

External Program Review

**Department of Biology
Bachelor's of Science & Master's of Science Programs**

College of Arts & Sciences

2015-2016

Contact Person:

Seán O'Connell

Department Head of Biology

132 Natural Science Building

Western Carolina University

Cullowhee, NC 28723

Phone: 828.227.2203

Email: soconnell@email.wcu.edu

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Our last program review was in Spring 2010 and included a joint review of our undergraduate and graduate programs. At that time, we had 19 faculty members, including three who were split appointments ($\leq 50\%$ in Biology), two instructors, three lecturers, and 11 tenured or tenure-track faculty. Since then, we have added an additional split-time faculty member, two instructors, and three lecturers, while replacing two tenure-track faculty and adding two tenure-track faculty, for a total of 26 faculty members with some or all of their duties in Biology. We also rely on 6-7 adjuncts per semester to deliver our curriculum. The number of majors in the program has increased greatly in the last six years and now exceeds 400 students as well as more than 100 minors (Table 1), as has our service to other disciplines (Figure 1). It is a dynamic time for the department to say the least and we look forward to continuing in our growth and progress as an academic unit dedicated to making a difference in the lives of our students.

Table 1. Number of Biology majors by concentration and Biology minors in Fall 2012 versus Fall 2015, including all double majors and minors (PHP = Pre-health Professional concentrations, GB = General Biology, MB = Molecular Biology, and EE = Ecology & Evolutionary Biology). Note: Data reporting tool only goes back to 2012.

Term	PHP	GB	MB	EE	Majors	Minors
Fall 2012	185 (66.5%)	44 (15.8%)	26 (9.4%)	28 (8.3%)	278	92
Fall 2015	282 (67.5%)	55 (13.2%)	43 (10.8%)	38 (9.1%)	418	121

Our strengths documented in the Program Development Plan from 2010 included the following: 1) our faculty are committed to and concerned about student education and development at all levels, 2) our undergraduates appreciated small class sizes and accessibility to the faculty, 3) the involvement of faculty and administration in shared governance, 4) a commitment to continual program review, 5) the location of our campus to much natural biodiversity, and 6) the proximity of Highlands Biological Station. These features of our program remain strengths for the department. Some of the areas that the previous program review recommended for attention included:

- a substantial increase in the permanent budget of the department
- hiring a full time administrative assistant and working to hire a half-time ASA
- hiring cell and molecular biology faculty
- hiring a full-time lab support person for confocal microscopy and DNA sequencing
- obtaining new vehicles for field courses
- developing a formal faculty mentoring program
- making improvements to the website for advising, highlighting senior research resources, career development, and professional school applications
- expanding space for teaching; conducting a space audit; and planning for a new science building
- determining factors of success for BIOL 140, and
- developing the BIOL 480 research capstone and assigning credit to faculty.

We have made progress on many of the above items: we hired a full-time ASA, hired three new cell and molecular biology faculty (one a replacement faculty member), developed faculty mentoring processes, refined our website, refined space use, improved upon our BIOL 140 curriculum, and added BIOL 480 to the course schedule with major improvements to the course beginning this year. We still have no new vans for our field courses, though requests for new vans have been given support, but no funding, in the university's budget request process the last few years. We are also lacking permanent increases to our operating and educational budgets. However, we have received many one-time funding items in the last few years following a budget process that the chancellor introduced upon his arrival. These items include equipment for cell and molecular biology (e.g., ultracold freezers, nanodrop spectrophotometer, fluorescence microscope),

items for ecology and organismal biology (new greenhouse, soil respiration system), and funding for renovating teaching and research space. Additionally, our graduate teaching assistantships increased from \$10,500 to \$12,500 last year and we were allotted for 2014-2016, three graduate stipends of \$15,000 to help recruit high-potential students. We were also given a position, in 2010, for a research operations specialist to help maintain equipment and to train students in microscopy and DNA sequencing, however these funds had to be absorbed back into the university's budget due to financial exigency. Thus far, we have worked around this shortcoming by hiring a faculty member to specialize on the confocal and fluorescence microscopes and by assigning duties to adjuncts that help in making teaching and research equipment available to students. Lastly, much work has been done by the administration to get funding for a new science building onto a state-wide bond referendum which will take place on 15 March 2016. Please see Standard 7 for more details about our available resources.

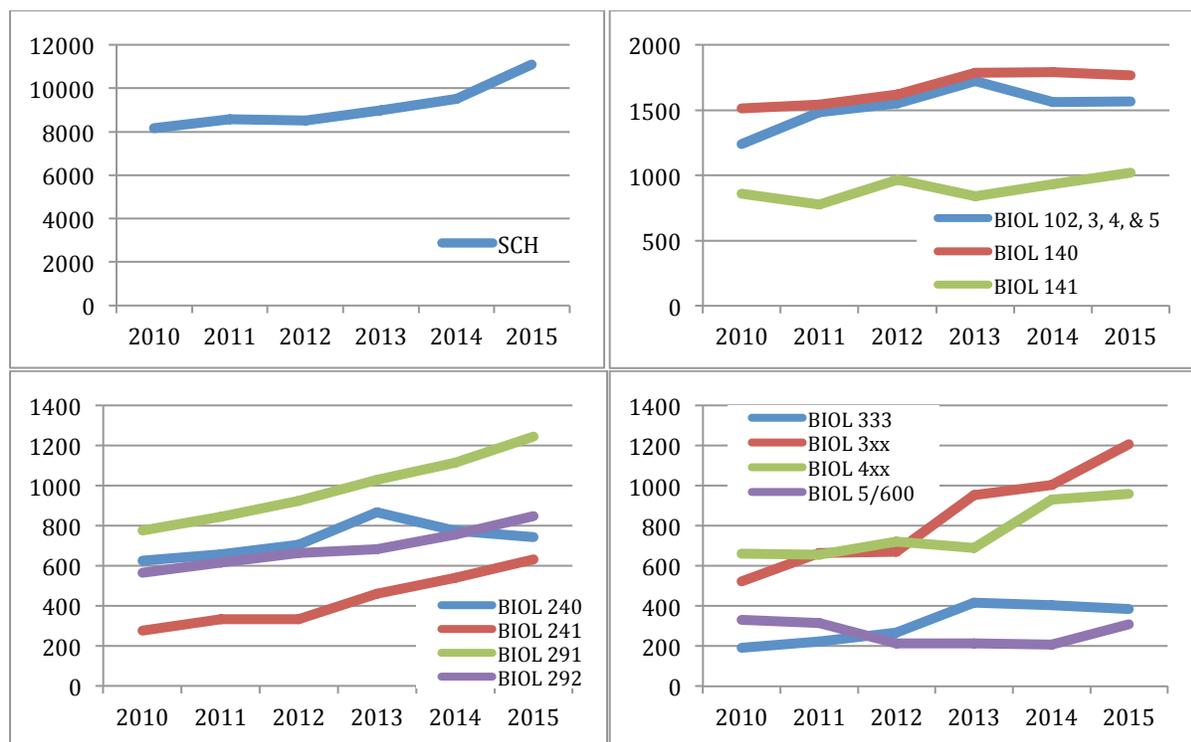


Figure 1. Student credit hours (SCH) generated by the Department of Biology over the last six years showing total SCH (upper left), freshman courses including majors (BIOL 140, 141) and Liberal Studies (BIOL 102, 103, 104, 105) classes (upper right), sophomore courses including majors (BIOL 240, 241) and human anatomy and physiology (BIOL 291, 292) courses (lower left), and upper level and graduate courses (lower right). A full list of courses and descriptions are in the appendices. Note: the drop in BIOL 240 occurred after the Nutrition and Dietetics program removed it as a required course.

The Biology Department continues to grow and is one of the largest and most critical academic units on campus. We have increasing demands for our undergraduate and graduate courses (Figure 1) that serve not only our majors but also students in majors such as Chemistry, Forensic Science, Environmental Science, Natural Resources Management, Nursing, and Nutrition and Dietetics. We also take an active and large part in our general education (Liberal Studies) program and value its importance to the university as a whole. In summary, we endeavor to be a program of excellence and a key player in our students' success. We believe we have earned the respect of the university and have been rewarded with one-time purchases to help us improve what we offer. Funding at a higher level will directly relate to improved student achievement and will help in recruitment and retention of not only students but faculty as well.

Standard 1. The purpose of the program reflects and supports the mission and strategic vision of Western Carolina University and the mission of its College.

The undergraduate and graduate programs in Biology at WCU are designed to provide high quality preparation for a diversity of career paths in the biological sciences, ranging from the health sciences to environmental science and management to academic research. In keeping with the broad-based mission of WCU as a Regional Comprehensive University as well as the liberal arts tradition of the College of Arts & Sciences, the Department of Biology also serves to impart to non-majors scientific literacy and understanding of fundamental biological concepts and principles. The teaching and training philosophy of the Department is well expressed by its mission statement:

The fundamental purpose of the Biology Department is to provide an environment that encourages learning, critical thinking, and scholarship in biology. The Department aspires to foster teaching and learning in accordance with the most current knowledge and science literacy standards of the National Science Foundation, and strives to provide service and research to assist and benefit western North Carolina expanding across the globe. We support the National Science Foundation goals of preparing students for immediate careers in the sciences, integrating research into our teaching as a means of preparing our majors for graduate and professional programs leading to future careers in the biological sciences, and training well-qualified science teachers for all levels of instruction.

Our undergraduate Biology program seeks to balance rigorous subject content with research opportunities, both of which are built into the Department's five core or foundational courses: *Principles of Biology I & II, Introduction to Genetics, Introduction to Ecology & Evolution, and Senior Research*. Students build upon this foundation with a menu of courses in more in-depth focal areas, or concentrations. The majority of undergraduate Biology majors express interests in pre-health professional careers (e.g., medicine, pharmacy, dental, and veterinary sciences), while a smaller group is interested in molecular biology or ecology and evolutionary biology. Regardless of concentration all students engage in scientific research as part of the Department's commitment to WCU's Engaged Learning and QEP (Quality Enhancement Plan) initiatives, in the conviction that the best way to learn science is to engage in science. Accordingly, research as a capstone experience is required of seniors in the major; in this regard the Department realizes a key recommendation of the NSF/AAAS "Vision and Change in Undergraduate Biology Education" document (2015, p. 31; www.visionandchange.org). Research is, of course, central to the graduate program in Biology.

The Biology program aligns well with several important goals and initiatives of the University's *2020 Vision* strategic plan. For example:

Goal 1.1, delivering high-quality academic programs designed to promote regional economic and community development, with curricular focus areas that include education and environment and promoting regional leadership in the study of the environment and environmental policy;

The Department of Biology makes impacts to regional economic and community development as our graduates go on to become productive professionals who end up working in offices, classrooms, laboratories, clinics, and hospitals across the region. Our program trains cellular/molecular biologists to work in biotechnology industries, and ecologists/ conservation biologists who can work for consulting firms and government agencies that help strike a balance between protecting the region's natural resources and development. A traditional strength of the Biology curriculum has been its environmental focus, an area for scholarship and engagement that is embraced in the *2020 Vision* document as a natural asset. We also prepare students for acceptance into graduate and professional programs that upon completion, enables our alumni to work in the area.

Goal 1.2, fully integrating with the General Education Program, with rigorous expectations in regard to integrating information, problem-solving, and effective communication;

The Biology curriculum aligns fully with this goal. Critical thinking, integration of information, and problem-solving are central to rigorous scientific training, and these are also central goals of WCU's General Education/Liberal Studies program.

Goal 1.3, affording cross-curricular, experiential, applied, and global awareness opportunities;

Biology faculty have engaged in cross-curricular teaching (e.g., with the Departments of Philosophy & Religion, English, History, and Chemistry & Physics) and, as mentioned above, the Department made it a priority to build into the curriculum experiential, hands-on educational and research opportunities. Moreover, the diverse Biology curriculum affords many opportunities to engage students with bigger-picture issues — for example, many environmental biology subject areas naturally raise such issues as climate change, ecosystem health, invasive species, and more, while other equally compelling societal issues bearing on genetic engineering, GMOs, gene therapy, DNA fingerprinting, etc. routinely come up in cellular and molecular biology courses.

Goal 2.1, fostering academic excellence and personal growth, realized in part by enhancing the total student experience through experiential and leadership opportunities;

Experiential learning is, again, a hallmark of the Biology program, as best exemplified by its research requirement. Students in the Department are also empowered to take on leadership roles: the very active Biology Club routinely engages in service and educational activities, and graduate students in the Department play a significant role in organizing the departmental seminar series, from planning and invitations to hosting visiting speakers.

Goal 3.1, aiming to enhance external relationships, achieved in part through long-standing partnerships with community organizations, non-profits, government agencies, and others.

The Department has long engaged in scholarly and service activities benefitting the western NC region, the state of North Carolina, and the scientific community more generally. Many faculty, for example, serve on editorial or advisory boards of scientific journals and professional organizations. Similarly, Biology faculty and graduate students routinely work with Federal, State, and local agencies or organizations (e.g., National Park Service, US Forest Service, NC Wildlife Resources Commission, etc.) on research projects aimed at scientifically addressing environmental issues. The Department also has a long tradition of educational engagement and service for the WCU community, our county, and our region.

The Department supports the Secondary Science Education program (B.S. Ed.), which is administered by Dr. Kefyn Catley. In addition, Biology faculty support regional schools in many ways. For example, the Western North Carolina Regional Science and Engineering Fair is organized by Dr. Catley and many Biology faculty and students serve as judges. Biology faculty also engage with local schools through programs and cooperative projects with teachers, as well as with life-long-learning organizations, non-profits, and other organizations. Finally, the Department periodically hosts educational events open to the public (e.g., the annual Darwin Day event and Sigma Xi Science Cafe events).

Like the University as a whole, the Department of Biology has long been regionally engaged in its curricular and scholarly endeavors. Cullowhee is sited in the midst of one of the most biologically significant regions of North America, with ready access to a great diversity of habitats and biological communities that collectively support remarkable organismic and ecological diversity. In this regard the surrounding region is a natural extension of the laboratory and classroom. In addition to local assets such as WCU's Wolf Creek Watershed Natural Area and the West Campus Outdoor Laboratory, Biology faculty and staff have access to numerous field sites such as extensive National Forest lands, the USDA Forest Service's Bent Creek Experimental Forest and Coweeta Hydrologic Laboratory, Great Smoky Mountains National Park, the Blue Ridge Parkway, Balsam Mountain Preserve, and the several river systems of Jackson and surrounding counties. These assets are invaluable for field-based instruction in class field trips as well as providing student research opportunities.

The Biology program further benefits from coursework and research opportunities available at the Highlands Biological Station (HBS; see www.highlandsbiological.org). WCU has provided administrative oversight of HBS on behalf of the University of North Carolina system since

1981; the HBS director (James Costa) is a Biology faculty member and the Biology Department Head serves on the HBS Board of Directors. The special relationship between HBS and WCU means that WCU students and faculty have privileged access to the Station and its programs. One or more WCU graduate students conduct their thesis research at HBS annually, and a growing number of WCU faculty teach courses at HBS. These course opportunities afford a level of immersive teaching and learning not readily duplicated in traditional academic departments, as students gain significantly more hands-on experience with their subject than in a traditional classroom course.

WCU's Southern Appalachian Biodiversity and Ecology Center (SABEC), a resource for education, research, and service focused on the biodiversity and ecology of the region, facilitates collaboration between the Biology program and other programs within WCU as well as with other regional institutions. This is enhanced by our oversight of the Helen Patton Environmental Studies Center in Franklin, NC, which provides a research site, meeting space, and temporary housing for visitors and students. These assets collectively illustrate a strength of the program in serving students interested in ecology, evolution, conservation biology, and related areas of environmental science, a strength that is matched by the research interests of many of the faculty. Recognizing, however, the pitfalls of concomitant programmatic issues in other important aspects of biology, such as cellular, developmental, and molecular biology, the Department has made great strides over the past five years in achieving a balance in faculty specialty areas and available courses to serve students whose interests lie more in laboratory-based biological disciplines.

WCU's Department of Biology has a great many **strengths**, largely stemming from its (1) diverse faculty, representing most key modern biological sciences subdisciplines; (2) modest class sizes, fostering a more intimate and personal learning environment for students; and (3) location, with all of the rich natural biological/ecological assets discussed above. One indication of the strength of the Biology curriculum is its close alignment with core concept and competency standards articulated in the recent NSF/AAAS "Vision and Change in Undergraduate Biology Education" document:

Core concepts that students must understand in order to become biologically literate. These concepts are: 1) evolution (the diversity of life-forms that have evolved over time through mutations, selection and genetic change; 2) structure and function (the basic units of biological structures that define the functions of all living things); 3) information flow, exchange and storage (the influence of genetics on the control of the growth and behavior of organisms); 4) pathways and transformations of energy and matter (the ways in which chemical transformation pathways and the laws of thermodynamics govern the growth and change of biological systems); and 5) systems (the ways in which living things are interconnected and interact with one another).

The below concepts are indeed core elements of the Biology curriculum, built into the rigorous foundational courses required of all majors (*Principles of Biology I & II, Introduction to Genetics, and Introduction to Ecology & Evolution*).

Core competencies--beyond the concepts identified above--that students must experience in order to become biologically literate and practice science. These competencies are: 1) the ability to apply the process of science; 2) the ability to use quantitative reasoning; 3) the ability to use modeling and simulation; 4) the ability to tap into the interdisciplinary nature of science; 5) the ability to communicate and collaborate with other disciplines; and 6) the ability to understand relationships between science and society.

The Biology Department curriculum does a better job instilling some of these core competencies in our majors than others. Giving our students an understanding of how to apply the process of science, foster communication skills and a recognition of the value of collaboration, and gain an appreciation for the nature of science-societal relationships are all achieved through a diversity of in-class and out-of-class experiences. Harder to gauge is the extent to which the Department fosters an ability to tap into the interdisciplinary nature of science, or to apply the process of science. Students are *introduced* to modeling, simulation, and quantitative reasoning in a number of majors' courses, but these skills are mainly fostered in selected upper division undergraduate or graduate courses. The research requirement is a crucial component of the curriculum that fosters several of these recommended competencies: experimental design, data analysis, hypothesis testing, and ultimately communicating results are all a part of this invaluable experience.

The **weaknesses** of the Biology Department stem mainly from lack of resources. The Department's commitment to immersive field experiences for students is compromised by lack of reliable and safe vans. The departmental operating budget has been flat for many years, with inadequate resources for such critical areas as faculty professional development, service contracts, and equipment purchases. Much of the teaching and research infrastructure is exceedingly dated or lacking (a problem that could be remedied with the planned replacement sciences building). The faculty teaching load is such that it is very difficult to maintain an active extramurally funded research program, let alone one that involves taking on large numbers of undergraduate students stemming from the departmental research requirement. At the graduate level the Department is lagging far behind other peer institutions in graduate student compensation (\$12,500 with limited availability of tuition waivers), making it increasingly difficult to recruit outstanding graduate students.

Despite these problems the Department of Biology at WCU does an excellent job in teaching and training, and its success is reflected in its steady growth. Since 2010 student credit hours (SCH) generated in Biology have increased over 30%, from ~8,000 to ~11,000 SCHs in 2015. However, for the Department to continue to serve its rising number of majors as well as non-majors in its many service courses (health sciences, social work, forensic science, NRM, & environmental science program students) it is imperative that core resources be increased to a level commensurate with the level of teaching, training, research, and service necessary to maintain a standard of excellence. Only in that way can the Department truly serve the goals of WCU's *2020 Vision* strategic plan, and advance the broader goals of helping produce an educated citizenry and teaching and training the next generation of scientists.

Standard 2. The program engages in ongoing, systematic planning that is reflective of the University's strategic priorities

The Biology department was last reviewed in 2009-2010, the year the Quality Enhancement Plan (QEP; see Appendix) was implemented and three years after the Biology curriculum (see Appendix) was revamped to meet the department's mission to "encourage learning, communication, critical thinking, and scholarship in Biology" in four concentration areas: Ecology and Evolution, Pre-health Profession, Molecular Biology, and General Biology. Since 2010, Biology has participated in the development of strategic plans at the college and university levels, which has allowed Biology program objectives to be linked to the broader WCU mission and goals. Overall, Biology engages in an ongoing, adaptive planning process (see Appendix) to ensure that curriculum, advising, and pedagogy meet learning goals for the growing number of Biology majors, allied programs such as Nursing and Environmental Science, and Liberal Studies.

The QEP is a primary planning tool for the Biology undergraduate curriculum. It was designed to help assess progress toward Biology educational goals for undergraduate students in all four concentrations; specifically, that students have a strong biological knowledge base, are able to integrate and apply their biological knowledge to solve novel problems, and have the knowledge and skills to become productive members of the world community. The impact of the QEP was assessed in 2012 and 2014. These assessments, combined with planning for the growing number of Biology majors, have prompted us to change our approach to particular classes and suites of classes that share a common goal. For example, we have formed a committee to examine the senior research course, Biology 480, as well as how and when we teach research-related skills. More specifically, we have begun to introduce exercises related to acquiring, evaluating, and

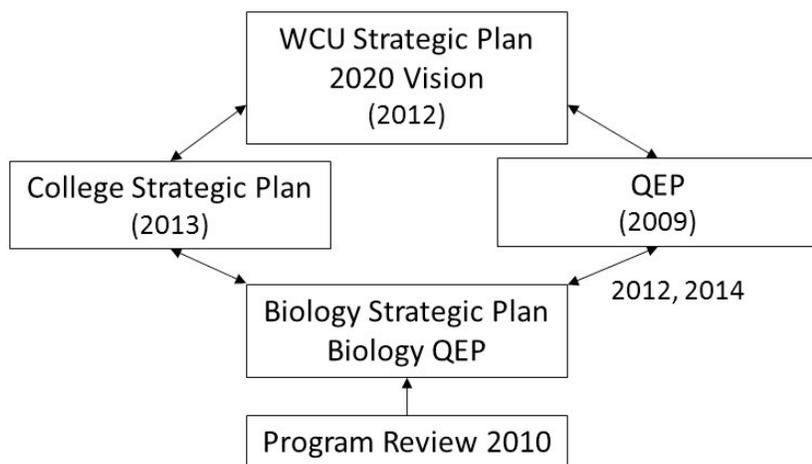
communicating scientific information at the freshman and sophomore levels (BIOL 140, 141, 240, 241), and we are planning to revamp Biology 480 to encompass more options and opportunities for students to gain experience conducting research at the junior and senior levels.

The 2009-2010 program review, *WCU 2020 Vision*, and A&S Strategic Plan (see appendices) have provided guidance for reviewing and planning program activities. For example, we have added faculty in cell and molecular biology, enhanced faculty mentoring, and added concentration-specific advising sessions and information specific to each class level in our program.

Biology engages in ongoing planning through:

- departmental faculty meetings every 3-4 weeks throughout the academic year,
- curriculum and concentration-specific group meetings,
- regular (e.g., Graduate Committee) and ad-hoc (e.g., QEP committee) meetings, and
- an annual Biology retreat each fall and longer retreat every few years in spring.

These activities are used to develop and modify departmental goals, incorporate and align departmental goals within college and university-wide strategic plans, and ensure that the curriculum and programmatic activities are designed to encourage learning, communication, critical thinking, and scholarship in Biology. This adaptive process is illustrated in the diagram below:



Flow and timeline of Biology planning efforts. Boxes show the resulting documents and their implementation dates; arrows show the input and revision flows. Dates beside the arrows are review dates.

Biology faculty contributed to WCU's *2020 Vision*, which was developed in 2012, and the College Strategic Plan of 2013. These efforts resulted in the Biology Strategic Planning table (see Appendix) of strategic goals and the ways and means to achieve them. Evaluations of impacts of the QEP in 2012 and 2014 also provided direct feedback for modifying the curriculum, especially

structure and content of focus courses, to meet QEP goals. Overall, the Biology planning process is dynamic and adaptive, to meet the needs of our growing department and university.

Standard 3. The program provides and evaluates a high quality curriculum that emphasizes student learning as its primary purpose

Bachelor of Science in Biology. The B.S. in Biology degree consists of four concentrations: Pre-health Professions (PHP, 66% of majors), Molecular Biology (MLB, 9%), Ecology and Evolutionary Biology (EVB, 12%), and General Biology (GBI, 13%). Example advising check-sheets for each concentration are provided in the Appendices. Each concentration consists of a 44 credit-hour common core set of courses: *Principles of Biology* I and II (BIOL 140 and 141), *Introduction to Genetics* (BIOL 240), *Introduction to Ecology and Evolution* (BIOL 241), two semesters of inorganic chemistry, two semesters of organic chemistry, two semesters of physics, and a semester of calculus. Each concentration then has 3 prescribed courses (10 credit hours) to provide depth in the concentration. A further 3 courses (9 – 12 credit hours) must be chosen, 1 each from a menu of cell and molecular electives, ecology and evolution electives, and organismal biology electives, to provide breadth for the degree. We require 25 credit hours for the concentration. Additional upper-level electives may be chosen from among any of the elective groups to sum to the required total. The required three credit-hour capstone research experience typically is fulfilled by high-impact courses such as *Research in Biology* (BIOL 480) or *Senior Thesis* (BIOL 495-499; four credits). The university Liberal Studies requirements consist of 42 credit hours (including 9 covered in the major requirements) out of a total of 120 credit hours for the B.S. in Biology degree.

Prerequisites facilitate the sequence of learning in core and upper-level elective courses. Our majors complete BIOL 140 to take BIOL 141, followed in order by BIOL 240 and then 241. Other majors can take BIOL 140 then 240 (e.g., Forensic Science) or BIOL 141 then BIOL 241 (e.g., Natural Resource Management). In either case, these freshmen and sophomore courses then serve as gateways for key junior courses such as BIOL 304 (*General Ecology*), BIOL 306 (*Evolutionary Biology*), BIOL 311 (*Animal Physiology*), BIOL 333 (*Cell and Molecular Biology*), BIOL 375 (*Methods in Ecology and Evolution*), and other upper-level required or elective courses. This curriculum was put in place in 2005 and has not been altered greatly, with the exception of fine-tuning the prescribed and menu courses and developing BIOL 480 as the senior research capstone. In addition new upper-level courses that reflect the interests of new faculty, have been added. The approach of prescribed and menu courses offers sufficient flexibility to allow students to switch concentrations late in their degree program with only minor back-tracking. And, as the prescribed courses are also

menu choices for students in other concentrations, it is possible for students to graduate from different concentrations with the same set of biology courses. This flexible curriculum is one factor that has allowed us to achieve and maintain a time-to-degree of 3.9 years over the last five years, even while numbers of graduates have increased by almost 70%.

In addition to serving our own B.S. in Biology students, students in the B.S. programs in Forensic Science, Chemistry (Premedical/Biomedical Science & Technology concentration), Environmental Science, Nutrition and Dietetics, and Natural Resource Conservation and Management are required to take at least a part of our core sequence of courses. These students also often take upper-level electives offered by the Biology Department and frequently minor or double-major in Biology. In addition to these multi- or interdisciplinary ties to other programs, we offer service courses that are designed specifically for other degree programs on campus: e.g., *Human Anatomy and Physiology I & II* (BIOL 291 & 292) are required for B.S. degrees in Nursing and Emergency Medical Care. The Biology Department also offers Liberal Studies courses for the general student population, e.g., *Human Genetics* (BIOL 102), *Environmental Biology* (BIOL 103), and *Human Biology* (BIOL 104). These courses have provided a laboratory science experience for a combined total of 5,520 students over the last 5 years. In addition, BIOL 102 is offered as an online distance course and BIOL 103 will be offered as such in summer 2016 for the first time.

Each Biology course syllabus has a statement of course objectives that reflect the expected student learning outcomes for the course and the program. Any faculty member may initiate a discussion of changes to the curriculum. In the event that a curricular change is deemed warranted by the Department's faculty the departmental Curriculum Committee initiates the appropriate requests. After departmental approval, approval is required by the Arts and Sciences Curriculum Committee, Faculty Senate, and Provost's office.

Over the last five years, we have used our Quality Enhancement Plan (QEP) for program assessment. Our QEP (see Appendix) has measurable criteria, though some planned approaches to assessment were later found to be infeasible or did not produce reliable data. For example, in our QEP we had planned to determine if "Students will have skills to develop their career path." We found that students did not respond or did not respond in a responsible manner to self-assessment survey instruments during advising or with our senior capstone class. We also found that plans to use results from standardized exams such as the GRE or MCAT were economically infeasible and were never instituted.

The basic approach of our QEP assessment was to use focal courses taken by a majority of our students, one at the end of the core sequence, BIOL 241, one at the junior level, BIOL 333 or

375, and one at the culmination of the program, BIOL 480. There have not been major curricular changes driven by this assessment process. But, there have been adjustments to course content, for instance we now formally introduce hypothesis testing, quantitative data analysis, and report writing in the first biology course, *Principles of Biology I*, and reinforce those skills in each of the core courses to better prepare our students for their upper-level courses.

Master of Science in Biology. Graduate students admitted to the M.S. in Biology degree must have completed, at minimum, the following undergraduate pre-requisite courses: *Principles of Biology I and II*, *Introduction to Genetics*, *Introduction to Ecology and Evolution*, and *Introductory Chemistry I and II* (CHEM 139 and 140). In addition the students are required to have a degree in Biology or related field. Given their nature, departmental graduate courses have no pre-requisites. Graduate students in the M.S. program complete 24 hours of coursework and six hours of thesis research (BIOL 699) after submitting their research proposal. During their tenure students must complete three semesters of BIOL 696 (*Seminar Series*). All students entering the Biology program in fall semester also complete BIOL 697 (*Introduction to Graduate Studies*). The remainder of the curriculum is personalized, each student pursues their interest as guided by their advisory committee. Some courses such as Biostatistics are completed by almost all graduate students, while other classes are much more subject-specific such as BIOL 523, *Biophysics*. A minimum of two years is required to complete the curriculum.

The graduate program is interdisciplinary in a number of ways. Students can pursue graduate courses in the Chemistry program (such as Biochemistry) or those presented by the Forensic Science Program (such as Forensic Biology). In addition students can immerse themselves in summer graduate biology classes at the Highlands Biological Station. The courses at the station are approximately two weeks in length with students staying on location. Most of the classes are field-based and focus on organisms and ecological systems of the southern Appalachians.

Each Biology graduate course syllabus has a statement of course objectives that reflect the expected student learning outcomes of the program (please see graduate class syllabi in the Appendices). Intended curriculum changes are first examined by the Biology Graduate Committee and subsequently the departmental Curriculum Committee. Approval is required by the Arts and Sciences Curriculum Committee, Professional Education Council, Graduate School, Faculty Senate, and Provost's office.

To examine the success of the Graduate Program it is useful to examine the employment of some of our alumni (see Appendices for more information). The employment varies from university faculty, medical doctors, U.S. Forest Service biologists, environmental consultants, high school

teachers, fisheries biologists, research technicians, post-doctoral researchers, Ph.D. candidates, veterinarians, and others. These varied endeavors show the success of our program both within North Carolina, in other states, and in other countries. The open curriculum for the M.S. degree allows students to pursue various interests and thus easily obtain employment upon graduation.

Despite the open curriculum students must pass a comprehensive exam (BIOL 698) prior to their second year. This ensures quality in the program and provides a snapshot of student knowledge. Gaps noted in the exam serve as an indication of student weaknesses and indicate remedial coursework the student will need to pursue prior to graduation. The required curriculum presents students with the needed background to defend their thesis while enrolled in BIOL 699. The thesis defense requires students to draw on a large body of knowledge and to use this information to address questions from their committee. These oral communication skills are linked with the writing skills needed to prepare the thesis document. At the student's defense it is possible to assess their content knowledge. If this knowledge is lacking consistently among graduate students, the Graduate Committee can prepare a recommendation to the faculty requesting a change in the curriculum. Assessment of student learning outcomes, as measured in various ways, is presented in the Appendices. This assessment provides information regarding the assessment for the last five years.

Standard 4. The program has sufficient faculty resources to meet its mission and goals

Faculty credentials are consistent with SACS standards in terms of appropriate degrees, related work experiences, honors and awards, and demonstrated competencies and achievements that contribute to effective teaching and student learning outcomes. There are 22 full-time faculty in Biology (including fixed-term, tenure-track, and tenured). Four other affiliated faculty include Jim Costa (25% time in Biology), director of Highlands Biological Station, Kefyn Catley (50% time in Biology), director of the Science Education Program, Kelly Grisedale (50% time in Biology), Interim Director of the Forensic Science Program, and Laura DeWald (25% time in Biology), director of the Environmental Science program. All faculty, their rank, and their expertise areas are listed in a table in the Appendices.

The Biology faculty is comprised of 2 full professors (5, including those with other affiliations - Drs. Costa, DeWald, and Catley, the latter who will become full time in the department in fall of 2016), 8 associate professors, 3.5 assistant professors, 5 instructors, and 4 lecturers. The latter two categories are non-tenure track (fixed term) positions; the instructors are full time and the lecturers are considered 80% time (with full benefits). The Department also relies heavily on

adjunct support, primarily for teaching laboratory courses, and employs approximately 6-7 individuals to cover 25-30 lab preps and sections each semester. The faculty range in age from their 30s to their 60s with the majority between the age of 40-59 (range = 32-65 with a mean of 49.5). Twelve full-time faculty are male, 10 faculty are female, and two faculty members are non-White. As indicated in the Appendices for Standards 4 and 5, the faculty demonstrate continuing growth as professional practitioners, teachers, and scholars. Biology faculty regularly attend and present their research at regional, national and international conferences in their field, and also participate in teaching improvement workshops at professional conferences and through WCU's Coulter Faculty Commons, such as the annual Summer Institute for Teaching and Learning. The University and UNC system offer several teaching awards, of which Drs. Hyman and Pechmann received the WCU STAR Engagement Teaching Award in 2015.

The strength of the faculty involved in research tends towards the ecology and evolutionary biology areas of Biology compared to cell and molecular biology. The full-time faculty with active research programs in ecology and evolution (EE) disciplines include 7 tenured and 1 tenure-track professor while in cellular and molecular (CM) biology there are 3 tenured and 3.5 tenure-track faculty. The Department is critically aware that it is understaffed in cell and molecular biology areas, particularly relative to the number of majors who declare Pre-health Professional and Molecular Biology concentrations. While we offer many courses in the CM area, many of the faculty who teach them are either fixed-term faculty with no research job duties or faculty who no longer maintain active research programs. We are in the process of integrating career development courses within our undergraduate curriculum to increase our student success in entering health careers, including medical school. In addition, our faculty are continuously updating the curriculum for the B.S. and M.S. in Biology to create coherent course sequences from freshman to senior years and beyond, so that students can acquire and build upon skills and synthesize knowledge at each level.

The faculty have obtained over \$1,500,000 in extramural funding in the past five years for research and education projects. Faculty have received grants from national institutes such as the National Science Foundation (Advancing Digitization of Biological Collections – K. Mathews), American Heart Association (Career Development Grant for Apical Sorting Mechanisms in Renal Epithelial Cells - Youker), Burroughs-Wellcome Fund (Exploring Science and Math in Cullowhee Creek - Costa), NOAA (A Prototype Phenological Observatory in the Southern Blue Ridge for Research and Education - Costa), and the Agricultural and Food Research Initiative Competitive Grants Program (Landscape-Scale Thresholds of Early Successional Habitat: Reconciling

Biodiversity, Timber Yield and Public Perception in Managed Forests – Drs. Collins, DeWald, and Hyman). We have also received funding from state and local institutes, such as the Cherokee Preservation Foundation (Revitalizing the WCU Cherokee Garden - Collins), and North Carolina Biotechnology Center (hosting Molecules in the Mountains conference – O’Connell; Using RNAi to Identify New Drug Targets in *Cryptococcus* - Bose). As examples of collaborative research, Drs. Collins and DeWald were funded by NOAA to study near-ground climate in contrasting sites; Drs. K. Mathews, Bose, and Coan have all been involved in collaborative research projects with Chemistry faculty; Dr. Bose and Ballentine collaborate to study telomere length in song sparrows, Dr. Grisedale collaborates with a History professor to study ancient DNA in marine mammals, and Dr. Youker continues to work with colleagues in molecular imaging at the University of Pittsburgh.

Professional and pedagogical development opportunities for faculty are provided by institutional resources including the Chancellor’s Travel Fund for presentation of scholarly work at a conference (\$1,200), WCU Faculty Research Grants (\$5,000), College of Arts & Sciences Faculty Research Grants (\$1,000), Hunter Scholar Award (1 course release per semester plus graduate research assistant), Professional Development Grants (\$1,200), and the Scholarly Development Assignment Program (one semester paid leave plus one semester unpaid leave). Many of our faculty have taken advantage of one or more of these programs in the past five years, with three faculty members receiving Scholarly Development Assignment awards (sabbatical). Dr. Coan received a special seed grant award from the Office of the Provost (External Funding Support Grant) for \$10,000 for “Genetic Analysis of Keratin Biomaterial-Mediated Cell Survival” and has supported many undergraduate student research projects with this grant funding. Drs. Coan and Youker received funding from the first two years that the A&S Faculty Research Grants have been available.

There is excellent collegiality among the Biology faculty as expressed in the constructive outcomes and congeniality of faculty meetings, collaborative instruction and research among Biology faculty, and a generally positive workplace environment. For example, Drs. Collins and Pechmann co-teach undergraduate and graduate Methods in Ecology courses, and Drs. Collins and K. Mathews have co-taught Flora and Ecology. Drs. Coan and J. Mathews are developing a Pre-med cohort community with an associated first-year seminar. Dr. Pechmann and Hyman now co-lead class-based salamander surveys that have been ongoing for over 30 years. There are also strong links from the Department to programs in Environmental Science, Forensic Science, and Science Education, including this year’s inaugural offering of the SEA-PHAGES virus discovery class for freshmen, offering in concert with the Chemistry & Physics Department.

The standard teaching load of the tenured/tenure-track faculty is 9 credit hours or 9

contact hours per semester. That for the fixed-term faculty is 12 credit hours. The percentage of reassigned faculty time in Biology per semester is: 67% for the Department Head (O'Connell), 33% for the Assistant Department Head (K. Mathews), 33% for the Undergraduate Program Coordinator (Martin), 33% for the Graduate Program Coordinator (Rundle), 50% for the Science Education Coordinator (Catley; other teaching assignments are in science education courses), 84% for the Director of the Highlands Biological Station (Costa), 17% for the Herbarium Director (K. Mathews), and 17% for the maintenance of our confocal and fluorescence microscopes (Youker).

Current faculty teaching loads do not include the time faculty spend training graduate students, nor the time they spend doing capstone research with undergraduates enrolled in independent research classes (*Senior Thesis* and BIOL 480) or supervising internships (BIOL 389; Powell). Extensive time is dedicated by faculty in guiding their graduate students to develop a research project and subsequently mentoring their students through the 2- or more year process of completing their research and writing a thesis. Most tenure stream faculty serve as the primary advisor to M.S. students, with the number of graduate student advisees per primary advisor ranging from 1-5 this year. In addition, individual faculty members advised from 2-12 undergraduate students on research projects (including Senior Thesis and Independent Research credits) this year. No official credit or release time is earned by faculty for mentoring students in research.

The university and Biology Department are committed to clear and transparent standards for tenure, promotion, and reappointment (TPR), as expressed in the departmental Collegial Review Document (CRD). All tenure-track faculty are evaluated in their 2nd and 4th years and given constructive feedback at the department and college levels before going up for full review in the 6th year for tenure and promotion to Associate Professor. Post-tenure faculty are evaluated every 5 years at the departmental, college, and university levels, and can petition for promotion to Professor after the 5th year post tenure. In addition, the Department conducts annual faculty evaluations (AFE) of all full-time faculty, as specified in the guidelines of our AFE document. Both documents are attached in the Appendix for Standard 4.

A specific questionnaire has been developed for undergraduate students to informally evaluate the teaching effectiveness of their graduate teaching assistants. Often these are used both at the middle and end of the semester to ensure the student teacher can learn and improve throughout the semester. Each semester the instructor of record meets with teaching assistants to discuss the meaning of the results of these evaluations. All teaching assistants also receive official student evaluations through the university online teaching evaluation system. The faculty are discussing ways in which TAs can also receive formal assessment of their teaching performance

from the instructor of record.

Distribution of faculty resources differs between the graduate and undergraduate programs, making it difficult to neatly categorize the load for a faculty member. The demographics of students in the Biology B.S. and M.S. degree program are quite different, with more cell and molecular biology-interested students in the undergraduate ranks and more ecology and evolutionary biology-focused students at the graduate level, although the number of M.S. students interested in CM fields is growing. Research advisors in EE fields have more graduate students, while faculty in CM train fewer M.S. students but are sought out more frequently by undergraduates who wish to do their capstone research project in a CM area. It is impossible for the faculty to engage in research with all the undergraduates who express interest in working with them. We are therefore contemplating and piloting new ways in which capstone research can be integrated into group courses. Currently students enrolled in the 2-hour Microbiology lab (O'Connell and Gainey) complete a research project that can substitute as their capstone research requirement. We are piloting new BIOL 480 group courses, in contrast to the individual, independent research BIOL 480 courses, in which students write review papers on a topic, including Case Studies in Ecology (Martin) and Cellular Stress and Human Disease (Youker). Undergraduate research is considered a high-impact learning practice nationwide. Faculty should receive more recognition for research mentoring at all levels, given its great rewards countered by its time-intensiveness and possible impediment to their professional research goals and departmental expectations for scholarship.

Standard 5. The program attracts, retains, and graduates high quality students

The Biology Department has approximately 430 undergraduate majors and 25 Master's students. The most recent demographic data for both groups combined show that 64.6% of our majors are female and 35.4% are male with 98.4% being United States residents (see Appendix for more information). Ethnic diversity generally mirrors that of the university as a whole, with Whites being the dominant group (82.7%) followed by those identifying as Blacks/African Americans (6.3%), Asians (4.4%), two or more ethnicities (4.4%), Hispanics (1.4%), and American Indians (0.5%). Seniors make up the single largest cohort (31.8%) and freshmen the next largest at 26.8% of students followed by sophomores (16.7%), juniors (18%), and graduate students (6.8%). The vast majority of our students are native to North Carolina.

The number of majors in Biology is the third largest on campus, behind the Criminal Justice B.S. (514) and Psychology B.S. (498) programs. Within the College of Arts & Sciences, our program is behind the Criminal Justice and Criminology Department, which is home to three distinct

undergraduate programs, including two which are entirely conducted via distance education. Our Department ranks third in SCH generated in the college, accounting for nearly 10% of all SCH across the 31 programs in A&S. We also account for about 12% of the total of the FTE for the College (ranking second behind Criminal Justice and Criminology). Our program is healthy and continues to grow, going from 280 majors in 2010 to the 430 this term. These numbers compare favorably to trends across the University of North Carolina system, which tracks upperclassmen at 15 institutions (See Appendix). In the last reported dataset (for fall 2014), WCU's program accounted for 167 junior/senior majors, which is similar to other schools near our size and/or mission (e.g., Fayetteville State, NCA&T, NCCU, UNC-Pembroke, and others, which accounted for 1,390 of 4,557 total Biology B.S. majors). Most institutions across the system have seen growth over the last ten years in their B.S. programs in Biology. For institutions granting the M.S., WCU accounts for nearly 10% of all students (and 7.5% of degrees granted), owing to many of the larger institutions preferentially awarding the Ph.D. (e.g., UNC-Chapel Hill, NC State University, UNC-Greensboro, East Carolina, UNC-Wilmington, and UNC-Charlotte). The academic qualifications of our incoming freshmen align with those of the other new students on campus (for 2014 data) with the high school GPA 3.76 compared with 3.74 (for all students), SAT combined score of 1021 versus 1057, and ACT score of 22.3 compared to 22.0 for the university as a whole. GRE scores of incoming graduate students for the university as a whole were 152 (verbal) and 147 (quantitative) and, for our program, scores were 151 (verbal) and 154 (quantitative).

All indications are that the future viability of our program is sound. We have seen sizable increases in the numbers of majors and students in our service courses since our last program review (see Appendices). Additionally, the number of minors in Biology has increased from 72 to 136 since 2010. Please see Standard 7 for information on resources we have acquired recently from the university and which have helped to support the growing needs of our faculty and students.

The number of undergraduate advisees per faculty member is approximately 35-40, based on our high number of majors and relatively few full time faculty advisors. Consistency and accuracy of advising is maintained by regularly updating our curriculum checksheets and eight-semester plans, training new advisors, holding group advising sessions by class or concentration each semester, and via information disseminated at regular faculty meetings. The monitoring of progress toward degree completion is done via regular advising sessions, typically on Advising Day. For graduate students, a mandatory committee meeting takes place each semester to ensure progress is being made. The Department has had a strong track record in working with the Advising Center and with the Honors College in handling incoming freshmen and transfer students and with

Honors students once they are enrolled. We have also been working on ways to improve our pre-health profession advising, especially as it relates to pre-medicine and pre-veterinary science, and have greatly benefitted from the expertise of and collaboration with Emily Sharpe in the Honors College. Drs. Mathews and Heather Coan oversee our efforts in coordinating pre-health advising and will be offering a special course in spring 2016 to high-achieving freshmen in an effort to help them be successful in ultimately gaining admission to health professional programs.

Our efforts to retain and attract students include engaging them in high-impact activities outside of the classroom. We have been most notably successful in the past few years in providing research opportunities to seniors who complete a capstone experience with a professor. As mentioned elsewhere in this report, we have been stretched to the point where we cannot accommodate the large number of majors that we have and are working on ways to provide alternative experiences for some students. These other opportunities will include cooperative educational internships, research in other departments, and seminar courses where research in major fields is analyzed. The Department's Biology Club is thriving and this has provided a means for our majors to form a community, assist in our recruiting efforts, and provide for volunteer and recreational activities outside of class. Current majors assist us in the two open houses the university puts on each semester and we also take part in majors fairs and graduate recruiting sessions (many of our M.S. students completed B.S. degrees in our program). We also realize that many prospective students will seek information about us online and we are working to continually improve the presentation and amount of information on our webpage. Graduate student recruitment is often by word-of-mouth from colleagues of our professors outside the department as well as based on our research related to southern Appalachian biology, which is historically strong (e.g., plant community dynamics, fish ecology, salamander natural history). We also have engaged in recruitment opportunities via research talks and visits at other institutions and by advertising at regional conferences.

Departmental support for undergraduates includes seven scholarships awarded each year ranging from \$500 to ~\$2,200 (see Appendix). The amount of the awards varies based on how the university's endowment does, but typically, five of these awards are for \$1,000 or more in total funding, with one targeted for a pre-med student, another for a student interested in genetic or cancer research, and one other for a young woman with career interests in science. Students have the opportunity to be employed as work-study students if their financial aid allows and we usually have between 3-5 students take advantage of this. These students typically assist in helping in research labs and also with some clerical tasks in the office. The Department also uses some of its

operating budget (usually ~\$2,000) to support students with funding to help in departmental work (e.g., maintaining our insect room, helping in data entry, etc.). Our graduate program's chief funding incentive comes from teaching assistantships which are now \$12,500 per year and may include in or out of state tuition waivers. The combination of waivers and assistantships are often not enough to recruit high quality students into our programs. Other means that we have of supporting graduate students include modest funding for research support (\$400 per student last year) and summer support that is sporadic via either competitive grants from the university (\$2,000) or teaching assignments during summer school (\$1,800). Some faculty are also able to support students via their research grants.

Standard 6. The program has an administrative structure that facilitates achievement of program goals and objectives

The Biology Department is currently under the leadership of Dr. O'Connell, Department Head (DH), who shares administrative duties with Assistant DH, Dr. K. Mathews. Dr. O'Connell has served as DH for 6 years and was reappointed for a new three-year term in Fall 2015. Dr. Mathews has served as Assistant DH for 3 years. The DH duties include oversight of departmental budget, purchasing oversight (with secretary), organization of departmental meetings, AFE-TPR processes, and liaison with Arts & Sciences Dean. Assistant DH duties include building course schedules, overseeing the curriculum, and managing instrument service contracts (see Appendix for complete list of these duties).

Major initiatives completed since the last review include hiring a full time secretary, creating an Undergraduate Program Coordinator position, and adding several part-time undergraduate positions to assist in day-to-day administrative and research duties. In addition, three new tenure-track faculty hires in the molecular & cellular biology fields were completed (two *de novo*, one a replacement) to add to our already strong background in ecology and evolution expertise (one replacement tenure-track position was added in this field as well). The Undergraduate Program Coordinator has been created to address the growing administrative needs of our undergraduate programs. This position complements the Graduate Program Coordinator (Dr. Rundle) who runs the Master's Programs. Dr. Tom Martin is the Undergraduate Program Director and his duties include oversight of undergraduate assessment programs, senior exit interviews, and the senior research program (see Appendix for complete list of the duties for the program coordinators).

The DH and Assistant DH attend college and university workshops and meetings

throughout the academic year to keep abreast of the latest information in order to make informed administrative decisions. Faculty continuously strive to stay current in their respective fields in order to keep course content up to date and relevant in a changing scientific workplace. Junior faculty have access to mentors (senior faculty) to aid in career development and navigation of the promotion and tenure process. The tenured faculty form the body of the departmental Annual Faculty Evaluation and Tenure, Promotion, and Reappointment (AFE-TPR) Committee (aka the Collegial Review Committee or CRC). Biology faculty members also serve on College and occasionally on the University TPR committee. Faculty provide yearly evaluation for the DH, Associate Dean, and Dean of the College of Arts & Sciences (see Appendix).

Standing committees that serve to ensure effective decision-making include the Curriculum Committee (chaired by K. Mathews), Graduate Committee (chaired by S. Rundle), QEP Assessment & Program Assessment Committee (chaired by T. Martin), Pre-Health Professional Committee (co-chaired by J.B. Mathews and H. Coan), CRC (chaired by S. O'Connell - *ex officio & non-voting*), and Biology Awards Committee (chaired by A. Sharma). Special committee topics for 2015-2016 include Faculty Search and Collegial Review Document Revision. Committee business is brought to the full faculty for deliberation, modifications (if necessary), and final approval.

Since 2009, graduating seniors have been interviewed to obtain student feedback as to the effectiveness and design of undergraduate degree programs (see Appendix). These formal interviews complement the anonymous course evaluations and informal conversations with students. These three forms of feedback have been invaluable in helping to meet the needs of an expanding and diverse student body.

Standard 7. The program has adequate resources to meet its goals and objectives

The budget for the Biology Department comes from two sources: the General Biology Fund ("operating budget") and the E&T (Education and Technology) fund. The operating budget has remained at the same level for many years (~\$33,000). This fund is used for a wide variety of departmental needs, from office supplies, photocopying and postage, to equipment costs, vehicle and infrastructure maintenance, educational materials, facilities management fees, as well as funding faculty travel and development (including conference registration fees). The second source, the E&T fund, is generated from student fees, and varies depending upon infusions of new funds on occasion and funds that can be now rolled over from year to year. In general, our annual allocation is ~\$40,500 with additional E&T funds (~\$28,000 per year) dedicated to service contracts. The E&T fund must be used only for educational supplies and technology needs.

Over the past 5 years, the Biology Department has experienced considerable growth in class enrollment, due to the increases in both the number of biology majors and in outside majors that take our courses. For example, in our introductory core class, BIOL 140, enrollment in 2010-2011 was 386, and in 2014-2015 it was 448 (see appendices). Over the same time period, enrollment in BIOL 291, *Anatomy and Physiology*, a class taken by large numbers of Biology majors as well as Nursing majors, has grown from 194 to 339, and enrollment in an upper-level elective, BIOL 333 (*Cell and Molecular Biology*), has grown from 56 to 92. We highlight these courses because they all have labs that require expensive materials, and thus, our expenses related to these and other classes have grown considerably, while the Biology Department operating and E&T budgets have not changed. Additionally, many of our students (ca 75%) are associated within the Pre-health Professions (PHP) and Cell and Molecular (CM) concentration tracks. These students identify as having career interests in the medical fields. Unfortunately, the cost of lab materials in this field of study is high and growing resulting in students being exposed to outdated techniques. Although these outdated techniques are appropriate for supplementing learning in their corresponding courses, the students are not exposed to techniques that are used in modern biomedical labs. Students have reported being at a disadvantage when applying for jobs, graduate programs, and other programs that require that they have an understanding of the current state of the discipline. It also undermines our students' confidence in their area of study because they cannot see the connection between newsworthy research advances and the concepts learned in lab classes. In short, we are losing ground because the pace of research/discovery does not stop, but our labs are unable to teach modern more expensive techniques due to budget constraints.

An example of this is the May Minimester Cell Culture course taught by Dr. Coan. This course requires that a significant amount of funds be invested so that the students can learn techniques and perform relevant research that is translatable to a number of modern labs. Unfortunately, our budget does not allow for this type of course to be taught for more students and a longer duration, even though students express a great interest in the course, and the long-term benefits to the students greatly outweigh the costs. Other intensive, high-impact courses should also be developed in all of our subdisciplines.

Among the goals of the University's 2020 plan is to implement research at all levels of the curriculum (*Goal 1.2.3*) and to increase support for scholarship (*Goal 4.4.3*). In the Biology Department, we recognize the value of giving students research experiences, and for the last several years we have had a senior research requirement (BIOL 480) for all biology majors. As the number of majors has increased, obviously, the number of students involved in research has increased as

well. Unfortunately, for many disciplines within biology, research can be an expensive undertaking even at the undergraduate level. In particular, the current system is inadequate for the 75% of majors that identify as having interests in PHP or CM. Student research is vital for experiential learning of concepts and techniques. However, with no permanent pool of money, faculty in these areas and in EE are required to spend their start-up funds and/or grant funds teaching students research. A very small number of students in CM are doing research relevant to their areas of interest because the CM faculty can take very limited numbers of students. This is also a hardship to any faculty member who must fund students from start-up funds and grant money. Training students in CM areas often requires a lot of resources and typically doesn't result in usable data. Startup funds and grant money ideally should be spent on generating preliminary data to support external funding applications.

We have been fortunate to receive additional funding for undergraduate research (e.g., QEP funding and Honors College grants) as well as using some of our own departmental funds to cover such research; however, a larger and more reliable pool of funding sources (including operating and E&T budgets) for undergraduate research would be a wonderful resource to help in giving all of our students a meaningful research experience. Of note, the administration does recognize the need for increased research funding. Both the Dean of the College of Arts and Sciences and the Provost have created competitive internal funding opportunities. To this end, several of the new CM faculty have been awarded these funds which allowed them to supplement their lab funds.

Also among the goals of the University's 2020 plan was to ensure professional development opportunities for all employees (*Goal 4.2*). For faculty in the Biology Department, professional development and the ability to stay connected to and current in our field often depends on our ability to attend conferences and meetings. Funds for supporting faculty travel have historically been available either through the operating budget or competitive grants through the internal Chancellor's Travel Fund. However, as our number of faculty grows, we will need increasing funds to ensure these professional development opportunities, and sources of funding that could be counted on in advance would be greatly appreciated.

The Biology Department is housed primarily in the Natural Science Building (NSB), which is now nearly 40 years old. Unfortunately, the electrical and mechanical infrastructure of this building is inadequate and frequently results in leaks and failure of features such as the heating and cooling systems and the elevator. The backup power system was replaced a few years ago and this has minimized damage done to equipment and loss of research materials as occurred in the past. Due to increases in the size of the Biology Department, this building is now quite inadequate for the

teaching needs of the Department and for the Department of Chemistry & Physics, which shares our building. Few lecture classes are taught in this building due to a lack of classrooms large enough to hold a typical section of most of our core level classes. Most of the “classrooms” in NSB are used for teaching labs, which typically have lower enrollment caps. Teaching laboratories and classrooms in the Stillwell Building were renovated in 2008, and provide more usable, modern space, which is used primarily for teaching introductory (BIOL 140, 141, 240) and non-majors Liberal Studies courses as well as upper-level courses in microbiology and cell and molecular biology (e.g., BIOL 313, 333, 414/514, and 422/522). However, labs for 200 level courses such as BIOL 291 & 292 (*A&P I & II*) and BIOL 241 as well as many upper-level classes, use the less well equipped labs in NSB. In addition, the separation of teaching space often necessitates inefficiently moving materials between buildings when those materials are used for multiple classes, such as biological specimens used for teaching both BIOL 141, which is taught in the larger, renovated Stillwell rooms, and BIOL 374 (*Vertebrate Zoology*), which is taught in NSB. The Biology Department could greatly benefit from increased and modernized teaching space.

As noted above, the infrastructure of the NSB is inadequate and in many cases in disrepair. In addition, the current building is inadequate because faculty are spread out and cannot easily share resources. The lab spaces were designed with individual labs in mind and not with collaboration in mind. We are a small institution that relies on collaborative approaches to research, including with Chemistry & Physics and with Forensic Science, both of which are also spread across multiple floors in the two buildings. Because our resources are minimal (compared to larger more research-centric institutions), we must pool resources in order to be productive and to generate publishable and relevant data. Also of note, faculty offices are often located in a different building/floor than their own laboratory space. This makes it difficult to oversee students in the lab because we are not in close proximity to our offices. In fact, some faculty have multiple research locations and are required to cart reagents, supplies, etc. to other buildings to perform their research.

A recent addition to our facilities includes a greenhouse, which has added to our teaching and research capabilities. Our new greenhouse, obtained primarily due to the efforts of Dr. Beverly Collins and Dean Richard Starnes, also provides an excellent resource for graduate and undergraduate research for any student interested in plant ecology or botany and also helps us keep teaching preparations of plants available. Our herbarium, maintained by Dr. Kathy Mathews, is the largest botanical resource in western North Carolina, with over 27,000 vascular plant specimens collected primarily in the southern Appalachians and southeastern U.S. This resource

provides opportunities for both undergraduate and graduate research, as well as collaborations with botanists at other universities. We are examining ways to fund the upgrading of the storage cabinets this year so that they are fire, water, and insect proof in order to protect this unique and extensive collection.

The need for a new Natural Science Building is recognized at both the University and the State level. A bond issue to pay for a new science building will appear on the March 15 primary ballot in 2016, and the Biology Department is in the early stages of discussing what we'd like to see in a new building. Though less acute a need than a new building, the Department would also welcome funds and space for field facilities for teaching and research. Though we are surrounded by National Forests and National Parks, the Department does not have easily accessible outdoor classroom areas. The area on the millennial campus that has been used as a site for such use would be greatly improved with the addition of electricity, water, and fencing for security. In addition, even an area within 5 minutes of the main campus is difficult to use without vans to transport students. In recent history, the Biology Department had two departmental vans, but we are now down to one, and this remaining van is unreliable, is 20 years old, and is arguably unsafe. Our ability to provide students with field experiences would be greatly improved if we were once again able to purchase vans.

We have been given support over the past few years from the administration in a few key areas including: the awarding of two new tenure-track positions in cell and molecular biology; the investment of ~\$300,000 in teaching and research equipment including the new greenhouse facility, three ultra cold freezers, a fluorescence microscope, a soil respiration system, a server for bioinformatics, a nanodrop DNA quantitation system; and an increase in our graduate student stipends from \$10,500 to \$12,500 (as well as three awards for \$15,000 that we hope can be provided again as a means of recruiting high-performing students). We also have received additional support in fixed term and adjunct faculty which allows us to offer over 70 lecture and lab sections per year. All of these resources have proved critical as we experience unprecedented growth while our operating budget and E&T budgets have been essentially flat in the same timespan (see Standard 7 for more information about the budgets). For our growth and strength as a department to continue, we'll require concomitant increases in our day-to-day funding sources. Other targeted resources we identify as mandatory include new vans, new tenure-track faculty positions, and increases in graduate stipends and tuition remissions.

The instructional technology available to the Department is generally adequate. All instructional spaces in the NSB and Stillwell Building (except for two teaching labs in NSB) have

been supplied with computers and digital projectors. Network connectivity has been greatly improved by the expansion of the campus Wi-Fi network. Each faculty member is supplied with a computer upon hire, and university-provided computer refreshes are usually available after 5 years. Our library resources are currently adequate to support the mission and goals of the Biology Department (see Appendix). Despite frequent fears that budget cuts will cause the loss of important research databases and journal packages from major publishers, we have not yet lost the resources we need to be an effective biology department. However, if threatened budget cuts ever come to pass, it could be extremely damaging to the university if faculty are suddenly unable to use research databases or to access important journals from major publishers.

The imbalance in our faculty resources puts a strain on our students and on our faculty in the field of CM biology in a variety of ways. Primarily, our lack of CM faculty limits our ability to offer multiple sections of some key upper-level electives, such as BIOL 311 (*Animal Physiology*) and BIOL 333 (*Cell and Molecular Biology*), thus causing a bottleneck for students needing these classes for their concentration. In addition, we currently offer fewer upper-level electives in the field of CM. Finally, as mentioned above, all of our undergraduates are required to participate in senior research, but there is a shortage of CM faculty to provide research experiences for these students. Clearly, increasing the number of faculty on the CM side would be a great benefit to our program in terms of serving the needs of our undergraduates.

The majority of our graduate students are in the field of ecology and evolution, and they are well served by our faculty. Our emphasis in Ecology and Evolution makes sense given our location in the southern Appalachian Mountains, and proximity to Great Smoky Mountains National Park and several National Forests which serve as locations for field studies. In addition, our faculty have many contacts with people in the Parks, Forest Service, and other agencies which can help our graduate students both in finding research opportunities and jobs post graduation. Increasing our number of faculty with expertise in cell and molecular biology would allow that side of our graduate program to grow as well, and help us to build a better balanced and diverse Biology Department.

When attempting to fill our program staffing needs, we are often hampered in our recruiting efforts by the poor infrastructure of our building and the low start-up package we are able to offer new hires (typically \$16,000; see Appendix). This amount has not increased in the last 15 years or longer, which means that the purchasing power of the start-up package has likely decreased by at least 15%, according to US Bureau of Labor Statistics calculations. The Department and Dean have provided additional, one-time funds to help support the last three tenure-track faculty members. The fact that start up must be spread out over multiple years means that large

purchases are often beyond the reach of a new faculty member. The lack of a sufficient startup package has a number of ill effects: 1) We have trouble attracting and recruiting faculty because our startup is insufficient to allow a new or early stage investigator to get a research lab up and running, particularly in the CM field, 2) The start-up is not sufficient to allow investigators to generate preliminary data that could be used to support external grant applications which could potentially generate external funds. More start-up money will increase the likelihood that investigators can support applications for external funding, thereby bringing money into the college that can be used to further research and provide students with vital opportunities in laboratory sciences, and 3) Because the start-up is insufficient, faculty are less able to accept students into their labs, meaning many of our students are not getting the research experiences that they would like and need. Without adequate start-up funds, faculty are forced to depend on equipment already present, and in some cases, our shared departmental equipment is already past its prime. Furthermore, requests to granting agencies to purchase some expensive, but needed, pieces of general equipment (e.g. vehicles, freezers, ovens, computers, compound microscopes) often go unfunded because they are considered to be part of the normally available infrastructure of a university.

Poor funding influences not only our ability to attract faculty, but perhaps even more strongly, poor funding influences our ability to recruit highly qualified undergraduate and graduate students. Our graduate stipends are not competitive with the stipends offered by other universities in neighboring states (see Appendix), and coupled with the fact that we have a limited number of tuition waivers to offer, this means that highly qualified students will often have offers that are much more financially appealing. While we have had many high quality graduate students over the years, the Department would benefit greatly from having the ability to attract students from a greater geographic area to build a more vibrant, diverse cohort of graduate students.

At the time of the last review, we were in dire need of an administrative assistant, which we now have. Misty Cope has been a major asset to our Department. The Department also has some support provided by the research operations manager from the Chemistry & Physics Department for lab materials, safety, and waste management issues. Our Department does its best to make effective and appropriate use of our staff. We regularly have work-study students in the Department who contribute in ways ranging from basic office work to helping with research projects.