

Astrobiology Graduate Certificate Program Review Committee Report
Site Visit: Nov 2-3, 2005
Final Report: December 13, 2005

I. Members and Activities

The membership of the review committee:

Professor Suzanne Hawley, Astronomy Department, University of Washington (chair)
Professor Caroline Harwood, Microbiology Department, University of Washington
Professor Chris Impey, Astronomy Department, University of Arizona
Professor Robert Blankenship, Chemistry and Biochemistry Department, Arizona State University

The internal members (Hawley, Harwood) met initially with representatives from the Graduate School, the College of Arts and Sciences and the Provost's office to discuss the scope of the review, the process to be followed, and the actions required. A Charge Letter, dated October 13, 2005, was then sent to the committee members from Dean Ortega and Associate Dean Austin of the Graduate School. In addition, the self-study document prepared by the Astrobiology Program members was made available to the committee in early October. Hawley and Harwood met individually with a large fraction of the graduate students and faculty in the Program during late October, before the site visit. The outside members of the committee traveled to Seattle to attend the site visit during November 2-3, 2005. The site visit consisted of additional private interviews with key faculty and administrators, as well as group discussions with staff members, graduate students and affiliated faculty. The committee met privately over dinner the night of November 2 and during the morning of November 3 to discuss and formulate recommendations, which were then communicated to the Astrobiology Program Director and members of the University administration in the exit interview on November 3. This document summarizes the committee's findings and recommendations, and represents the formal outcome of the review process. The following sections address the specific areas given in the Charge, and incorporate additional material deemed important by the committee.

II. General

Astrobiology is an emerging discipline that seeks to understand the origin and evolution of life on Earth and the likelihood of life at other locations in the Universe. The subject has been propelled to high visibility by several exciting developments—the discovery that life on Earth occupies an amazing range of environments, the possibility that several moons and planets in the Solar System could harbor life, the growing census of over 160 extrasolar planets, and a better understanding of the way that life began on the primeval Earth. Even in advance of the anticipated discovery of life beyond Earth, astrobiology researchers are gaining insights into the nature and limits of evolution and the

interactions between life and the planetary environment. The academic vigor of the subject is enhanced because it is highly interdisciplinary. Astrobiology resonates with students, scholars, and the public because it seeks to answer profound questions about our place in the universe. The discovery of life elsewhere would without question be considered the most important scientific discovery in human history. It would have profound implications for the study of biology and more broadly would affect the spiritual and emotional lives of all people on Earth.

The University of Washington Astrobiology Program is the leading program in this discipline both nationally and internationally. It provides the broadest educational training, has the largest student enrollment and has faculty participation from the widest variety of departments and colleges compared to programs at any other institution worldwide. Of particular note is the major participation of oceanography faculty and students in the program, bringing the unique UW expertise in extreme ocean environments to the forefront of astrobiological research. With a National Science Foundation IGERT grant (recently renewed for a second five years) supporting graduate training and a NASA Astrobiology grant supporting student and faculty research, the program is obviously successful in a very competitive funding environment. Perhaps the best benchmark is the excellence of the students, who have received many awards at conferences, have published numerous significant papers in prestigious journals, and have established a truly interdisciplinary culture resulting in several collaborative student efforts across departments and colleges. The students now identify themselves as astrobiologists, and these UW astrobiologists are already the leaders in the first generation of scientists to be trained in this new discipline.

The success of the students is directly attributable to the well-organized and effective program of graduate education that is required for the Graduate Certificate. Indeed this education has extended to many of the faculty who are affiliated with the Program, such that several key faculty now identify themselves as astrobiologists, despite decades of training, research and teaching in a formal department such as Astronomy or Oceanography. The Program has definitely established itself as a distinct, interdisciplinary entity. The proposed expansion of the program into engineering initiatives, including life support and control systems and robotic technology, represents a new interdisciplinary vision, and again the UW is playing a strong leadership role in promoting this activity.

In summary, the UW Astrobiology Program is currently at the very top of its field, and is a recognized leader in astrobiology graduate education and astrobiology research at the national and international levels. The challenge for this University is to maintain and promote the excellence that has been achieved.

III. Faculty

Faculty participation in the Astrobiology Program is impressive with more than 20 professors from 12 departments in four colleges currently participating. The rules for participation are not well-defined, with new faculty being added mostly by virtue of working with colleagues who are already in the Program. As a primarily volunteer effort, the attitude has been that anyone who wants to pitch in is welcome. Governance is carried out through a steering committee, which apparently operates on a very collegial basis, and without extensive need for rules and policies. Thus far, this open-ended approach has worked well, largely due to the personal effort of Woody Sullivan who is the Program Director and Chair of the steering committee. However, the need for guidance and authority (and therefore oversight) from the upper administration in order to resolve funding and personnel inequities, as described in detail in section V. below, may also create a need for a somewhat more structured process for faculty participation and governance. This is an area that should come under consideration as the administrative home of the Program evolves.

A concern is that it is difficult for junior faculty to participate. This is largely because these individuals must concentrate on research that is acknowledged by their home departments in order to obtain tenure and advance. Also the volunteer nature of the Program and lack of support and acknowledgement at the department level in some (though not all) departments means that it is much more difficult for younger faculty to participate. Further, it is the more senior faculty who have the time and experience to take on additional volunteer activities on top of their normal duties. This is particularly obvious in the administrative side of the Program, where all of the faculty members who are involved are quite senior. It is also clearly a problem, since those faculty members will be retiring in the not-too-distant future, leaving a significant leadership gap.

A very impressive success of the Program is that it provides a home for faculty who were otherwise on the edges of their home departments. Those faculty members whose research and interests are interdisciplinary by nature have thrived and prospered in the Astrobiology environment, and several indicated they are more successful (grants, students, etc.) and much happier now. Another measure of success for the faculty came from a few senior, quite prestigious professors who have wholeheartedly embraced Astrobiology and have remade their research careers in this new field. They spoke in a heartfelt way about this opportunity to change their research emphasis at an advanced stage in their careers, and were outspoken in their support for the Program. Significant new research funding has been obtained by these faculty members, and they now identify themselves as astrobiologists and take on students primarily in astrobiology rather than in the fields of their home departments. Other faculty participants have been touched in lesser ways and are not as involved in the core mission of the Program, but nevertheless find it valuable to some aspects of their research, and worthwhile as a scholarly enterprise.

Volunteer faculty involvement in the Program, though widespread across campus, does leave a few gaping holes in the overall field of Astrobiology research. These are in the areas of chemistry and biochemistry, particularly focusing on organic chemistry and the origin of life. Thus far, the culture in the Chemistry department on campus has not been conducive to faculty participation. The committee notes this with regret, although without any concrete recommendation about how to fix the problem.

The faculty members who are participating in the Astrobiology Program fall into two categories: affiliated faculty who supervise students, attend seminars and participate in research, while perhaps giving an occasional lecture in a class; and core faculty who, in addition to the above, carry out the primary teaching and administrative duties in the Program. The two University Initiative Fund (UIF) funded faculty positions in the College of Arts and Sciences form the heart of the core faculty. These positions were filled by one faculty in Earth and Space Sciences, and one in Atmospheric Sciences. Discussions with students and other faculty provide overwhelming evidence that these two core faculty members are the single most important factor that has led to the current success of the graduate educational program. They have provided the nucleus for curriculum development, workshop organization and student mentoring, and have carried out much of the core teaching effort.

One of the core faculty recently left the UW to take a position as head of a new Astrobiology program in Great Britain, leaving the other alone to carry on the bulk of the work. While he is performing yeoman's effort to keep the Program going, it is clear that he is heavily over-loaded. In the view of the committee, at least two core faculty members, with at least half time devoted to astrobiology (rather than the current one-third time), are needed to fulfill the requirements of the Program mission. After extensive discussions with other faculty, and key department chairs, it is clear to the committee that the working environment for astrobiology faculty has varied widely depending on the particular department into which they were hired. Care must be taken, therefore, when making new hiring decisions, to insure that the home department will provide a supportive environment for astrobiology faculty.

Oceanography has a major role in the Astrobiology Program, and the hiring of a core Astrobiology member in that department would be a good option. We note that the study of extreme organisms has shifted the locus of the entire subject, and many of the best oceanography graduate students now choose to work in astrobiology. However, there are no commitments in place for Oceanography or COFS to contribute to the faculty lines for the Program. Guidance from the upper administration (see section V. below) is needed to address the issues of cross-college funding and hiring.

Finally, the role of postdoctoral associates in the Program appears to be very minor. The committee was unable to discern a reason for this, but it is certainly an area for improvement. Postdocs, having fewer University duties, could play an important role in the teaching and mentoring of graduate students, as well as bringing fresh ideas and resources from other institutions into the Program. While there is no explicit funding for Astrobiology postdocs per se, there certainly are postdocs working with faculty

associated with the Program, and supported by the NASA research grant. These postdocs should be encouraged to participate in the Program activities and integrated much more deeply into the research and teaching aspects than they apparently are at present.

IV. Graduate Certificate Program

Requirements for the Graduate Certificate in Astrobiology include two core classes (ASTBIO 501 and 502), annual, multi-day workshops, a one quarter research rotation in a lab separate from the home department, a weekly seminar series, and PhD research in an astrobiology related topic. Graduate student feedback indicates that this Program in total provides excellent preparation for carrying out substantive interdisciplinary research and for full participation in scholarly activity. In particular, many students expressed the opinion that the UW preparation far exceeded any other graduate program in Astrobiology, and that when they went to conferences they were easily able to participate and understand talks from the broad range of fields covered, while students from other programs were not. The “disciplines” class (ASTBIO 501) which offers an overview of many fields, was credited with providing the background and an introduction to the jargon needed to understand even basic research talks, while the “topics” class (ASTBIO 502) was widely acknowledged as providing in-depth exposure to current hot topics (e.g. Mars, being taught this quarter). Students were universal in their accolades for the courses taught by the UIF astrobiology faculty members, and felt these were the backbone of their educational experience in the Program. This underscores again the importance of the core astrobiology faculty in meeting the Program’s educational goals.

The students are an impressive group, with many coming from very prestigious undergraduate institutions. Most (though not all) said that they chose the UW for graduate school because they wanted to participate in the Astrobiology Program. Their record of achievement is superb, with numerous publications, including many interdisciplinary projects, and several have received awards at conferences for their work. Particularly notable is that several groups of students have worked together to publish results on their own research, without faculty involvement. It is truly an achievement that the students provide a significant, probably even the majority, amount of the creative vision and leadership in the scholarly research efforts of the Program. This success is reflected in the outstanding record of placing students into prestigious postdoctoral positions after graduation. Nearly all of the students who have continued in Astrobiology are now working at NASA Astrobiology Institutions across the country. Indeed the UW is becoming well known as producing excellent students who are being heavily recruited for those postdoctoral positions. The success of the Astrobiology Program in recruiting and training young scholars means that the largest impacts of the program are still to come.

The committee did not feel that the curriculum needed significant changes. Students were uniformly enthusiastic, even though the coursework is done as an additional requirement for them. We did hear of issues with the research rotation, and with the

uneven administration of the seminar series, but these are relatively minor problems that the faculty are aware of and are already trying to address.

The NSF IGERT funding has definitely been an important component of the Program, primarily because it allows students to explore interdisciplinary topics without the requirement to produce immediate results for a research advisor in the home department. An effort to maintain some graduate student funding in this capacity after the IGERT grant ends will be very important to encourage this explorative aspect of graduate astrobiology training. Nevertheless, most of the students that we spoke to indicated that they received IGERT funding for less than half of their graduate careers and as they were not dependent on it entirely, they could imagine having the Program continue even without it. Foreign students even now are not eligible for IGERT funding, but still form an important minority of the student cadre. The committee therefore felt that the Program will remain viable without IGERT funding, but that every effort should be made to provide at least some graduate student support to encourage the interdisciplinary investigations that are at the heart of this research field.

Diversity is an issue that the committee could not properly address, as the improvements described in the self-study (many women and minorities having been recently recruited) were not evident among the – mostly senior – students that we interviewed. The plan described in the self-study is a good one, if it works. Further monitoring is needed over the next few years to assess the implementation of the plan.

Finally, the committee was asked to comment on the possible evolution of the Graduate Certificate into a Joint PhD program. However, it was not made clear exactly how the requirements for the Joint PhD would differ, nor what specific benefits would accrue to the students from this change. During our interviews, students and faculty were generally supportive of the idea of a Joint PhD program, but there was not an overwhelming message of urgency and enthusiasm to push it forward. Also, it was not obvious how the Joint PhD would be administered across colleges, which again speaks to the need for higher level University involvement (see section V. below). More information and a clearer view of the ramifications of the Joint PhD program are needed in order to inform a thoughtful decision on this change.

V. Infrastructure and Resources

Being a separate, interdisciplinary entity in a university environment designed around departments and colleges presents some unique challenges for the Astrobiology Program. The University of Washington is well known as a leader in nurturing and promoting interdisciplinary research, and the use of University Initiative Funds (UIF) for faculty positions obviously played a key role in establishing the UW Astrobiology program as the top program in the country. The result of this foresight and startup funding is a well-established Program that is a national leader in an important new area of interdisciplinary research, exactly what those funds were meant to promote. The challenge that the

University now faces is to manage and maintain the Program to ensure its long term success.

The committee perceived that, in conjunction with UIF funded positions, a strong grass-roots effort at the faculty level is responsible for the growth of the Astrobiology Program to its current status. Faculty participants from some departments are meeting resistance at mid levels (Chairs, Deans) within the University infrastructure as they try to obtain ongoing support for their work in the Program. It is clear that top-down guidance from the upper administration is required to manage such an interdisciplinary program in an environment where funding and advocacy are carried out through a hierarchy of departments and colleges. Astrobiology has members from twelve departments in four different colleges: it is absolutely essential that oversight and management at a higher level (e.g. the Graduate School or Provost's office) be put into place. A key element of this management is the coordination of activities among the colleges, particularly in standardizing and achieving equity in the compensation of faculty members for teaching and other participation in the Astrobiology Program. At present, faculty members in some units are participating entirely on a volunteer basis, teaching Astrobiology classes as an overload on top of their normal duties. In other units, Astrobiology teaching is counted toward the normal teaching load. This inequity greatly affects the ability of the faculty, and particularly the younger faculty, to participate in the Program at a significant level. To be blunt, the University has benefited from significant volunteer effort on the part of dedicated and inspired faculty members who have been willing to sacrifice their time and effort for this Program. While this is perhaps reasonable in the short term, to grow a new program into a successful world-class endeavor, it is not a long-term recipe for continued success.

Some examples of inequities in funding, resources and participation are:

1. Oceanography – the largest fraction of students in the Program have come from Oceanography, and it is widely acknowledged that the prospect of participation in Astrobiology is now a major graduate student recruiting tool for the department. Several prestigious senior faculty members volunteer significant time and effort in the Astrobiology teaching curriculum. However, the Oceanography department and its College (COFS) do not provide compensation for Astrobiology teaching, nor have they provided any funds or commitment for Astrobiology faculty positions.
2. Earth and Space Sciences – ESS has benefited tremendously from the Astrobiology Program, with the next largest fraction of students involved, and a new senior faculty position. It is clear from talking with numerous ESS students that the reason they came to the UW was because of Astrobiology, and they uniformly rank the Program as the very best thing about their graduate experience. Yet the astrobiology faculty member is teaching overloads nearly every quarter, despite the original agreement of 1/3 time for Astrobiology and 2/3 for home department under which he was hired. To the committee, it appears that ESS has taken advantage of the benefits of the Program without significantly

contributing any department resources, e.g. monetary, teaching relief, space, administrative support, etc.

Some management entity with the authority to address these inequities is required. If the University truly wants to support interdisciplinary research, then it must develop a mechanism whereby faculty can participate as part of their normal duties, as opposed to superhuman volunteer efforts that are not sustainable. Relying on Chairs and/or Deans to “do the right thing” is obviously a hit or miss proposition, and is not working in some cases.

During our discussions, Susan Jeffords from the Provost’s office described a model agreement in the CSSS program that uses MOU’s among the various units to formalize the rules for participation and eliminate inequities such as those described above. This may be a possible model to pursue for the Astrobiology Program.

VI. Strategic Plan and Future Directions

As described in the self-study, the Program hopes to expand its educational mission in two ways. First, they would like to teach more sections of the undergraduate introductory course for non-science majors (ASTBIO 115). Second, they would like to add a new course at the 300 level for undergraduate science majors. Both of these initiatives are well founded and should be supported by the University. Scientific literacy in the United States at present is pathetically lacking. Recent surveys show that only 30% of Americans believe in the scientific basis for evolution and the Big Bang theory of cosmology, compared to 90% in many western European countries and Japan. Astrobiology is a perfect vehicle for teaching science that integrates astronomy, geology and biology in a holistic and easily understood (and intrinsically interesting!) way. The demand for ASTBIO 115 is very high, and classroom and TA resources currently limit the enrollment. For a very modest investment, the University could make a significant impact on a major societal problem. A side benefit of increasing enrollment in ASTBIO 115 is that it will provide additional opportunities for the graduate students in the Program to obtain teaching experience, which many of them mentioned as a potential new benefit in their graduate training.

The case for an ASTBIO 300 level class is also strong. Science majors are increasingly focused on narrow topics in their majors, and this class would address the issue of broad scientific literacy among future scientists. Very few interdisciplinary courses in the sciences for undergraduate majors are currently offered. The proposed 300 level course will be an important addition to undergraduate training in the sciences, as preparation for a world that is increasingly interdisciplinary in nature.

Though not mentioned by the Program in its self-study, the committee was also interested in the possibility of using Astrobiology as a vehicle for promoting science education in K-12 classrooms, perhaps following a model like the successful GK-12 Math program

already underway at the UW. This may be an avenue that the Program could explore in the future.

Another important future direction of the Program is in the area of development (code word for fund raising). The administrative faculty of the Astrobiology program recognize the importance of graduate student funding through the IGERT grant, and have formulated a plan to raise money from private donors to endow graduate student fellowships in the post-IGERT era. This is a worthwhile cause, but the committee recognizes the difficulty in any fund-raising endeavor. It will be essential that the University throw its support and resources behind this effort if it is to have a chance for success. Again this speaks to the importance of having a University level administrative body with the authority to speak for the Program and the ability to advocate for it.

The future scientific direction of the Program includes a new initiative in Engineering. The committee thinks that this is a timely and innovative direction and believes that this initiative should be supported. In particular, we are aware of the deep cultural divide at NASA between the scientists and engineers that has led, in part, to recent news items such as the problems with the space shuttle. A grass-roots effort at the graduate level to bring together these two cultures will be very important in future generations of space research.

VII. Recommendations

Based on the report given above, the recommendations of the committee are:

1. It is essential to replace the vacant UIF faculty position with a new astrobiology faculty member as soon as possible. This is required to carry out the goals of the Program, and to relieve the burden from the one remaining UIF faculty person. Further, since the record of mentoring and support for astrobiology is very uneven across the departments in the College of Arts and Sciences, and because the new hire will need to take an immediate leadership role in the Program, the committee recommends that the hire be at least at the Associate Professor level (i.e. with tenure). This would provide the additional benefit of hiring an immediate colleague and peer for the current astrobiology faculty member, and would obviate the added burden of mentoring the new hire.
2. The Graduate Certificate Program in Astrobiology should be continued. It is an excellent Program that has achieved national and international recognition, and demonstrated substantive success for its students. The committee recommends that the Program be reviewed again after another five-year term, primarily to assess the health of the Program after IGERT funding has ceased.
3. The University should identify an administrative body at a level above the Colleges that has the authority to negotiate between separate units to ensure equity in faculty compensation and commitments from the units that are commensurate with their participation in the Program. This body should also advocate for the Program in University-level discussions of funding and

- development, and should be involved in the discussion of the proposed change to a Joint PhD program.
4. The educational opportunities afforded by teaching Astrobiology at the undergraduate level (115 and 300 level) are very important for the major societal issue of scientific literacy. Resources should be found to support additional TA positions for ASTBIO 115 and to teach a 300 level ASTBIO class. Teaching these classes, which benefit general education or broad science interests, should not be an overload but should be subject to the workload agreements in item 3 above.
 5. The development plan to provide graduate student fellowships in future years is a worthwhile effort and should be incorporated into the overall University Development effort.