Florida A&M University

Biology Department

Academic Program Review External Evaluation

College of Science and Technology

Conducted

by

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I. Introduction

This review of the management, programs and resources of the Biology Department, College of Science and Technology, Florida A&M University was performed on March 3-4, 2016. Information provided before the review included an academic program review self-study done by the department and a brochure outlining the general guidelines for the review from the Office of Institutional Effectiveness. Supplemental material provided during the visit included the external review from 2009 and CVs of all current faculty members including teaching and research activities.

Individuals interviewed during the visit included Dr. Marcella David, Provost and Vice President for Academic Affairs, Dr. Maurice Edington, Dean of the College of Science and Technology, Dr. Sonya Stephens, Associate Dean of the College, Dr. Lekan Latinwo, Chair of the Biology Department, Dr. Sundra Kincey, Office of Institutional Effectiveness, faculty, undergraduate and graduate students, the advising coordinator/pre-health advisor, the graduate program coordinator and representatives from other disciplines related to biology including allied health, nursing, pharmacy and food sciences.

During conversations with members of the central administration, information was provided on plans for new hires in biology, support for changes in pedagogy including active learning approaches, plans for developing a PhD program, changes in advising, new STEM Living Learning Communities, and Freshman orientation. Also goals to improve the 6-yr graduation rate and the number of first year students who return for the second year were discussed. General information about the University strategic plan were provided and concerns about faculty course overloads were discussed. Achieving balance between teaching, advising and research were also discussed and ways to support faculty initiatives and maintain morale were mentioned.

Opportunities were provided to visit research laboratories of faculty and some of the faculty offices and classrooms. A brief visit with the Dean of the School of Pharmacy was also provided.

II. Status of Discipline (National Perspective)

The field of biological sciences remains one of the most dynamic disciplines in the academy. The discipline is advancing in many exciting directions powered by new national initiatives such as the BRAIN and Cancer Moonshot Initiatives recently announced by President Obama. These large scale initiatives emphasize the need for new technologies to advance the study of biological molecules and cells as well as complex processes such as learning and memory, neurodegenerative diseases and cancer.
The excitement within the discipline and its high national profile have attracted large numbers of undergraduate students to the field. **Biology remains the largest major in the natural sciences at most institutions.** Students seek out the major for a variety of reasons but in large part because of the potential to engage in a profession that addresses real-world problems and contributes directly to improving the human condition.

In addition to new initiatives in the biomedical arena such as neurodegenerative diseases and cancer, there are many other areas in the life sciences of equal importance and as engaging for the discipline and for students. These include environmental challenges such as global warming and climate change, food shortages and genetically modified organisms, overuse of antibiotics and antibiotic-resistant organisms, hormone used in animals and endocrine disruptors, and diseases caused by viruses such as Zika and Ebola. Each of these areas are driving new discoveries in basic research across the different areas of biology including ecology and evolutionary biology, genetics, biochemistry, cell and molecular biology and organismal biology.

**Emerging Fields in Biology**

As these initiatives push the disciplinary boundaries, they most often require interdisciplinary approaches and have spawned new fields such as Bioinformatics, Biotechnology, Genomics (Big data/Big Science) and Synthetic Biology. These emerging fields require the integration of the biological sciences with quantitative, physical and computational sciences. Preparing students for these new areas of study require rethinking the biology curriculum to integrate in a serious way, math and computer science in the introductory biology courses. The introductory courses will also have to incorporate the content knowledge and approaches used in the interdisciplinary fields.

**Innovation Culture**

The field of biology has also benefitted greatly from the development of an innovation culture within universities and in biology departments in particular. Funding agencies including the NIH and NSF continue to emphasize translational research that moves basic knowledge from the laboratory to invention of new commercial products and services. This requires that research scientists begin to think like entrepreneurs and look for potential commercial applications of new knowledge produced in the research laboratory. **Students are also encouraged to acquire basic knowledge about entrepreneurship and the processes by which new knowledge is translated into products and services.** All of these new developments are placing increasing pressure on biology departments to change many of the fundamental approaches to teaching and research.

The changing dynamics in the field of biological sciences are accompanied by disruptive technologies in cyber space including cloud computing, artificial intelligence and mobile devices. These changes will affect how we integrate technology in the classroom as
well as the laboratory. They will also drive online learning and alter the way classrooms and laboratories are designed. Properly accessing the information on the web will require a new skill set and new infrastructure on our campuses. While these may seem like daunting challenges, they represent great opportunities for advancement of science as well as the way we deliver content to this generation of students. There has been no more exciting time for the biological sciences than we see today. Biology will continue to be an attractive discipline for funding agencies, including federal agencies and private foundations as well as corporations. It will also continue to attract large numbers of students who seek a degree in STEM. Universities must prepare for the high demand and pursue opportunities to engage in these latest developments.

Active Learning Pedagogy

In addition to the many changes in the technologies, practices and knowledge base of the discipline, many institutions have embraced the idea that pedagogy, especially for introductory biology courses must change. There is a compelling body of evidence, drawn from more than a couple decades of experimentation, that illustrates better ways to educate today’s diverse student body. **These new approaches to the way we teach significantly increase persistence and degree completion.** The new methods are particularly effective for students who are low income, minority, working, or adult. The evidence shows that high-impact practices, which include both experiential and applied learning, i.e. internships, service learning, and rigorous course-based practices such as extensive writing, undergraduate research, peer projects and capstone work, increase educational effectiveness.

CREs

The new pedagogy moves away from the lecture format to active learning in the classroom and from “cookbook” laboratory exercises to course-based authentic research experiences. It is incumbent upon institutions to provide the professional development for faculty to learn these new approaches to teaching and to provide the resources to incorporate these practices in the classroom and teaching laboratories. These practices are being embraced at the highest levels as evidenced by the recent report of the President’s Council of Advisors on Science and Technology (PCAST, 2012). This report suggested as national policy “advocate and provide support for replacing standard laboratory courses with discovery-based research courses”. **In response to this policy initiative, many institutions have introduced CUREs or CREs (course-based undergraduate research experiences) to replace the standard introductory laboratory course.** CREs represent one of the most cost efficient ways to provide a research experience for large numbers of students and achieve many of the same benefits acquired from a mentored summer research internship. Students who participate in CREs work on a problem that experts in the field consider to be important and timely, and their work contributes to advancing or refining knowledge, rather than simply repeating or “rediscovering” something that is already known. **What the research tells us is that when these high-impact practices are put into place and when they are coupled with strong mentoring, a supportive**
community, caring and culturally competent instructors, well-sequenced programs, smart advising and proactive, even intrusive guidance, student performance improves dramatically and students stay on course.

Today, as never before, higher education is seen as the next best hope for the future. STEM in general, but biology in particular is leading the way. This is a window of opportunity for all colleges and universities to reform the academy and make sure that the students we educate today are prepared to lead the nation into the future.

III. Program

a. Overall comments regarding the existing program

Overall, the Biology Department has excellent departmental leadership, high faculty quality and morale, and outstanding commitment to teaching and research. The Department has in place an effective student advising system and provides opportunities for students to participate in mentored research with individual faculty members, opportunities for career exploration especially in the health-care professions and community service projects.

Many faculty members have active research programs but the research laboratories, specifically those located in the old high school building, are substandard and in need of major repair. Individual faculty members have shown incredible ingenuity by finding ways to renovate spaces to serve as laboratories but the building lacks adequate ventilation, heating and air conditioning and other basic safety features of working research laboratories. **Deficiencies in the basic infrastructure of the research laboratory building are urgent matters that requires immediate attention for the safety of both faculty and students who work in these facilities.**

Despite the challenges posed by the poor quality laboratory space, faculty members continue to pursue research and seek external funding. Faculty members also mentor students and provide research internships during the academic year and the summer. The leadership of the department strongly supports faculty research and sets expectations that all faculty remain research-active, and productive, to achieve promotion and tenure.

The teaching loads for most faculty members are heavy because of the large number of students who take biology courses as a core requirement for degrees in other programs (allied health, nursing, chemistry, pharmacy and food science) as well as the large number of biology majors. The high demand for seats in courses have led to teaching overloads, which affects the ability of faculty to satisfy other expectations including student advising, service to the department and university, and research. **The planned addition of new faculty lines will help to alleviate this problem but the addition of 2 new faculty members may not be sufficient to ensure adequate staffing of core courses in the curriculum.** A closer look at the problem of instructional capacity in the Department is recommended. In addition, the hiring of “professors of practice” or
instructors who are expected to devote the majority of their effort to teaching, may be a way to address this problem. If such a strategy is adopted, these teaching faculty members should have a clearly defined process for promotion and tenure.

b. Appropriateness of program goals and objectives

The goals of the department are appropriate and should be pursued. If, on the other hand, one of the goals is to increase the participation of minority students and “at risk” students, the Department should dispel old notions of “at risk” and embrace the concept of inclusive excellence as described below.

c. Appropriateness of admissions and graduation requirements

For undergraduate students, the admission requirements are set by the University and the admission requirements are appropriate. However, after students matriculate, the Department should make a bigger effort to insure that all students with an interest in biology are well-served including students from non-traditional backgrounds such as first-generation students, low income and transfer students. It is important to ensure that the curriculum allows entry from multiple points and that models of inclusive excellence are embraced. The practice of identifying students as “at risk” indicate a tendency to label students as deficient and in need of remediation. Inclusive excellence recognizes that students start at many different entry points, and therefore it is important to bring students along by integrating math and chemistry into biology courses rather than shunting students into foundational math courses that take students off track and delay graduation.

For master’s level graduate students, the admission requirements are appropriate. Students in the graduate program should have a teaching requirement which better prepares them for career opportunities in many different professions. Teaching assistantships would also provide additional instructional capacity for the Department.

d. Appropriateness for the credit hours for degree

The requirement for 120 credit hours is standard for the discipline and is appropriate. The number of core courses is excessive and should be examined. The inflexibility of the core course requirement, delays graduation and prevents students from entering the major after the first year. These are unnecessary hurdles that delay student completion of degree. By elevating analytical skills to a position of equal importance to breadth of knowledge, it should be possible to reevaluate the core requirements and expand the list of courses that rightfully satisfy the requirements for the degree and learning outcomes.

The requirements for the graduate degree are appropriate and standard for the discipline.

e. Appropriateness of curriculum, student learning outcomes
The list of courses for the bachelor’s degree is appropriate and the curriculum is standard for the discipline. As stated above, the curriculum should be more flexible with fewer core course requirements and more opportunities for authentic research experiences. The requirement for breadth of knowledge takes precedence over critical thinking and analytical skills, and this should be reviewed and reconsidered. A focus on experiential and applied learning and problem-solving skills would provide a stronger foundation for careers in the private sector and for study in graduate or professional school.

The curriculum and learning outcomes for the graduate degree are appropriate. Most students complete a research project for the thesis and this is appropriate. Students must pass the comprehensive exam to meet requirements for the degree and this is appropriate.

f. Adequacy of program self-evaluation mechanism

The Biology Department uses both the FAMOUS and STARS assessment approaches to determine the extent to which undergraduate and graduate students meet or exceed the expected learning outcomes. Assessment data were provided for 2009-2014 academic years. The outcomes at the undergraduate and graduate levels are appropriate. The assessment data show that students are meeting or exceeding expectations in all outcomes areas including content knowledge which had been below expected outcomes in 2009. The self-study document identified two potential changes that led to the improvement in learning outcomes in the content knowledge area. The Department implemented a progressive examination process throughout the semester for the two introductory courses. Each exam included material from the previous exam. The other important change that took place was an increase in the number of faculty that participated in the Faculty Learning Community (FLC) sponsored by the Innovative Active Instruction Project (IAIP). The FLC and IAIP began in 2010 and this corresponds to the beginning of the improvements in learning outcomes. It is recommended that faculty continue to participate in FLC and IAIP professional development activities and maintain or exceed the current performance measures.

The five areas identified as program goals;
1. Content knowledge
2. Communication skills
3. Critical thinking
4. Collaboration skills
5. Laboratory skills
are appropriate but the priority order should be adjusted and the goals better defined. Students need analytical skills that include problem solving and metacognition (the ability to think like a scientist). Therefore, # 3. critical thinking should be coupled with analytical skills and moved to the top of the priority list. In addition, this goal should be expanded to include not only evaluation and synthesis of information, but hypothesis development, experimentation, data analysis and publication. These are skills that are
best acquired by engaging in research either through a course-based research experience (CRE) or a mentored research internship. (See earlier comments about the power of CREs as a pedagogical method for teaching analytical skills).

The assessment data for the graduate program show that of the 45 students who entered the program, 35 passed the comprehensive exam on the first attempt. Five students left the program and 5 are scheduled to take the exam in the near future. Thus far no students who took the exam failed it. The program evaluation mechanism is appropriate and adequate.

g. Suggestions for improvements of existing programs

The faculty has introduced active learning approaches in their courses and this is to be commended. It is strongly recommended that more courses incorporate active learning paradigms. In addition, it is important to evaluate the effectiveness of the methods used therefore professors should monitor not only the learning outcomes but the improvements that can be attributed to the active learning strategies. It is important to establish what pedagogical practices lead to improved student performance.

h. Involvement of business and industry in establishing goals, objectives, learning outcomes and curriculum

Information about the involvement of business and industry in establishing goals, objective, learning outcomes and curricula for degree programs in Biology was not provided during the review. It is strongly recommended that the Department establish closer working relationships with local businesses and with alumni who work in industry and establish an External Biology Advisory Board (BAB). Such a group can provide excellent input on goals and objectives as well as help students find internships and help faculty identify potential funding sources. Advisory boards composed of alumni and business leaders are also very helpful with philanthropy and public relations.

i. Articulation with community colleges (AA and AS) for bachelor’s programs

The Biology Department participates in the Statewide Articulation Agreement established with community colleges. Students who complete the associate degree and the common prerequisites are accepted into the Biology major if request upon entering the University.

IV. Students

a. Adequacy of enrollment, retention and graduation

The department currently has approximately 600 majors, 450 females and 150 males. The number of students with declared majors in biology in the first, second, third and
fourth years of matriculation are 167, 110, 144 and 192 respectively. The drop off in majors after the first year has been noted in previous Program Reviews. This may not be of major concern since the number in the junior year is higher and may suggest that students remain undecided until the end of the sophomore year, the period when students must declare a major.

Degree completion on the other hand is cause for concern. The degree completion rate in 4 years is 33% and increases only to 43% after 6 years. The very low graduation rates in 4 and 6 years must be addressed. Most institutions now recognize that the first step in improving retention and graduation rates is to appoint an administrator to serve as the campus retention and graduation champion. This person is charged with making progression to degree completion in 4 years a campus priority and must work closely with Student Affairs professionals and academic leaders to foster greater collaboration. Activities of this office would include implementing an early-warning system, helping students find their “academic home” and begin building relationships there, ensuring student support services are accessible and easy to navigate, and collecting data to document reasons why students fall off track. The Department should take a close look at the curriculum to identify the stumbling blocks and find ways to mitigate the problem. Proactive and intrusive advising is also highly recommended.

Based on the data in the self-study report, 24 graduate students enrolled during the period of this review successfully completed the program. This represents an increase of nineteen (19) over the previous review period. The average length of time spent in the program was 3 years.

b. Adequacy of advising and other academic support services

Faculty members are assigned advisees and in addition, the Department has a professional advisor who works with students. The responsibilities of the professional advisor include academic advising in the major as well as general graduation requirements. Students expressed a high degree of satisfaction with the advisement system. It was unclear how the departmental advising system interfaces with the college level advising and with Student Affairs. It is highly recommended that a stronger working relationship be established between the different advising units on campus so that students have less difficulty finding the information they need and obtaining advise in a timely manner.

c. Outcomes, placement and satisfaction of students and graduates

The assessment data presented showed that graduating seniors felt that the biology training program had resulted in significant increase in their knowledge of biology compared to their knowledge at the beginning of the program, a significant increase in communication skills, a significant increase in critical thinking ability and a significant increase in the ability to work collaboratively with other.
Placement data was not available in the self-study review. **Such data should be collected in the future.**

V. Faculty

a. Quality and productivity in teaching

The department has 8 tenured, 12 tenure-earning faculty members, 2 visiting professors and 3 instructors. The large number of assistant professors represent the addition of new faculty lines, which has significantly strengthened the department. The new hires bring strong resumes and enthusiasm to the department. They significantly increase the productivity of both teaching and research.

The major concern mentioned earlier in this report is the high teaching loads of the faculty. The typical teaching load is 5 classes per semester. **The high teaching loads must be addressed.** Class size is also an issue for the faculty. Adjunct faculty teach many of the introductory courses but cannot accommodate the minimum office hours needed each semester. Faculty offices are inadequate and classroom space is a problem.

b. Faculty productivity in basic and applied research

Most of the junior faculty are research active and have submitted proposals for external funding. Some have grant support for their research. This trend is to be encouraged and supported. **The time the faculty devotes to research should be included in the effort reporting of the Department and documented as part of the workload of each faculty member.**

c. Quality of departmental leadership

The chair of the Department provides excellent leadership and maintains a command of current trends in science education as well as funding opportunities in the biological sciences. He is respected by his colleagues and admired for his dedication to the well-being of the students and faculty. The co-chair is equally hard working and dedicated to the mission of the Department. Therefore, the morale of the Department is high and the faculty’s enthusiasm for the direction of the Department is strong.

d. Appropriate workloads

As mentioned earlier in this report, the faculty teaching loads are too high, especially the number of faculty with 1 or 2 course overloads. Therefore, the workloads are not appropriate. They are too heavy. **It is recommended that junior tenure-earning faculty, in particular, be given a maximum of 3 courses per semester to allow them time to pursue research and publish.**

e. Adequacy of faculty to deliver program (number and qualifications of
The expertise of the tenured and tenure-earning faculty is appropriate for the specific programs offered by the Department. The number of full-time faculty is too low for the instructional demands placed on the department. **It is strongly recommended that new faculty lines be added to the Department so that the maximum teaching load for each faculty member is limited to no more than 4 courses per semester.**

**f. Use and integration of adjunct faculty**

The use of adjunct faculty to increase instructional capacity and expertise is appropriate.

**g. On-going professional development**

Professional development of faculty has improved significantly with the increase in participation of faculty in the Faculty Learning Community (FLC) sponsored by the Innovative Active Instruction Project (IAIP). Improvements in student outcomes have been achieved as a result of these measures. **It is recommended that faculty continue to participate in FLIC and IAIP as well as other professional development activities.**

**VI. Resources**

**a. Effective use of resources**

The Department uses the resources that it has `effectively. However, the space needs and equipment currently available are inadequate. **It is strongly recommended that better quality laboratory facilities with appropriate equipment be made available to the Department for both teaching and research.**

**b. Adequacy of access to library resources**

The library resources for faculty and students in biology are appropriate.

**c. Adequacy of equipment for existing and proposed programs**

The current equipment is inadequate for existing programs and should be upgraded and expanded.

**d. Adequacy of space for existing and proposed programs**

As stated throughout this report, space for existing and proposed programs is inadequate. This is a major concern and requires immediate attention.
e. Exploration of alternative funding sources (contracts and grants, etc.)

A significant number of faculty have grants but the Department as a whole needs to be more proactive in the pursuit of funding opportunities for both teaching and research. Because of the heavy teaching loads, faculty members do not have sufficient time to collect preliminary data and write grant proposals. Many faculty members have obtained funding even with the unusually high course loads. It is strongly recommended that faculty be encouraged and supported in their efforts to secure external funding for teaching and research.

VII. Response to previous program review recommendations

The Department and University have begun to address the recommendations made in the previous program review but the responses have not been sufficient in most areas. There have been several new faculty members hired in the department since the last review but the size of the faculty remains too small to accommodate the growing population of students served by the Department. The space limitations identified in this review were mentioned in previous reviews. Student learning outcomes have improved but degree competition and time to degree have not improved significantly since the previous review.

VIII. Strengths

- Highly credentialed and dedicated faculty
- Commitment to excellence in teaching and research
- Use of high-impact active learning practices in the classroom
- Strong student interest and improving student learning outcomes

IX. Needs and Recommendations

a. Recommendations that require no new resources

1. It is recommended that the curriculum allow entry from multiple points and that models of inclusive excellence be embraced.

2. It is recommended that the core requirements be reevaluated and the list of courses that rightfully satisfy the requirements be expanded to reduce time to degree and improve graduation rate.

3. It is recommended that the Department place more emphasis on experiential and applied learning and problem-solving skills to provide a stronger foundation for careers in the private sector and for study in graduate or professional school.

4. It is strongly recommended that more courses incorporate active learning paradigms.
5. It is strongly recommended that the Department establish closer working relationships with local businesses and with alumni who work in industry and establish an External Biology Advisory Board (BAB).

6. It is highly recommended that a stronger working relationship be established between the different advising units on campus so that students have less difficulty finding the information they need and obtaining advise in a timely manner.

7. It is recommended that the time the faculty devotes to research be included in the effort reporting of the Department and documented as part of the workload of each faculty member.

8. It is recommended that faculty continue to participate in FLIC and IAIP as well as other professional development activities.

b. Recommendations that require modest resources

1. It is strongly recommended that the Department is allowed to hire more than 2 new faculty members to ensure adequate staffing of core courses in the curriculum.

2. It is strongly recommended that all students engage in research either through a course-based research experience (CRE) or a mentored research internship.

3. It is strongly recommended that the high teaching loads of the faculty be addressed. The typical teaching load is 5 classes per semester.

4. It is strongly recommended that faculty be encouraged and supported in their efforts to secure external funding for teaching and research.

5. It is recommended that junior tenure-earning faculty be given a maximum of 3 courses per semester to allow them time to pursue research and publish.

c. Recommendations for transformative change that require new resources

1. It is strongly recommended that new faculty lines be added to the Department so that the maximum teaching load for each faculty member is limited to no more than 4 courses per semester.

2. It is strongly recommended that a new laboratory building with appropriate equipment be made available to the Department for both teaching and research.
3. It is strongly recommended that the deficiencies in the basic infrastructure of the research laboratory building be given immediate attention for the safety of both faculty and students who work in these facilities.

4. It is strongly recommended that the very low graduation rates in 4 and 6 years be addressed by appointing an administrator to serve as the campus retention and graduation champion.