduate and graduate courses to support students. In F19/Sp20 the Department offered 14 distinct courses online (Anchorage campus; A100, A102, A103, A111, A112, A240, A242, A288; A427; A455/655: A471; A477/677) compared to only two (Anchorage campus; BIOL A100 and BIOL A102) in F13/Sp14. BIOL A288 by Cindy Trussell and BIOL A455 by Brandon Briggs are both Quality Matters Certified.

Program Student Learning Outcomes assessment AND student success

The BA/BS Program Student Learning Outcomes are to

1. Demonstrate an understanding of the core concepts in the biological sciences: evolution; structure and function relationships; information flow, exchange, and storage; transformation of energy and matter.
2. Apply the process of science and construct knowledge through observations, experimentation, quantitative reasoning and hypothesis testing
3. Read, analyze and synthesize primary literature, and communicate scientific concepts and data in written and oral form.

The BA/BS PSLOs are assessed via multiple measures. These include

1. Student success (assessment of student artifacts) and retention in our entry course (BIOL A108 Principles and Methods in Biology).
2. Success (based on assessment of artifacts) in BIOL A492 senior seminar assignments addressing literature analysis, oral presentations and written proposals
3. Administering Educational Testing Service’s Major Field Test in Biology to seniors in Undergraduate Seminar (BIOL A492). The test address for core areas, cell biology; molecular biology and genetics; organismal biology; population biology, evolution and ecology.
4. Overall undergraduate GPA

Since implementation of the revised curriculum (see currency of the curriculum and innovative program design) we have continued to integrate the principles of Vision and Change into courses at the 300- and 400 level (e.g., BIOL A483 and BIOL A484, Exploration Ecology and Experiential Learning: Exploration Ecology Field Studies; BIOL A413 Neurophysiology; numerous other BIOL and MBIO courses).

Overall, since implementation of our new curriculum, we have found BA/BS BIOLS majors are at or near mean values for the ETS test. The test is nationally normed with 440 institutions of higher learning, including selective public and private institutions. Approximately 10% of our students score at or above 90th percentiles in two of the four core areas. We have also found that much higher percentages of students are retained beyond the first year (90% of students enrolled in BIOL A108 vs 50% retention rates in the previous, two-semester introductory series).

Currently we assess artifacts submitted via student ePortfolios from our entry-level course (BIOL A108) and our senior seminar (BIOL A492). In order to improve assessment of our PSLOs we are developing assessment artifacts and corresponding rubrics specific to our required 200-level theory based lecture courses and experiential learning courses. These are fundamental to meeting our student learning outcomes. These new assessment artifacts and tools will enable us to more fully utilize student ePortfolios to track student learning and success across their degree program.

In an effort to support student success faculty in Biological Sciences engage BA/BS BIOS students in undergraduate research. Faculty mentor undergraduate students through their own research programs and a variety of internally and externally funded programs. Indeed, from the 2011 spring semester through to the 2019 summer semester, departmental faculty have mentored 420 BIOL 498 Individual Research students (1,101 student credit hours). These numbers underestimate the number of students impacted by faculty research and our graduate program (via near-peer mentorship), as undergraduates also work in faculty labs as paid student research assistants. Not only does participation in this highest impact teaching practice improve retention and decrease time to degree completion, inclusion of undergraduates as lab members alongside graduate students and postdocs in integrated research teams demonstrates clear and attainable paths to future goals, from “novice” to “expert”. Open-ended research projects give students a deeper experience developing lab skills and problem solving skills that often transcends classroom learning and transforms their lives. Students’ perceptions of what science is and does is fundamentally changed as a consequence. While this may lead to changes in career choice, more importantly, the development of a true understanding of science as a process and a body of knowledge about the natural world is critical to the development of an informed citizenry able to participate responsibly in a democracy.

4. Student Accomplishments (due to the availability of these reviews to the public, student names are not included).

From Fall 2017-Fall 2019, 33 BS/BA BIOS students graduated with honors. Ten students earned Departmental Honors in Biological Sciences (which requires completion of an undergraduate research project and written undergraduate thesis along with GPA requirements) and a BIOS/Chemistry double major earned Chemistry Honors. Twenty six students graduated cum laude, magna cum laude, or summa cum laude. Numerous students earned Leadership Honors or graduated as University Honors Scholars.

Biological Sciences retains a long-standing tradition in undergraduate research that is reflected in the efforts of individual faculty, involvement in the National Science Foundation’s Research Experiences for Undergraduates (REU) program (AY09-15), and in students’ involvement in the UAA Honors College. A substantial portion of undergraduate students in Biological Sciences and Natural Sciences participate in research that is conducted under the mentorship of Biological Sciences faculty. For example, in AY14, 17 undergraduates (all of whom were supported by Undergraduate Research Grant Fellowships) presented at UAA’s undergraduate research symposium open day and in AY15, this number increased to 20 and included 2 Discovery Award and 4 Alaska Heart Institute Fellowship recipients. Throughout the review period, a similar number of BA/BS BIOS and NSCI undergraduates have presented their research at other venues including UAA-hosted symposia such as the Behavioral Sciences of the North Conference and national and international research symposia such as the American Geophysical Union, American Association for the Advancement of Science, American Society of Virology, Murdock Trust College Science Research Conference American Society for Biochemistry and Molecular Biology (ASBMB) Annual Meeting. The high standard of these student research projects has, in many cases, resulted in their publication.

5. Program Duplication / Distinctiveness (300 words or less)

There are baccalaureate degrees in biological sciences at all three main campuses in the UA system; however, the degrees are not duplicative. As outlined previously in this report, our programmatic approach, which aligns with the recommendations of Vision and Change, emphasizes experiential learning as a high-impact practice throughout the

curriculum, and whether in or out of the classroom (i.e. experiential learning courses or undergraduate research), experiential learning opportunities are informed by individual faculty research programs, which are not duplicated across the state. In addition to our emphasis on experiential learning and undergraduate research, we are the only program in Alaska with an option to concentrate in microbiology. Prior to our implementation of this option, Alaska was the only state without a microbiology degree in the US. This year, funding from the National Institutes of Health is supporting the growth of both intellectual and physical infrastructure in microbiology on the UAA campus, which will enable growth and expansion of the microbiological sciences at UAA. UAA is the health campus of the UA system, and biological sciences and microbiology are integral to the biomedical and ecosystem health sciences. As the largest city in Alaska, Anchorage employs 1000s of people in health professions, natural resources and conservation, wildlife management and education, and as such, local demand for students educated in the biological sciences is high. Lastly, we educate between 400-500 biological sciences majors each semester, as does UAF; thus, there is clearly significant demand for biological sciences not only in Southcentral Alaska, but across the state.

6. Summary Analysis (500 words or less)

Through our innovative program design and emphasis on experiential learning and undergraduate research, the BA/BS BIOS programs prepare students for public and private sector jobs with state and federal agencies, school districts, industry and health, or for advancement of their education via research or professional advanced degrees. In addition, ours is the only program in Alaska with an emphasis in microbiology. Lastly, courses taught by Biological Sciences faculty support numerous degree programs across UAA leading to significant SCH production and generation of tuition dollars. Although our programs are faced with declining enrollments and majors along with the remainder of CAS/UAA, we educate between 400-500 majors each semester; a clear indication of the high demand of the BA/BS in Biological Sciences. In consideration of the above, investment in the growth of this program is warranted.

The BA/BS BIOS and BS NSCI programs are highly integrated and interdependent with our MS BIOS program. Faculty work is integrated across the curricula at all levels, and faculty build research communities in their labs that incorporate undergraduate and graduate students working together. Declining university funding, departure of faculty and increasing competition for extramural support from state and federal agencies pose challenges for all programs in Biological Sciences. Maintaining cutting-edge laboratory facilities and equipment is critical to support and grow a competitive research faculty and to maintain and grow programs. Growth and support of our graduate program is integral to the success of faculty in the department (directly through the publication of research in peer-reviewed journals), as well as the success of the department's undergraduate programs. Institutional support for research and research faculty is critical to the continued success of our department and programs.