Program Review

Graduate Program in Biology Sonoma State University

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Executive Summary

The graduate curriculum in Biology at Sonoma State University is an excellent example of a curriculum steeped in inquiry-based learning. The goals of the program are three-fold: 1) to develop in students a skill set that includes critical reasoning, creativity, self-expression, and the ability to collect, synthesize, and analyze information from a variety of sources, 2) to prepare students for a career or career shift either by pursuing a PhD. or by obtaining a job that uses their biological knowledge and skills, and 3) to generate new knowledge about the biological world. The faculty in Biology at Sonoma State University is extremely well prepared to offer a graduate program in Biology. Furthermore, the graduate program is invaluable to the training of BS level undergraduates because of the role graduate students play as teaching assistants, role models, and in allowing faculty to stay current in their field via engagement in scholarship.

The single greatest strength of the Department of Biology at Sonoma State University is its excellent, engaged, and committed faculty. This is what makes the graduate program in Biology possible and insures the excellence of the undergraduate program as well. Any weakness of the Graduate Program in Biology stems predominantly from the lack of support provided by the University rather than issues that can be corrected by the faculty in Biology. The University should: 1) provide more workload credit to faculty for their role in mentoring of undergraduates and graduate students, 2) provide adequate release time for the Graduate Coordinator, 3) provide more funding for graduate students teaching assistantships and fees waivers, 4) streamline the grant submission and the procurement process, 5) increase the number of and provide adequate start-up funds for faculty in cell and molecular biology, 6) insure that greenhouse and animal care facilities are improved and expanded, 7) develop mechanisms for research or adjunct faculty to participate in the Biology Department, 8) encourage, not inhibit cross-college collaboration in teaching and research, and 9) reward an excellent department with greater autonomy and its accompanying responsibilities.
Graduate Curriculum

1. Philosophy

The graduate curriculum in Biology at Sonoma State University is based on the philosophy that graduate education is about learning to learn on your own, learning how to gather and evaluate information, learning how to design experiments and analyze data, learning how to write cogently about one’s ideas, and learning how to articulate those ideas to other individuals or larger audiences.

This philosophy comes through clearly in the learning objectives, skills, and values as articulated in the Department’s self-study document. This philosophy is also clearly the driving component of the individual courses offered as part of the graduate program in Biology. Graduate programs in biology fall into one of two models. The first model is a heavily coursework dominated program where research and learning by doing are less emphasized. The second model is a much more inquiry-based learning approach, dominated by research and learning by doing, with less emphasis on a curriculum in which graduate students are exposed to the scientific literature in a pre-digested form via instructional lectures and cook-book lab exercises. The graduate program in Biology at Sonoma State University represents an excellent example of the second model. Graduate students take a mixture of upper-division undergraduate courses and graduate courses to solidify their knowledge in content areas of biology, seminar style graduate courses which engage them in learning how to critically read the primary scientific literature in various sub-disciplines of biology, and research courses to provide them research skills.

The philosophy of the graduate program in Biology at Sonoma State University is eminently suited to developing students and professionals who become active learners, hence increasing their chances of success in further graduate studies and in professional fields. It is also fully in stride with the Sonoma State University Mission Statement.

2. Goals

The goals of the graduate program in Biology at Sonoma State University are three-fold: 1) to develop in students a skill set that includes critical reasoning, creativity, self-expression, and the ability to collect, synthesize, and analyze information from a variety of sources, 2) to prepare students for a career or career shift either by pursuing a PhD. or by obtaining a job that uses their biological knowledge and skills, and 3) to generate new knowledge about the biological world.

The goal of developing student skills is clearly articulated and implemented in the graduate curriculum. The goal of preparing students for careers in biology is implicit in the curriculum, and more explicitly achieved by the counseling and schooling that each graduate student receives from their faculty research advisor and other members of their research lab. Knowledge of what a PhD. degree involves, how to select a program, and what the career implications of such a degree may be is acquired informally throughout a student’s stay in the graduate program at Sonoma State University. Employment options
and employment opportunities for MS students in biology are also communicated informally in each lab since they may differ substantially depending on a student’s research specialty (e.g., molecular biology versus ecology). The goal of generating new knowledge is the explicit goal of faculty research programs. Each graduate student is integrated into one of these research programs as an educational vehicle for the student, but also to enable faculty to continue to be engaged in scholarship. Faculty cannot actively pursue research without student participation, and graduate and undergraduate students learn best when engaged in an inquiry-based curriculum founded on research to acquire new knowledge.

3. Faculty preparation

The faculty in Biology at Sonoma State University is extremely well prepared to offer a graduate program in Biology. The entire faculty is actively engaged in scholarly research and publication which are necessary to remain current in the rapidly changing field of biology. The fact that the faculty remains productive in research in face of an onerous instructional workload is a testimony to their dedication and excitement about inquiry-based education.

4. Relationship of the graduate program to the undergraduate program

Graduate students in Biology at Sonoma State University take some upper division undergraduate courses to obtain foundational material to solidify and expand their knowledge of various areas of the broad discipline of biology. No matter how elaborate the curriculum, no undergraduate biology student enters graduate school without need of further classroom instruction. Hence, the curricular structure in Biology at Sonoma State University provides efficient instruction to two audiences, upper division undergraduates and beginning graduate students. Graduate courses are also available to advanced undergraduates, particularly those who are participating in the BS degree program and therefore must complete a research experience as part of their degree requirements. These courses are important in developing the ability of undergraduate BS degree students to read, comprehend, and critique the primary scientific literature.

Graduate students serve as teaching assistants (TAs) extending the ability of the faculty to reach students and personalizing the educational experience for undergraduates. While faculty members in Biology at Sonoma State are very approachable, students everywhere feel more comfortable chatting with peers, and graduate students fit the peer model better than do faculty. Hence, undergraduate students learn much from graduate students through their formal role as TAs, but also informally after class. For advanced undergraduate biology majors who participate in the BS degree, graduate students are fellow lab members and assist enormously in the research training of these BS degree candidates. Graduate students also serve as role models for undergraduates who are contemplating careers that require an advanced degree. Having access to graduate students provides an invaluable conduit of information to the undergraduates which helps to de-mystify what getting an advanced degree is all about, what to expect in a graduate program, how it serves as career preparation, how staying in the Biology Department at
Sonoma State for a MS degree might be the best way to obtain the desired career preparation, or test the waters before entering a PhD. Program.

Probably the most undervalued role of graduate instruction at comprehensive undergraduate institutions is its essential role in populating faculty laboratories thus allowing faculty to engage in research and hence keep abreast of their rapidly changing discipline. Faculty members remain current in their field of biology through their research. I cannot emphasize how important keeping current is for the quality of instruction provided at the undergraduate level.

5. Diversity

The Biology graduate program makes an active effort to recruit graduate students from underrepresented groups. The Biology Department participates in the California State University Louis Stokes Alliance for Minority Participation, the McNair Scholars National Graduate Student Achievement Program and the Mathematics, Engineering, Science Achievement program. All of these programs rely heavily on the Biology Department's facilities to increase research training and graduate school preparation for underrepresented groups.

6. Strengths and weaknesses of the Graduate curriculum

The strength of the graduate curriculum in biology lies in the excellence of the biology faculty and in their adoption of a curricular model based firmly on inquiry-based learning. The only weakness I perceive is not so much in the curriculum per se, but in the small size of the faculty which limits instructional options and research supervision of MS and BS students in cellular and molecular biology.

Assessment of Effectiveness

The assessment of program effectiveness is accomplished at a number of stages during a graduate student’s career in Biology at Sonoma State University and after completing their graduate program. External reviews such as the current one are also important in assessing program effectiveness.

1. Student assessment

Entering students must be judged to be prepared for graduate level study in Biology based on their undergraduate degree, GPA, GRE, and letters of recommendation. Within their first semester students complete a plan for their program of study which must be approved by their thesis advisory committee and the Graduate Committee. By the end of the second semester, each student must complete their oral qualifying exam demonstrating their broad knowledge of biological concepts and a depth of knowledge relating to their thesis research project. Successful completion of this examination is required before the student can advance to degree candidacy. A progress report or completed thesis is required at the end of the second year in the degree program.
Upon completion of the requisite coursework and thesis research, each student must defend their thesis in a public forum. The student’s thesis advisory committee then determines the acceptability of the thesis toward meeting the degree requirement.

Each of these steps in the student’s program allows the faculty to assess progress toward the degree and guide students to successful completion.

2. Program effectiveness

Upon completing the degree program students fill out an exit evaluation consisting of 75 questions. So far only one cohort of graduate students has completed this evaluation, and regular use of the exit evaluation will not be implemented until 2010.

Other sources of information used to determine overall program effectiveness include: 1) informal feedback from students, 2) tracking data on student success in employment and in further graduate training, and 3) publications arising from the thesis research. The second of these sources testifies to the goal of effectively preparing students for further employment and education, while the latter testifies to the goal of generating new knowledge.

3. How assessment has lead to program change

The last external review of the Department of Biology was in 1994. Recommendations from that review were taken to heart resulting in the development of new courses and an expansion of the role of graduate teaching assistants in the Biology curriculum.

Resource Use

1. Faculty workload

Faculty in Biology at Sonoma State University and everywhere else in the CSU system are overworked. The historical legacy of the WTU concept and its implementation have distorted the curriculum at campuses throughout the CSU system and resulted in faculty that have already or are on the verge of shutting down any effort at scholarship or academic excellence. The current budget crisis has the potential to lead to a further ‘community-collegization’ of many CSU campuses. A 12 WTU classroom/research mentoring teaching load is anathema to effective education and scholarship. Faculty who are active in scholarship and training graduate students should have no more than a 9 WTU classroom/research mentoring teaching load. The Department of Biology should be given the opportunity to rethink their curriculum and how it is delivered so that they can meet their FTES target, but reduce the classroom instructional work load of the faculty. This may involve teaching larger classes to non-majors and to entering majors, also reducing the unit requirement for the BA and BS degrees, and teaching fewer upper division undergraduate Biology classes. In any event, faculty engagement should not be
measured in WTUs, but in their dedication to teaching, research and service to the institution.

2. Release time for the Graduate Coordinator

Administration of the graduate program including coordinating the application review process, maintaining communication with graduate students and their committees, insuring the smooth functioning of the oral examination and thesis defense for enrolled students, and administering and evaluating the assessment and follow-up information from graduate students takes considerable effort on the part of the graduate coordinator. At least 3 WTU per semester of release time should be provided to support the efforts of the graduate coordinator.

3. Laboratory space

The Biology instructional and research laboratories have undergone a recent remodel and appear to be effectively designed for instruction and research. Much of the research space is shared between faculty which results in much efficiency in equipment use, but has the potential to become overcrowded very quickly.

4. Greenhouse and Animal Facilities

It is my understanding that a proposal to improve greenhouse and animal care facilities is currently under review. Facilities such as these are every bit as essential for research and education as are microscopes and DNA sequencing machines. Regardless of the outcome of this proposal, these facilities will need improvement.

5. Student Space

In my interview with the graduate students they asked for a graduate student work area for evening use. I suggested that an instructional lab, perhaps a different lab on different nights (not in use for instruction), be made available for the graduate students as a common work/study area. Much information can be transmitted between graduate students when gathering informally. New students learn from more senior students and ideas about research projects and current literature are exchanged freely. Given the small size of each faculty member’s research lab, having more cross fertilization between labs would enhance the graduate student experience and improve collegiality.

6. Field Stations

Sonoma State University is blessed with two excellent field research facilities, the Fairfield Osborn Preserve and the Galbreath Wildlands Preserve. The University should make every effort to make these facilities accessible to faculty and students in Biology, other departments at Sonoma State University, and groups from other institutions with compatible research or instructional uses.
7. Shared and Common use lab facilities

The Department has shared and common use research facilities that have been established with research grants, but that serve both research and instruction at both the undergraduate and graduate level (e.g., DNA sequencing facility). To teach modern Biology requires state of the art technology and the cost of supporting such facilities should be largely borne by the University. Better support for instructional and research equipment is essential.

Challenges for the Future

1. Balancing workload

The challenge to balance workload between classroom instruction and research mentoring that the faculty currently face will continue in the future. The University should give the faculty more credit for the time they spend mentoring BS degree students and graduate students. A 3 WTU maximum is not enough given the mentoring load that most faculty members shoulder. The University should also be planning to develop more lecture rooms to house large classes. The quality of classroom instruction is not inversely proportional to class size. However, it is directly proportional to how current each faculty member is with the biological literature and research methodology. More time to engage in scholarship leads to better instruction at all levels since faculty have a better mastery of the essential course content.

2. Funding graduate students

Funding graduate students is a challenge everywhere in the CSU system and talk of making programs like an MS in Biology self-supporting is nonsensical. The salary and employment expectation of MS students in biology is much lower than that for students in professional degree program such as law, medicine, and business. Attempting to raise tuition to make such a program self-supporting will kill the program.

The University needs to make every effort to make teaching assistantships and fee waivers available for graduate students. The Biology faculty also needs to try harder to obtain external funding for graduate students support through such program as the NSF – STEM program.

3. Continuing post-baccalaureate involvement

One of the tasks the CSU system does well is to provide opportunities for post-baccalaureate students to get the training necessary to shift careers. I personally have had students with undergraduate degrees in literature take courses at Sonoma State University to begin the process of retraining for a career in Biology. It would be very unfortunate if the current budget crisis limits the ability of the CSU to provide this service. These post-
baccalaureate students often make good graduate students after they have obtained some foundational training in Biology.

4. Streamlining grant submission

Faculty in Biology complained that the process to submit a grant for external support was quite difficult at Sonoma State University. Every effort should be made to streamline this process so rather than an obstacle securing external support, the University facilities such initiatives.

5. Streamlining procurement process

The procurement process should be streamlined by encouraging faculty with sponsored projects to obtain procurement credit cards. Furthermore, more support for procurement, human resources, etc. should be provided to faculty with grants by the Office of Research and Sponsored Programs, rather than burdening the already limited and overworked departmental staff. The University indirect cost rate includes funds for such services and they should be provided by ORSP rather than borne by departmental budgets unless the departments receive a substantial portion of the indirect costs.

6. Rewarding with autonomy and responsibility

The CSU system seems always to be in the position of having few resources to give to departments and their faculty. However, when resources are scare there are still ways to reward effective programs and individuals. One way is to reward those programs and individuals with more autonomy and the accompanying responsibility. For whatever reason, the CSU administration is paternal to the point of patronizing its faculty. This is in spite of the fact that in many departments faculty are quite accomplished and capable of organizing and managing their own academic and research programs with minimal supervision from the higher level administration. Rewarding programs with more autonomy, as long as they accept the accompanying responsibilities, is one means to energize a faculty worn down by years of budget cuts and being treated like children.

7. Graduate student collegiality and program cohesion

The Graduate program in Biology at Sonoma State University currently has 27 enrolled graduate students supervised by 11 full-time faculty members. Hence, individual labs average only about 3 graduate students, but are augmented by BS degree students involved in research. Since much of what students learn in graduate school comes from interacting with fellow graduate students it is imperative that the Department find ways to increase and improve the collegiality among labs. As a CSU faculty member with a young family, I know it is challenging to do those extra things to stimulate interactions among labs. However, partnering with a graduate student organization might be a way to effect such change without putting it all on the backs of faculty. In other words, get the second year graduate students to play a greater role in integrating first year students into the program. Again the need for a common evening study space would be a good step in the right direction. However, graduate students must be empowered to take some
responsibility for improving the cohesion and collegiality of the graduate program. Again, since there are few resources for graduate students giving them some autonomy and responsibility, and showing appreciation for their help in shouldering this load might do the trick.

**Overall Program Evaluation**

1. **Strengths**

The single greatest strength of the Department of Biology at Sonoma State University is its excellent, engaged, and committed faculty. This is what makes the graduate program in Biology possible and insures the excellence of the undergraduate program as well. The CSU system runs the risk of the faculty “teaching to the rule” if it continues to find no way to reward the excellent programs and faculty that it has.

The graduate curriculum in Biology is well-focused, inquiry-based, and encourages active learning by the graduate students.

The Biology Department has access to excellent field research facilities, and these facilities need the continuing support of the University.

2. **Weaknesses**

The greatest weakness in of the graduate program in Biology arises not by design but because of a confluence of retirements and budgetary constraints. With only 2 faculty members in Cell and Molecular Biology it is difficult to have a critical mass of scholars to stimulate each other’s research, supervise graduate students, and service the undergraduate curricular needs. The University should place a high priority on hiring additional faculty in this area of Biology and when recruiting provide inducements such as adequate start-up funding to set up a cell/molecular biology research lab.

Other weakness of the Graduate Program in Biology stem predominantly from the lack of support provided by the University rather than issues that can be corrected by the faculty in Biology.

First, research activity and student mentorship is not adequately rewarded by the University. Insufficient time is budgeted into faculty workload for student mentoring and research. Faculty active in mentoring graduate students, BS undergraduates, and in scholarship should be involved in no more than 6 WTUs of classroom instruction. It is possible that the overly elaborate undergraduate curriculum potentially contributes to the burdensome teaching load that faculty face. A BA or BS degree in Biology at SSU requires 81-84 semester units, compared to 72 units at CSU-Chico, 67 units at SFSU, 55 units at UC-Berkeley, and 42 units at the University of Virginia. Having spent 17 years on the faculty at Virginia, I can testify that our students got into good medical schools and graduate schools even though we required half the units that are required at SSU. Again this distortion in required units is almost entirely an artifact of the historically
burdensome instructional teaching loads at CSU campuses. If you have to teach many
WTUs, then you need to insure that your classes are populated with students.

The level of financial support for graduate students as teaching assistants or graduate
assistants, and the number of fee waivers needs to be increased. To the extent possible,
conversion of the funds used for lecturers to support the graduate program may be
desirable. Second year students or ABD students might be supported as lecturers for a
fixed period to permit them to finish the analysis and writing stages of their thesis work
before having to seek employment. The faculty also needs to be encouraged and given
the time to write student training grants to obtain additional graduate student support.

The current greenhouse and animal care facilities are inadequate and need to be expanded
and upgraded.

There is inadequate administrative support for grant funded research and administrative
obstacles to efficient grant submission. The Office of Sponsored Program and Research
at SSU needs to develop an attitude in which they see their role as service to faculty
rather than seeing faculty as more work.

Also during my interviews with faculty I surmised that cross-college collaboration in
teaching or research was not encouraged. This is clearly a short sighted policy resulting
from a balkanized system with too many Deans. CSU campuses have so little to offer
their faculty one would think that least they would not establish roadblocks to
instructional and intellectual creativity.

Finally, the University seems to provide little support, encouragement, or even allowance
for adjunct or research faculty, or cross-college collaboration. I was told that SSU does
not have a mechanism to permit research faculty, soft-money funded researchers, to
affiliate with the institution. This is a short sighted policy. Research faculty members
bring in indirect costs, fund graduate students, expand and improve the intellectual
environment within their host department, and through their research achievements
increase the visibility of the institution in the broader community.