

Florida Atlantic University
Biological Sciences Department
Program Review
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Review Team:

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OVERVIEW

The team of Dr. Lynne Fieber, Dr. Donald Edwards, and Dr. Michael Horswell reviewed FAU's Department of Biological Sciences on March 15-17, 2015. Ms. Lynn Sargent, Executive Assistant to the Dean of the College of Science provided the reviewers with a self-study and a detailed itinerary. Ms. Marjorie Cazeau provided logistical support. Additionally the review team met (in approximate order) with:

- Rod Murphey, Chair of Biological Sciences
- Russ Ivey, Interim Dean, College of Science and Associate Provost
- Several small groups of the Department faculty over meals
- Charles Roberts, Associate Dean for Graduate Studies
- Ingrid Johanson, Senior Associate Dean for Student Affairs
- Evonne Rezler, Assistant Dean for Assessment
- Ed Pratt, Dean of Undergraduate Studies
- A group of senior (tenured) faculty
- A group of non-tenure track faculty and junior faculty
- Michele Hawkins, Associate Provost for Planning and Budget
- Deborah Floyd, Dean of the Graduate College
- Daniel Flynn, Vice President for Research
- Graduate students in Biological Sciences
- Undergraduate majors in Biological Sciences.

For the names of all the individuals met, see "People Met list" in appendix.

More formally, the review team was asked to identify the steps needed for significant improvement in the department's effectiveness and recognition in research and instruction. We were also asked to respond to the points raised towards the end of the self-study, in the sections on Strengths and Opportunities, Weaknesses and Threats, and Resources, and Future Directions. We have attempted to address these in the context of the discussions we had on these issues with the students, faculty, and administrators whom we met.

Department and University Strengths

Collegiality. Progress in developing the strengths of the department and university depend on the character, vision and energy of the people involved. We were very happy to find that all of the people we met in our interviews, including students, faculty, and administrators, appeared to us to be friendly, thoughtful people who are keen to improve Biological Sciences at FAU. They all had very favorable views of the Department, its programs and accomplishments, but were aware of the challenges it faces. Both the strengths and the challenges they identified were those also identified in the self-study.

Emerging strengths in neuroscience and environmental studies. The satellite campuses at Jupiter, Davie, and Harbor Branch have provided the university opportunities to grow world-class research and teaching centers in neuroscience and environmental science.

Scripps Research Institute and Max Planck Florida Institute at the Jupiter campus amplify the neuroscience research and teaching opportunities and the visibility of neuroscience at FAU. The group of accomplished FAU neuroscience faculty and students at Jupiter interact daily with Scripps and Max Planck neuroscientists. This interaction is invaluable to both research and instruction, and dramatically enhances the international visibility of the neuroscience program.

Environmental sciences has a strong core of faculty and students working at the Davie campus. They are engaged both in advancing the discipline and addressing the environmental challenges facing Florida.

The research productivity of the Biological Sciences faculty as a whole has increased markedly over the last decade, doubling the numbers of scientific presentations, publications, and grant applications submitted. This is quite remarkable, especially in the face of a simultaneous doubling of the number of FTE students to teach and a national tightening of research support.

Undergraduate and graduate research. Undergraduates are actively engaged in research in faculty laboratories across the disciplines and campuses. Both Masters and Ph.D. students are engaged in rigorous programs and active in research on the Boca, Davie and Jupiter campuses. MS and PhD support models co-exist in the Department, and faculty's desire to train preferentially one or the other is respected.

Transparency in governance. We were told that departmental decisions were reached after open discussion among all stake-holders. This transparency extended to the faculty discussions of tenure applications, where only the votes were confidential. This transparency enables junior faculty to see how the P&T guidelines are interpreted by senior faculty, and thereby to understand what is actually required by them for tenure. One recently promoted faculty member said that this process was "invaluable" in helping to plan well before the tenure year.

It seems to us that this could only occur among faculty who had high confidence in each other and in their leaders and were well-accustomed to interacting in a friendly and professional manner.

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Energy, enthusiasm and ambition. All of the faculty and students we met were enthusiastic and ambitious for the university and its research and teaching programs. They (and we) were also impressed by how much the research programs, particularly the neuroscience program, had developed in the last few years. They stated that this growth was the result of energetic, far-sighted leadership in the Department, College, University, and the state.

Faculty expressed enthusiasm about building the research programs on the Jupiter and Davie campuses while retaining close ties between all three campuses.

Challenges and Opportunities

Departmental cohesion across separate campuses. An essential characteristic of a dynamic, growing university is a high frequency of interaction of students and faculty both within and between units. Both planned and chance encounters lead to new insights, new projects, and new discoveries. However the discipline-specific separation of research and teaching on different FAU campuses creates significant challenges for continued growth and departmental cohesion. These challenges are exacerbated by the lack of frequent, efficient, and predictable transportation between the campuses. It increases the time and the energy needed to participate in any activity not located at one's home campus, causing everyone to think twice when contemplating activities at another campus. This barrier reduces the opportunities for learning, teaching, and collaborative research available to students and faculty on their own campus and on the other campuses. It slows all of these activities while it erodes the sense of community within the department that is necessary for them to occur.

If timely and efficient transportation between the campuses is not available as the faculty and student populations at Jupiter and Davie grow, community feeling will erode across the Department and bring pressures to split the department along geographic and disciplinary lines. Faculty who originated on the Boca campus and moved to Davie or Jupiter will retire and be replaced by new faculty without that experience and sense of involvement with the Boca campus. As the numbers of new faculty grow on those campuses, so will a sense of self-sufficiency, especially as they share a sub-discipline of biology with their local colleagues (e.g. neuroscience on the Jupiter/Scripps campus, environmental science at Davie). This will reduce each group's interest and willingness to participate in research, instruction, and service with their Biology colleagues on the other campuses and it will promote the fission of the department.

The University should develop an effective shuttle bus system that runs between the campuses as soon as possible. Ideally, it would run on a fixed schedule several times a day, in both directions, from Dania Beach in the south to Harbor Branch in the north, and vice-versa. Equipped with a down-loadable app that tracks the bus locations, students and faculty could minimize their wait times at bus stops.

This transportation system would enable faculty and students to move quickly and reliably between campuses for round trips that might last only one-half day. This would facilitate class scheduling, teaching schedules, research collaborations, and spontaneous interactions between campuses. It would also enable all faculty to share more easily in the teaching burden located primarily on the Boca campus. Sharing the burden, and being seen to share the burden, will maintain the department collegiality we observed.

We heard some discussion about the possible use of the Tri-rail if there were an adequate shuttle between the Boca Raton and Jupiter campuses. The undergraduate

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students we interviewed indicated that this was impractical as the train trips took up to two hours for what should be a 1-hour trip.

Increasing intercampus interactions. Even with rapid, reliable transportation, a sense of departmental community across campuses will be a challenge to maintain and grow as the numbers of Biology faculty, students and staff on each campus grow. At present, this community sense is promoted both by the low numbers of faculty and students on each satellite campus and the dynamic leadership of the department. While it is strong, however, this sense of community should be reinforced by cultivating institutional habits and expectations that support it. These could include a monthly “Biology Day” on the Boca campus that would include a face-to-face all-department meeting, followed by a scientific talk by a distinguished guest and a departmental party/scientific exchange, with poster presentations by graduate and undergraduate students and a spread of refreshments. Inter-campus teaching might be incentivized and structured to encourage interactions and make it seem cost-effective to students and faculty to spend a day away from home-base.

The challenge of 2600 Biology majors for 31 faculty. It is remarkable that the 28 tenure-track Biology faculty and 3 instructors are able to teach 2600 undergraduate majors effectively while maintaining a vigorous graduate program and their individual research programs. Their success results not just from hard work, but also from efficient organization and leadership. We were told that this organization enables the tenure-track faculty to have a one-one teaching load: one large and one smaller class per year. That schedule enables the faculty to focus time and energy on their research while fulfilling the teaching needs of the department. We were also told that non-tenure track faculty have personal laboratories in which they perform their own research, often with the help of undergraduates. This arrangement ensures that, like the tenure-track faculty, the non-tenure track faculty see themselves as scientists as well as teachers, a view that is shared by their colleagues and their students. The morale-boosting effect of this arrangement enables them to be effective in instructing their many large classes and to share their research with students.

Despite these efforts, the large student/faculty ratio means that many students in the large classes have little opportunity for direct interaction with their instructor, whose assessments of their accomplishments are often confined to exams graded by machine. The large classes may or may not be assisted by a teaching assistant (TA), but TAs do teach the laboratory courses that are associated with the large classes. The laboratory courses seem to be extremely well organized and efficient at teaching the very large number of students who take them. The TAs are graduate students who are closer in age and culture to the students, which may facilitate finding solutions to problems that arise for the students. Nonetheless, every effort should be made to reduce the student/faculty ratios, which appear to be higher than the FAU norm. This will require hiring additional faculty, but changes in the way courses are organized may also help. One such change may be to break one session per week of a large lecture class into smaller “recitation” sections of at most 30 students, each taught by a faculty member or a senior graduate student. A 3-credit course in this model would divide into two lecture hours per week and one recitation hour, in which the recitation section would emphasize student-teacher interaction and problem solving.

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Retention rates. A primary challenge facing the Department is the failure to retain Biology majors until graduation. According to Fig. 4 in the self-study, the number of Biology majors in 2013 was lowest among the second year students, and greatest among the fourth-year class. If these numbers reflect the trend of each student class over time, the data show that the number of Biology majors who start at FAU as freshmen falls by 50% over three years, while transfer students account for the later rise. We were told that many of the students who drop the major also leave the university; the university is then penalized by the state for the lower retention rate.

Two reasons for the loss of students who begin their career at FAU were suggested to us: failure to progress in the major and personal plans to spend only a year or two at FAU before transferring elsewhere. The undergraduates we interviewed told us that many students begin their career at FAU already planning to transfer to the University of Florida or Florida State University. There are many possible reasons for these plans, including the family tradition, and differences in campus life, reputation, and education and research opportunities.

We were told that many students may fail to progress in the major because they are either not prepared for or simply not enthusiastic about the series of chemistry, physics and mathematics courses required early in the career of a biology major. A large fraction of Biology majors declare their pre-med status, and the Biology curriculum is arranged to accommodate them. Premedical students are asked to take a set of demanding courses in chemistry, physics, and mathematics at the outset of their education. However, we were told that only 15% of students are able to graduate in four years and less than 50% graduate in six years, and a very small percentage are eventually able to matriculate in medical school. This suggests that many students are misplaced as pre-medical students and as Biology majors. We learned from both students and faculty that several factors contribute to this. The first is that the students are poorly prepared at entry, both in their knowledge, learning skills, and work habits. It is practical to urge such applicants to seek remedial education elsewhere, perhaps at the local community colleges.

A second factor is that the incoming freshmen are ignorant of all the possible careers in healthcare and in life sciences generally, including business and finance, law, and public policy. We suggest that freshmen be required to learn about these in a first semester, 1 credit course that introduces them to careers in the life sciences, broadly construed. Such a course, which could feature a variety of outside speakers from across the life sciences, may help students and their parents consider the possibility of “my son the hospital CFO” instead of only “my son the doctor”. If the students are to pursue these alternate life science career paths, their undergraduate training must support them. Majors or major/minor combinations that support biology/business, biology/pre-law, or biology/public policy should be developed to give students alternatives to the traditional hard-science path. Faculty from the Medical and Business Colleges may contribute to these courses, a step that should appeal to students while also helping Biological Sciences. This will enable students to make positive choices among attractive alternatives before they ship-wreck on the shoals of organic chemistry. Those of us in public higher education would do well to remember that memories of their own shipwrecks may linger in the minds of the state legislators who sit on the committees that decide university budgets.

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Enticing Biology majors and avoiding shipwrecks. Many beginning students are likely to be tentative in the commitment to a Biology major, or they are much more enthusiastic about aspects of biology that don't require an initial immersion in the hard sciences. They should be able to take a course as first-term freshmen that excites them about biology and the major. It should also motivate them for the hard science courses by showing how chemistry, physics and math help explain developments in the life sciences.

It is also likely that the chemistry, physics and math courses focus on subjects that are appropriate for their own majors but are not needed by biology majors. These courses are often set up for chemistry, physics and math majors and are staffed by young people who, having faced the rigors of undergraduate and graduate training in their discipline, want to make sure that biology majors appreciate the finer points of the subject. However, by working with the chemistry, physics, and math faculty to design courses that are appropriate for the biology students, the biology faculty would help their students learn these subjects in a biological context and enhance retention. For instance, calculus might be taught in a "Calculus for Life Sciences" course where the examples and motivations are relevant to the students' interests. Moreover, the ready availability of software for numerical integration and differentiation reduces the need to memorize analytical procedures, and also provides opportunities for students to understand and appreciate how models of biological populations or chemical reactions work.

We heard from faculty and students that the centralized advising and registration processes often do not serve either the students or the Biology department well. Problems in advisement may arise because the advisors and Biology department are not in touch or because the advisors have independent views of the appropriate sequence of courses students should take. We were told that pre-med students were advised to take the series of hard-science courses regardless of their level of preparedness for them. We also learned that students were advised away from certain courses because they were "too hard", and not alerted to new courses that the Biology department had developed.

Questions about course scheduling and registration drew many complaints from students. We were told that students must go online immediately at the opening of registration to have a chance to get into desired or required courses. Classes are said to fill up quickly, even when they are required for the major, so that students who miss the opening of registration may have to defer taking them. One student we interviewed reported that she had to postpone graduation and register for an additional semester to take a required course that had not been available for her earlier. Another student reported that it was only through his personal contacts and research that he was able to plan a sequence of courses that would satisfy both graduation requirements and his interests and still allow him to graduate in 4 years. We strongly recommend that advisement, especially for sophomores and upperclassmen, be brought back into the department. It is important that students learn about the offerings and opportunities in Biology from the department faculty, and that the department faculty learn quickly what the students find frustrating in pursuing the major. We also recommend that the department interview a group of their most successful students shortly before their graduation to learn from them what is and is not working for Biology majors. Like the students we interviewed, such a group will contain articulate, keen observers who will be eager to report what did and did not work for them and their peers.

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Support and interventions. Failing students can often be helped by interventions that help them face reality and seek specific help. While the university may have a general program, Biology can help its own students by creation of student-run structures that provide peer support for specific courses and more general problems. One of these might be an undergraduate Biology Club that might serve several functions: (i) to bring life science professionals to campus to discuss careers; (ii) to help manage a peer-to-peer tutoring service for individual courses; (iii) to organize outreach activities, like school visits and demonstrations for events like Brain Awareness Week or Earth Day.

Data-driven answers. It is difficult to know the truth on the ground, and therefore what to recommend, from our brief interviews with administrators, faculty, and students. However, data should be available to help determine why Biology loses majors. Answers may be available from advisement interviews, from course evaluations and from student grades. These data may be supplemented by surveys that ask specific questions.

Graduate programs and Graduate Student support. Many faculty members mentioned that it was very hard to recruit graduate students from a national market given the non-competitive stipends and the lack of health insurance support. This has serious implications for the research program that GTAs often support by working in faculty labs and doing their own doctoral research projects. We recommend the University invest in more competitive GTA stipends and health insurance.

Faculty mentoring program. Though their faculty colleagues are generous with their time, some junior faculty mentioned a lack of a formal mentoring program meant that they often do not have clear and timely guidance for issues regarding research support, promotion and tenure issues, and other topics a former mentor might provide. We recommend that the College or Department establish a mentoring program, especially if the University invests in the many new lines in the strategic plan areas that Biological Sciences will have. As the department and college grows, informal mentoring may not be enough to ensure junior faculty success and retention.

Enhancement of research. Research activity in Biological Sciences is growing at an impressive rate and the policies that have led to that growth, including the development of the Jupiter and Davie campuses, should continue. The primary way in which that growth could be spurred would be to offer nationally competitive graduate fellowships (above). Although these might be limited in number at first, the first-rate students they would help attract would have an immediate impact on research productivity. A second step would be to enhance links on all campuses to other scientific and engineering disciplines. Electrical and mechanical engineers, computer scientists, physicists, and mathematicians may find much of interest on the Jupiter and Davie campuses, while biologists on those campuses may find the others' knowledge of measuring technology, data analysis, and modelling to be invaluable. Interdisciplinary "translational" and "transformative" projects that arise from these links are likely to be welcomed at funding agencies.

RECOMMENDATIONS

1. Continue to build research and instruction on the Boca, Jupiter and Davie campuses along the lines already established.
2. As soon as possible, develop a reliable, efficient transportation system between the different campuses for students and faculty.
3. Support the sense of community in the Biology department by developing institutional habits and traditions that support it, such as a monthly departmental day on the Boca campus that all are expected to attend.
4. Do not offer admission to under-prepared students. Consider limiting future University growth in the largest undergraduate major to enable the faculty to plan for orderly instruction in this discipline.
5. Develop a first semester, 1 credit course that introduces first year students to exciting developments in the life sciences, explains the need for tools and concepts from the hard sciences and mathematics, and identifies careers pathways in the life sciences other than pre-medicine.
6. Create course sequences and major/minor combinations that lead to degrees in Biology/public policy, Biology/law, Biology/business and finance and non-profits.
7. Hire additional faculty or non-tenure-track instructors to reduce the student/faculty ratio. Create a formal faculty mentoring program.
8. Consider course structures that increase the interaction of students and instructors; the 'recitation section' is one possible model.
9. Bring advisement for sophomores and upper class students back to the department.
10. Engage the better students in peer-support activities by developing an undergraduate interest/service club.
11. Consult the better graduating seniors about what did and did not work for them, and how it can be improved.
12. Supplement the anecdotal accounts of students with data from the university to identify the roadblocks to timely graduation and how they might be cleared.
13. Strengthen research productivity by encouraging more interdisciplinary ties with other departments and colleges and by improving the graduate student support package offered to PhD and MA/MS students.

CONCLUSION

The Department of Biology accomplishes remarkable feats of instruction, research, and external funding across campus distances with limited resources and little control over the growth of the undergraduate major. Our recommendations for the future are to promote a sense of inclusion for Biology faculty, staff and students on all campuses by regularly exercising their common bonds. We further urge The University to enable Biology to create ownership practices for early undergraduate enrollment, advising, and course content that may improve freshman retention and graduation rates.

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APPENDIX

List of faculty and students with whom review team met. (attached excel spreadsheet)