

Submission date: January 31, 2020

Program/s in this review: BS NSCI (Natural Sciences)

Specialized accrediting agency (if applicable): Not Applicable

Campuses where the program is delivered: Anchorage

Members of the program review committee:

- Khrys Duddleston, Director and Professor 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)

### The relevancy of the program

The Bachelor of Science in Natural Sciences (BS NSCI) provides a flexible degree program that emphasizes the fundamental interrelationships among the sciences. Students master basic natural science principles by engagement in classroom experiences and by conducting research that integrates critical thinking, writing and speaking in the context of the scientific method. The departments of Biological Sciences, Chemistry, Geological Sciences, and Geography and Environmental Studies provide opportunities for our students to pursue scholarly research and internships, and encourage public service. The BS NSCI aligns with the AAAS Vision and Change and AAC&U PKAL recommendations for interdisciplinary education and research. The complexity of the problems facing society will favor students who are prepared to consider knowledge from multiple disciplines. NSCI graduates serve diverse roles in Alaska and outside including work as state and federal agency scientists, teachers, and industry and health professionals.

### Any role the program plays in supporting other academic programs

The nature of the NSCI degree is interdisciplinary and students are required to take courses in multiple disciplines. All pathways provide headcount and SCH for the biological sciences, chemistry, physics, and math. The environmental science option additionally supports geology, geography, anthropology, and environmental studies. The pre-health option provides headcount and SCH to psychology, health sciences. Most departments within CAS receive support from students in this program.

### Any partnerships with outside agencies, businesses, or organizations

Like BS BIOS students, students in the NSCI program benefit from internships with a diversity of agencies and organizations in Alaska and beyond (e.g. ADF&G; LGL; AK Marine Conservation Council). 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

Degree holders gain employment at such institutions 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, and veterinary clinics. The NSCI program is an interdisciplinary STEM degree that reinforces and develops 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 natural sciences program, and Biological Sciences faculty generate extramural funds via grants primarily supporting new and continuing original and collaborative research, as well as facilities and major equipment. Funds are generated from external competitive sources such as the NSF, NIH, DOD, private foundations and others. From FY2013-FY2018, departmental faculty extramural grants totaled ~\$21M (likely an

underestimation, 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-active faculty (n = 13) are managing ~\$9.2M in active awards (~\$5.8M DC; ~\$3.1M ICR). Authentic research experiences are a fundamental component of the NSCI program, and undergraduate research in faculty research labs is highly valued by the department. Faculty research grants provide funds to support research activities that engage undergraduates, and also provide paid undergraduate research assistantships.

### **Any high demand job designation for the program**

The NSCI degree tracks prepare students for several high-demand job areas. According to the Alaska Occupations by Employment Outlook growth is strong and openings are high for many health-related fields and the pre-health professions track provides students with the necessary educational background to pursue higher education in those fields. While growth is low for secondary school instructors, openings are high and the general science track of the Natural Sciences degree is a particularly effective program for preparing STEM teachers at the secondary education level. Finally, the environmental science track is well suited to prepare students for environmental monitoring jobs, the Employment Outlook is similar to secondary school instructors with low growth, but high openings.

## **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 is stable but slightly increased from 2013-2019, beginning with 27 and ending with 39 majors, and averaging 36 +/- 9 majors over this period.

### **Credits Per Degree (Average Credits Earned):**

The number of credits per degree has increased over the review period from 2013-2019, beginning with 113.4 and ending with 135.5, and averaging 127 ± 8 credits over this period. This may reflect changes to the degree program as well as students who change majors into this more flexible degree program. While credits per degree has increased slightly, the Years per Degree has remained relatively stable.

### **Seven-year majors or program enrollment trend**

The number of majors from 2013-2019 increased from 183 to 232. The high was in 2018 with 251 majors. With declines in many of the CAS majors, this trend toward more majors indicates that the natural sciences degree is increasingly sought after.

### **Course Pass Rate data for Natural Sciences courses are not available for the following reasons**

First, it is an interdisciplinary degree where none of the courses actually use dedicated prefix (e.g., "NSCI"). As such, there is no way to get pass rates in courses that are specific to this degree.

Second, the degree is remarkably complex, having three options

Environmental Sciences Option requires

- a. 29 credits in core classes in BIOL, CHEM, ENVI, and GEOL
- b. 51 credits from 104 different courses in five disciplines in Natural and Physical Sciences
- c. 15 credits from 39 different courses in six disciplines in Math & Computational Skills
- d. 9 credits from 19 courses in six Social Sciences

Pre-Health Professional Option requires

- e. 23 credits in core classes in BIOL, CHEM, and PHYS
- f. 24 credits from 50 different courses in three disciplines in Natural & Physical Sciences
- g. 9 credits from 26 different courses in two disciplines in Math & Computational Skills
- h. 15 credits from 44 different courses in six disciplines in Social Sciences

General Sciences Option requires

- i. 31 credits in core classes in BIOL, CHEM, GEOL, and PHYS

- j. 49 credits from either
  - i. The above list of courses for the Environmental Sciences Option
  - ii. The above list of courses for the Pre-Health Professional Option
  - iii. 11 courses different courses in ASTR, PHYS or EE

Third, there is very little common core to the above three options. Although the three options have some overlap in their core requirements, the core requirements are different.

As such, data on Course Pass Rates for natural sciences courses is too impractical to ascertain for the three different cores and the multiple disciplinary areas.

**Internal demand**

None. Because there are no courses offered uniquely under an "NSCI" prefix, there is no internal demand.

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

SCH production in Natural Sciences courses are not available because there is no dedicated prefix for Natural Sciences courses, there are three interdisciplinary options (not one), and there is little common core to the three options. While these data are not available the increasing number of majors would indicate that they are also taking more SCH.

**SCH/FTEF**

Not available. For each of the comparisons with FTEF it should be noted that there are no Natural Sciences faculty such that all SCH contribute to the FTEF of faculty housed in other departments.

**Enrollment/Full Time Equivalent Faculty (FTEF)**

Not available.

**FTES/FTEF**

Not available.

**Class Size (Average Class Size)**

Not available.

**Cost/SCH**

Not available. While there are some administrative costs associated with offering the Natural Science degree as with all degree programs, however the Natural Sciences degree does not have additional faculty salaries.

**Tuition Revenue/SCH**

Not available.

**External Demand**

During the period under review, more graduates sought additional education than those who did not. The number pursuing an additional degree was particularly notable in the two most recent years.

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

**Specialized accreditation process and status**

Not applicable

**Currency of the curriculum**

The BS in Natural Sciences (BS NSCI) degree offers three options: Environmental Sciences, Pre-Health Professions, and General Sciences. Since 1998, Project Kaleidoscope (PKAL; AAC&U STEM leadership program) has focused on transforming undergraduate STEM teaching and learning and empowering an extensive network of over 7,000 STEM faculty and administrators committed to the principles, practices, and partnerships that advance cutting-edge, integrative STEM higher education for all students. In 2011, the American Association for the Advancement of Science and the University of Colorado Biofrontiers Institute hosted a workshop entitled "Science on FIRE: Facilitating Interdisciplinary Research and Education." From this workshop, one of the findings noted that "People with interdisciplinary training will be in great demand in the future. The complex problems of the 21st-century demand graduates who can integrate knowledge from many disciplines and domains. Future researchers will need to understand jargon, approaches, and standards of proof across fields. Colleges and universities will need to figure out how to provide students with this training despite their largely disciplinary structure".

Biological Sciences recently implemented a curriculum transformation to align with the American Association for the Advancement of Science (AAAS) Vision and Change recommendations for biology education. These changes benefit students in the NSCI degree as well. Biological Sciences faculty reinforce student comprehension of biological processes through hypothesis-driven inquiry. The curriculum integrates student learning of the scientific process through student-centered classrooms and learning outcomes with an overarching goal to develop an understanding of key concepts and competencies. Contemporary science inquiry is necessarily collaborative and integrative, crossing traditional thematic boundaries to develop higher levels of understanding. Therefore, our program has moved to implement both the Vision and Change and also strives to meet the goals of the AAC&U Project Kaleidoscope.

### **Innovative program design**

The BS NSCI is a flexible degree program emphasizing the fundamental interrelationships among the sciences. Students master basic natural science principles by engagement in classroom experiences and by conducting research that integrates critical thinking, writing and speaking in the context of the scientific method. The program aligns with UAA 2020 as the flexible nature of the degree allows students to persist and achieve their academic goals. Students accepted into the program select one of the three options below. Each option requires students complete a specific number of credits in the natural and physical sciences, social sciences, and math and statistics.

1. Environmental Sciences option prepares students for graduate school or for employment in the private or public sector. It emphasizes math and computational skills, and includes courses from a wide variety of disciplines, including anthropology, biology, chemistry, geology, geography, and environmental studies among others
2. Pre-health Professions option is designed to meet the admission requirements for specific professional schools in medicine, dentistry and veterinary medicine, and includes course options in the health sciences and psychology
3. General sciences option is designed for students interested in understanding the interrelationships among scientific fields, or those preparing to teach science at the secondary level

Central to the educational mission as well as the discovery and dissemination and knowledge in the College, University and UAA 2020 missions, faculty conduct original investigations in their fields and publish in peer-reviewed journals. This scholarly activity ensures that faculty are current in their fields of study, make significant contributions to the global knowledge base, and prepare faculty to implement current and relevant activities in their courses. The nexus between teaching and research is fundamental to quality undergraduate instruction. Authentic research experiences are a fundamental component of the NSCI program, and undergraduate research in faculty research labs is highly valued by the department. 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”.

### **Availability and indications of quality of distance offerings**

There are no courses with an NSCI prefix. The UAA Biological Sciences Department continues to increase distance offerings of undergraduate and graduate courses to support students. For example, in F19/Sp20 the Department offered 14 distinct courses online (Anchorage campus; BIOL 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. The interdisciplinary nature of the degree is such that NSCI students have access to distance offerings from numerous other departments and programs as well.

### **Program Student Learning Outcomes assessment AND student success**

New program student learning outcomes (PSLO), drafted by collaborative process with the Biological Sciences assessment committee and faculty from contributing departments (ENVI, GEOL, invited CHEM, invited PHYS), were implemented in the 19/20 catalog year. They are

- Students will design and implement scientific investigations to explore natural phenomena using experimentation, which includes exploration and discovery, and testing ideas (gathering and interpreting data).
- Students will clearly and accurately communicate scientific ideas, theories, and observations in oral and written forms.
- Students will apply scientific data, concepts, and models to craft interdisciplinary explanations across two of the natural sciences.

We are working closely with Digication (ePortfolio) to build appropriate assessment rubrics for the new PSLOs and have identified multiple courses in which students will submit artifacts for assessment of attainment of PSLOs.

We cannot report on the success of these most recent changes as they have just been implemented. To achieve success in our PSLOs we are emphasizing the following practices and pedagogies. Future program reviews will enable us to assess our success and make necessary changes.

- Enhance visibility of opportunities for undergraduate research to include more students.
  - BIOL A108 students conduct interviews with faculty about their research.
  - A subset of the courses have implemented classroom-based undergraduate research and discovery projects (CUREs).
- Digication (ePortfolios)
  - Introduced in BIOL A108 and compiled in BIOL A492. The curriculum committee added BIOL A492 as a degree requirement in all three NSCI tracks in order to collect artifacts for assessment.
  - Will reflect student learning across their entire undergraduate career
- Active learning
  - Student response systems are implemented in several core.
  - Other courses regularly implement case studies and/or team-based learning (PBL).
- Service-learning or community-based learning via collaborative assignments and projects
- Undergraduate research. Authentic research experiences are a fundamental component of the NSCI degree
  - Represents the highest impact teaching practice that improves retention and decreases 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”.
- Capstone experiences
  - Intended to bring opportunities for integration, application, and closure to the undergraduate career. The options for these experiences available to NSCI majors are diverse (from ANTH to STAT), and most are interdisciplinary by nature of the offered topic.

### **Student Accomplishments**

From Fall 2017-Fall 2019, 24 BS NSCI students graduated with honors (three were BS BIOS/BS NSCI double majors). Twenty one students graduated cum laude, magna cum laude, or summa cum laude, and several students earned Leadership Honors or graduated as University Honors Scholars. We do not have Departmental Honors in Natural Sciences; however, two students who double majored in NSCI and BIOS wrote an Honors Thesis and earned Biology Honors.

The Department 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 Biological Sciences and Natural Sciences 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 Murdock Trust College Science Research Conference American Society for Biochemistry and Molecular Biology (ASBMB) Annual Meeting.

**4. Program Duplication / Distinctiveness (300 words or less)**

Currently there are no programs identical to the Natural Sciences degree at UAF or UAS. The closest degree at UAF is the natural resources and environment degree, which “integrates knowledge in natural science, policy, economics and human values to advance the sustainable management of natural resources and agricultural systems.” At UAS there are programs in Biology, Marine Biology, and Environmental Science. None of these programs are as flexible as the Natural Sciences program at UAA, which allows students to choose one of three pathways with quite a wide variety of individual course options, and tailor their degrees to their career goals. Given that the number of NSCI majors is more than 200 and on an increasing trajectory, there is clear demand for this degree in Anchorage.

**5. Summary Analysis (500 words or less)**

In the past 7 years, we have had 249 graduates, and have increased our majors from 183 in 2013 to 232 in 2019. The Natural Sciences degree allows students to experience how different disciplines in science are related and how the same tools can be used in multiple disciplines. In addition, students in the degree learn how to ask questions that challenge the boundaries between disciplines. The PSLOs for the degree have been revised with an interdisciplinary team of faculty and we use high impact assessment practices to evaluate the interdisciplinary nature of the program. The requirement of BIOL A108 as an introductory course highlights the skills and competencies needed across the sciences. As there are no faculty specifically within the Natural Sciences degree program and no courses specific to the degree alone, the costs to the College are low.

The program is highly flexible, enabling students to tailor their degree to their future goals. The three options available in the degree are especially relevant to workforce development in Alaska. The environmental science option prepares students for careers in natural resources, environmental consulting and with state and federal agencies, the pre-health professions option prepares students for careers in the health professions, and the general sciences degree provides the required breadth needed for secondary education in the sciences. All three options also prepare students for success in graduate degree programs should they choose that path.

Unfortunately, the traditional Institutional Research data for program reviews does not extract the information about this program because there are no courses designated as Natural Sciences. Without these data, there is a concern that the program may be marginalized. We would like to work with IR create a mechanism to more effectively collect data on BS in Natural Science students as there is no course designator for Natural Sciences.

Given that interdisciplinary education is recommended by the major science and education agencies in the country, it is in the best interest of the university, the Anchorage community, and the state to invest in the growth of this program, especially in light of growing enrollment and majors trends.