

**Report of the
Astrobiology Graduate Certificate Program Review Committee**

Committee Members: Thomas Ackerman, University of Washington, Chair
Christopher House, The Pennsylvania State University

Final report: May 3, 2011

Site visit: April 15, 2011

I. Summary and recommendations

The Program Review Committee met on April 15 with the various groups that constitute the University of Washington Astrobiology Program. The Astrobiology (AB) Program is justifiably a very highly ranked program and a recognized national and international leader in astrobiology graduate education and research. The goal of the AB Program management and the UW administration should be to maintain and strengthen the program and its existing reputation. The Committee has six specific recommendations that it believes will help do so. These recommendations are summarized here. Further discussion and supporting arguments are included in the following sections.

1. *Initiate the change from a certificate program to a dual-title Ph.D. program*

The Astrobiology program is currently a graduate certificate program. The AB self-assessment indicated the intent to introduce a dual-title Ph. D. in Astrobiology in coordination with several existing departmental Ph. D. programs. The AB portion of this program will have the same basic requirements as the current certificate program, with the additional requirement that the student's Ph.D. dissertation have an Astrobiology-related theme. The desire to create a dual-title degree in Astrobiology appears to be driven primarily by students in the program who want to more clearly recognize the importance of Astrobiology as a central focus of their Ph.D. study. Based on our interviews, the faculty involved with the degree appears to be fully supportive of this change because they recognize and appreciate the enthusiasm of their students. There was some discussion of continuing the certificate program while also moving to a dual-degree program. The Committee felt that this was probably not necessary given the small size of the program and strong similarity between the current certificate program and proposed dual-title AB program. The Committee concludes that the move to a dual-title program would benefit the AB program in terms of visibility and recruitment and, therefore, recommends that the change occur as soon as possible.

2. *Hire a fourth Astrobiology tenure-track professor and begin strategic planning for the replacement of essential faculty*

The current AB faculty members represent most of the topics central to this field. In particular, the program has noted strength in astronomy, planetary atmospheres, and early Earth geosciences. As these areas have been strengthened, there appears to be less emphasis on several biological topics important to Astrobiology. These presently include biochemistry, molecular evolution, and origin of life chemistry. In order to maintain and strengthen its current

position as a national leader, we recommend that the AB director and steering committee work with the Divisional Dean to obtain support for an AB faculty hire in one of these topical areas. This current need is likely to become a critical need. Internationally recognized expertise in the microbiology of extreme environments currently resides in a prominent oceanography faculty member. The loss of this expertise is likely in the near future. We strongly recommend that the AB director and steering committee engage in strategic planning around his departure to ensure that the program continues to have recognized strength in the microbiology area.

3. *Continue support for administrative and academic needs*

The AB program currently receives ½ time support from the Graduate School for an administrative person. The other ½ time support comes from the IGERT, which will be ending soon. The Committee strongly recommends that the AB program continue to receive ½ time support for an administrative person. We realize that money is very tight and there is pressure on all administrative budgets. We think, however, that it is unrealistic to operate a program as diverse as AB without some minimal level of administrative support.

The requirement for all AB graduate students to spend a one quarter rotation in a research laboratory or group other than their own is a unique aspect of the program and one that enjoys broad support across the program. However, the end of the IGERT presents a problem regarding funding of students during rotations. The Committee recommends that the AB program director and university administration work together to find a solution to this issue that will provide some modest university funding that can be used to support students on rotations when no other funding is available.

4. *Initiate a change in AB program leadership and organization*

The AB program has benefitted immensely over the past decade from the leadership of Dr. Woody Sullivan. That leadership has resulted in a program that is arguable the best of its kind in the United States. There are, however, three younger faculty members who have been specifically hired as part of the AB program, one in Astronomy and two in Earth and Space Sciences. The Committee recommends that the AB program leadership should be transitioned to these younger faculty members as expeditiously as possible. They have had sufficient time to acclimate to the University of Washington and should now be entrusted with the program leadership. We also recommend that the AB program management become more vertical with the appointment of an AB Program Director who is charged with managing the program with the assistance of a Steering Committee. As part of this transition, we recommend that a set of program by-laws be developed in conjunction with the Graduate School, the College of Arts and Sciences, and the College of the Environment in order to more clearly delineate AB program management, the structure of the Steering Committee, and its connection to University administration.

5. *Initiate an immediate change in the Program Coordinator position*

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6. *Integrate the postdoctoral research associates into the AB program*

The post-doctoral research associates connected with the AB program requested a meeting with the review committee. From the discussion at this meeting, they made it abundantly clear that many of them chose to come to the University of Washington because of the AB program (even though it is a graduate program) and that they want to play a larger role in the program. The post-docs are willing and eager to contribute in a variety of ways that includes mentoring graduate students, teaching AB courses, and supervising (and perhaps funding) laboratory rotations. The Committee strongly recommends that the AB program faculty actively work with the post-docs to integrate them into the program and find ways to use them to strengthen the AB academic program.

II. Committee membership and activities

The members of the Astrobiology Graduate Certificate Program review committee are

- Professor Thomas Ackerman, Atmospheric Sciences, University of Washington (Chair)
- Associate Professor Christopher House, Geosciences, Penn State University

The Committee members met initially on Friday, November 19, 2010 with representatives from the Graduate School, the Graduate Student Council, the College of Arts and Sciences and the Provost's office to discuss the mandate, the process, and the required actions. The Committee members received a charge letter, dated November 19, 2010, from Dean Baldasty and Dean Antony at this same meeting.

A self-study document prepared by the AB program was made available to the Committee on February 14 along with a extensive set of Appendices. On April 15, Professors Ackerman and House carried out a site visit. During the site visit, they met individually with Professor Woody Sullivan, AB Program Director, and Professors Victoria Meadows and Roger Buick, whose faculty appointments fall partially within the AB Program. They met with Professor Hawley, Chair, Astronomy and then with Werner Stuetzle, Divisional Dean for Natural Sciences, and Professor Virginia Armbrust, Chair, Oceanography. They also

met with a group of faculty members, approximately 8 in number, a group of 5 post-doctoral research associates, and a group of 12 graduate students.

The Committee met alone for about an hour to discuss findings and recommendations. They then met with representatives from the Graduate School, the Graduate School Council, the College of Arts and Sciences and the Provost's office, as well as the AB Program Director, to communicate a preliminary synopsis of their findings. This report summarizes the committee's findings and recommendations, and represents the formal outcome of the review process. The sections below address the findings in more detail.

III. Background

Astrobiology is an interdisciplinary field that seeks to understand the origin and evolution of life on Earth and the likelihood of life at other locations in the Universe. This field is exciting and timely because it includes work on the biochemical and geological origins of life, the evolution of microbial life on the ancient Earth, life in Earth's extreme environments, diverse worlds being explored in our solar system, and a rapidly growing list of extrasolar planetary systems. Because astrobiology seeks to answer profound questions about our place in the universe, the subject is quite interesting to the public and resonates with students and faculty.

The University of Washington Astrobiology Program is a leading program in this discipline both nationally and internationally. It was the first of its kind and is seen across the nation as very important program with a large positive impact on the field. The faculty are top notch and the students produced continue on in the field with good evidence of success. The program has an appropriate academic curriculum, provides great educational training, has a large student enrollment, and boasts excellent faculty covering the broad topics required. At the present time, the most active faculty members in the program are from Astronomy, Biology, Earth and Space Sciences, Microbiology, and Oceanography.

The program over the years has been supported by two National Science Foundation IGERT grants and two NASA Astrobiology Institute (NAI) grants. The second of the two IGERT grants is now ending, leaving the NAI grant for the Virtual Planet Laboratory as the remaining multi-investigator award supporting students in this program.

The students currently in the program and graduated from the program are excellent. They have received many awards at conferences, have published numerous significant papers in prestigious journals, and have established a truly interdisciplinary culture resulting in collaborative student research. The students identify themselves as astrobiologists, and these UW astrobiologists are becoming leaders in the field as they move ahead in their careers.

In the previous five-year review of this program, it was concluded that the astrobiology program had clearly established itself as a distinct, interdisciplinary entity, and that students and some faculty were primarily identifying themselves with this program. At this time, the program continues to maintain a distinct community. The community is strong and clearly has academic excellence. As a committee, we have found considerable evidence that this program has a positive impact on the university. Twelve

graduate students came to our lunch; roughly half reported that they would not be at this university if the degree program did not exist. Similarly, faculty reported that the best students they have had in their career came through this program. Both faculty and students report that the program has created a positive community that fosters interdisciplinary science and discussion. Students note that the external speakers brought in have been very important for their development as scientists.

In summary, the University of Washington Astrobiology Program is currently a top program, and is a recognized leader in astrobiology graduate education and astrobiology research at the national and international levels.

IV. Astrobiology Graduate Certificate Program

The curriculum includes graduate-level core courses and seminars, field workshops, and a research rotation, all required in addition to each student's departmental requirements. The core courses are ASTBIO 501: Astrobiology Disciplines and ASTBIO 502: Astrobiology Topics. Also required is a third interdisciplinary cognate course. The program has an outstanding required weekly seminar series and an annual 2-5-day field workshop. Finally, the program requires that every AB student spend at least one academic quarter working in a lab outside his/her area of expertise (usually on campus with an AB faculty member, but some are off campus); upon completion, an oral presentation is also given. Each student's Ph.D. thesis committee must include one or two AB faculty members from outside the home department, and at least one chapter in the thesis must be relevant to astrobiology.

During the review of the program, it was clear that the current graduate students value the core classes taught and feel that the core Astrobiology faculty are doing an excellent job of providing a sound education in Astrobiology. The committee did not feel that the program needed to alter the curriculum, as it seems appropriate and effective.

Right now, the Astrobiology graduate program is a certificate, based on the completion of a set of requirements. The self-assessment submitted by the program indicated that there is a desire to introduce a dual-title Ph.D. in Astrobiology. This program would have the same basic requirements but would also require that the student's Ph.D. dissertation have an Astrobiology-related theme. The desire to create this style of graduate degree in Astrobiology appears to be driven primarily by students in the program wanting to more fully-recognize the importance of Astrobiology as the central field of their Ph.D. study. Based on our interviews, the faculty members involved with the degree appear to be fully supportive of this change because they recognize and appreciate the enthusiasm of their students. There was some discussion of continuing the certificate program while also moving to a dual-degree program. The Committee felt that this was probably not necessary given the small size of the program and strong similarity between the current certificate program and proposed dual-title AB program. The Committee concludes that the change would benefit the AB program in terms of visibility and recruitment and recommends that the change occur as soon as possible

V. Faculty and Post-doctoral associates

One of the great strengths of this program is the outstanding faculty that is involved. Many of the key faculty members have internationally-recognized research programs and two are members of the National Academy of Sciences. During our review, it was clear that four highly visible and highly regarded faculty members would not be at the University of Washington if the AB program did not exist. These are the three core AB faculty members, who are all highly-regarded in the field and would most likely not have been hired without this program, and a distinguished faculty member in Oceanography with an exceptional international reputation who stated that he would have left the UW a long ago without this program, its great students, and the interactions generated by it. The program has clearly served to recruit and retain outstanding relevant faculty.

The breadth of faculty participation in the Astrobiology Program is remarkable. There are 22 participating faculty. These faculty members hail from 8 departments (Aeronautics & Astronautics, Astronomy, Atmospheric Sciences, Biology, Earth and Space Sciences, History, Microbiology, and Oceanography) and 4 Colleges or Schools (Arts & Sciences, Environment, Medicine, and Engineering). The 5 key departments in terms of active faculty and student participation are Astronomy, Biology, Earth and Space Sciences, Microbiology, and Oceanography. It was clear from the review that the level of participation from this list of faculty is highly variable, ranging from the core faculty who are heavily invested in the program to members who rarely participate. This variance is not surprising, but the program nevertheless might want to consider establishing some boundaries for levels of participation.

The current AB faculty members represent most of the topics central to this field. In particular, the program has noted strength in astronomy, planetary atmospheres, and early Earth geosciences. As these areas have been strengthened, there appears to be less emphasis on several biological topics important to Astrobiology. These presently include biochemistry, molecular evolution, and origin of life chemistry. In order to maintain and strengthen its current position as a national leader, we recommend that the AB director and steering committee work with the Divisional Dean to obtain support for an AB faculty hire in one of these topical areas. This current need is very likely to be raised to a critical need in the near future. Internationally recognized expertise in the microbiology of extreme environments currently resides in a prominent oceanography faculty member. The loss of this expertise is likely in the near future. We strongly recommend that the AB director and steering committee engage in strategic planning around his departure to ensure that the program continues to have recognized strength in the microbiology area.

There are currently seven postdoctoral research associates connected with the program. In many of these cases, the students brought their own funding with them and chose to be at the University of Washington because of its Astrobiology program. These postdocs requested a meeting with the review committee. During this meeting, it was made clear that they want to play a larger role in the program and that they are willing to contribute in a number of ways, including teaching AB courses, mentoring students and supervising students during laboratory rotations. The Committee strongly recommends that the AB program faculty actively work with the post-docs to integrate them into the program and find ways to use them to strengthen the AB academic program.

VI. Management

The successful management of academic programs is as much art as science. Professor Sullivan has clearly performed a remarkable service to the University in developing the AB program to its current national preeminence. His management style has been inclusive, flexible, and emphasized consensus building. It has permitted interested faculty members to participate in the program with a level of engagement suited to each member's time and interest. The list of affiliated faculty includes more than 30 members. While faculty members can identify those who are relatively more or relatively less involved, there does not seem to be any kind of demarcation line between the programmatically "ins" and "outs", which attests to good management. Three faculty members have been hired, one in Astronomy and two in Earth and Space Sciences, each with a joint appointment in the AB program. All three are highly regarded in their respective fields and provide strong support for the AB program. As another marker of success, the program has produced students who are both highly successful in their careers and intensely loyal to the program.

To some extent, the success of the AB has been built on its funding situation. The University provided funds through a UIF and through informal agreements with the Divisional Dean and departmental chairs. The IGERT has provided flexibility for the program, including the opportunity to offer one to two years of graduate student support for every US graduate student. In addition, the AB program has been supported through a competitive grant awarded by the NASA Astrobiology Initiative.

This situation is about to change, however, The IGERT will expire soon and its expiration will likely necessitate some changes to the program structure. University funding is in dire circumstances and will likely reduce available support from departments. In addition, a maturing program requires a somewhat different management style than a beginning program. The issues of management, leadership and funding are addressed below.

Leadership

Several factors argue for a change in leadership structure, among them the likely unavailability of Professor Sullivan to the program three to five years from now, the hiring of three AB faculty members, and the maturation of the AB program. Professor Buick joined the UW in 2001, Professor Meadows in 2007, and Professor Catling in 2001 and then again in 2008 after a three year appointment in the UK. The Committee thinks that all three faculty members have had sufficient time to acclimate to the UW and AB program and that one of them should be promoted to AB program director as soon as possible. There is considerable interest on their part in having this happen and whoever becomes the new director would benefit strongly from the continued presence of Professor Sullivan in the next few years. In some situations, such an arrangement might not work well, but we believe that Professor Sullivan's personality and management style would suit him well as a senior advisor for the program.

At this point, the AB program requires somewhat more structure than it currently has. The site visit identified issues of organization, communication and funding that need to be addressed. A new director charged with implementing a more vertical management structure could well improve all these issues.

The current AB program structure consists of a Steering Committee, chaired by Professor Sullivan, who is appointed by the Divisional Dean for Natural Sciences in the College of Arts and Sciences. (The

Committee notes some potential awkwardness in this arrangement since some pieces of the AB Certificate Program are managed by the Graduate School, e. g., the IGERT and the associated staff position, and some pieces by the College of the Environment, e. g., the ESS affiliated faculty FTEs .) In addition, there are on the order of 30 affiliated faculty members and research scientists. The statistics provided to the committee identified 17, drawn from 9 departments, as active members, and 7, from four departments, as carrying approximately 75% of the load. The 24 students come from 5 departments, 50% from ESS and about 20% each from Astronomy and Oceanography. The membership of the Steering committee consists of two members from Astronomy (including the chair), two from ESS, and one from Oceanography. The procedure by which one becomes a member of the Steering Committee is vague and appointment is indefinite. The current structure has served the program well, but certain frictions are beginning to appear.

The Committee recommends that the Divisional Dean appoint an AB Program Director from among the three AB faculty members. The Director should be charged with developing a simple set of by-laws for the Steering Committee that define its size, how appointments are made, and what the term limits of those appointments are. It would be well to consider allocating appointments among the three or four departments that are heavily engaged so that these departments feel that they are represented in the program management. This will alleviate some of departmental concerns discussed below.

Communication was depicted as both a positive and negative aspect of the program during discussions, particularly among the graduate students. This is actually not surprising. During their first few years in the program, the graduate students take classes and attend seminars together. They develop a strong sense of identification with the program and tend to view communication as being relatively good. During subsequent years, the students are working on their own research and tend to spend most of their time in their own departments. They lose touch with the AB program and view communication as a problem. The post-doctoral associates uniformly felt that they were not well connected to the program and communication of program activities was a real problem. There was some indication from the faculty that communication could be improved, but this did not seem to be a high priority. Since the faculty members that met with the Committee were self-selected, they are likely to be more engaged and perhaps do not see communication as a problem.

The Committee recommends that the Chair and Steering Committee make a serious effort to increase communication across the program, but particularly with the senior graduate students and post-docs. There are a variety of ways that this can be done including the use of social media, informal get-togethers in conjunction with seminars, and scheduled social events. Some of these already take place but timing and location seem to be issues. Because the AB program members are scattered across the lower campus, extra efforts must be made to promote interaction and cohesion.

Support staff

The AB program is currently supported by one staff person, a Program Coordinator, who is paid 50% by the IGERT and 50% by funding from the College of Arts and Sciences. The staff person is physically located in the Graduate School offices in Loew Hall, which places her across the campus from the AB program and effectively out of touch with faculty, students and post-doctoral associates.

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Permanent funding

The current funding for the AB program derives primarily from the IGERT program and the NASA Astrobiology Institute (NAI) grant for the Virtual Planetary Laboratory. 70% of the IGERT money supports graduate students, typically 9 per year, and that funding extends for 1-2 years, including the one quarter rotation. The NAI grant supports a variety of research activities and some graduate student stipends, but these are related to the NAI research. In addition, a small amount of money (about \$22K per year) comes from the College of Arts and Sciences to support program activity.

The program is also supported by UW matching funds that are tied to the IGERT and NAI grant. The matching funds supply needed flexibility, especially for foreign students who are not eligible for IGERT funding. These funds are at risk because they are tied to existing external funds.

Support also comes from faculty salary money. The money for the original two positions came as part of a University Initiative (UIF) that started the AB program. Partial funding for a third position was obtained from Arts and Sciences in order to hire Professor Meadows. Total academic funding is the equivalent of 1.33 FTE. The exact status of this support if one of these faculty members opts to leave the UW is uncertain.

Such diverse funding is typical of small programs within the university. Unfortunately in a time of scarce resources, this diverse funding base can make small programs more vulnerable than their larger neighbors because (1) they have little flexibility in funding or expenses and (2) the agreements that generated the funding are informal or dependent on external factors. The AB program suffers on both accounts. The IGERT will expire in a year and cannot be renewed. When that happens, the largest piece of AB funding will disappear along with the UW matching funds. The impact of this loss on the AB program will be substantial. The most immediate loss will be the support for beginning graduate students that has allowed the program to flourish and allowed students to spend a quarter on a laboratory rotation.

It is probably not too strong a statement to say that in order to remain a vibrant, successful program, the AB faculty must successfully renew the NAI grant when it expires and obtain another substantive research grant. Obtaining research grants is largely in the hands of the faculty investigators. However, the AB program management, the core departments, and the Deans' offices must do everything in their power to both encourage and support the grant applications. Failing to do so will put at risk all the efforts of the last 10 years.

There are several items of support that can be directly addressed. Firstly, the AB program currently receives $\frac{1}{2}$ time support from the Graduate School for a Program Coordinator. (The other $\frac{1}{2}$ time support comes from the IGERT.) The Committee strongly recommends that the AB program continue to receive $\frac{1}{2}$ time support for an administrative person. We realize that money is very tight and there is pressure on all administrative budgets. We think, however, that is unrealistic to operate a program as diverse as AB without some minimal level of administrative support.

Secondly, the requirement for all AB graduate students to spend a one quarter rotation in a research laboratory or group other than their own is a unique aspect of the program and one that enjoys broad support across the program. However, the end of the IGERT presents problems regarding funding of students during rotations, both because of the amount of IGERT money and the fact that grant money cannot typically be used for such purposes. The Committee recommends that the AB program director and university administration work together to find a solution to this issue that will provide some modest funding that can be used to support students on rotations when no other funding is available. This support does not have to be at the level of the IGERT funding but must be a guaranteed source that students can count on.

Thirdly, the core departments need to sit down together and work out some sustaining support for the AB program. This is a very difficult problem given the current bleak financial support for academic departments within the university. Some of the needs, such as office or laboratory space, are easier to meet than others that require actual dollars. The core departments, however, clearly benefit from the AB program in terms of attracting quality graduate students, retaining faculty, and earning overhead returns on grant money.

The AB program management must also take some responsibility for the program funding situation. Too much of the current funding relies on informal agreements and ad hoc requests. While this may have been a successful strategy in better financial times, this arrangement is precarious in tough times. The AB program management needs to be more proactive in negotiating longer term arrangements with more stability. Furthermore, this informal style along with the staff personnel problem has left the core departments feeling that they each are carrying an unfair share of the funding burden for the AB program. The AB program director needs to address this situation in a timely fashion by getting the core department heads together for an extended and frank discussion of program finances and ongoing needs. The ability of the departments to help may be limited but there must be an understanding of what each department is doing for the program and how they collectively enhance the program. While this activity does not rise to the level of the other recommendations, it is important for the ongoing health of the program.