Astrobiology Program Interim Report 2017-2018.
Director: Victoria Meadows (Astronomy & ESS)

In the recommendations following the 2010-2011 Review of the Graduate Certificate in Astrobiology, the Astrobiology Program was charged by the Graduate School Council to submit an interim report in 2017-2018 that specifically addressed the following two requests:

> 1) provide an update on program funding in light of the current dependence on grant matching funds of limited duration to provide staff support and student research rotations;
>
> 2) describe the success of the newly initiated dual-title PhD option, offered in coordination with affiliated units.

Below, we provide an overview of the program and then address our specific charge.

Overview

The University of Washington Astrobiology Program (UWAB) is a world leader in interdisciplinary graduate education, and has played a vital role in the development, growth and current broad interest in astrobiology at the national and international level. Since its inception in 1998, the Astrobiology Program has graduated 45 students trained in the interdisciplinary science of astrobiology, which provides the scientific foundation for the search for life beyond the Earth. These graduate students and our affiliated postdocs have gone on to becom leaders in education, research and policy in astrobiology and related scientific disciplines. The UW Astrobiology Program provides unique training in interdisciplinary science, and extremely successful career outcomes for its participating students. All of our 45 graduates since 1998 have remained in STEM careers. 18 of our graduates are now faculty members in university departments encompassing Biology, Microbiology, Earth Sciences and Astronomy, and all still incorporate astrobiology and interdisciplinarity into their teaching. Nine of our more recent graduates are postdoctoral scholars at universities or NASA centers. Eight alumni now work at government laboratories in leadership roles: of these Ken Williford (PhD 2007, Earth and Space Sciences & Astrobiology Certificate) is the Deputy Project Scientist for the Mars 2020 mission at the NASA Jet Propulsion Laboratory (JPL), David Smith (PhD 2012, Biology & Astrobiology) is an Assistant Branch Chief at NASA Ames Research Center, Steve Vance (PhD 2007, Earth and Space Sciences and Astrobiology Certificate) is a member of the NASA Astrobiology Institute Icy Worlds Team and leads efforts at JPL on missions to find life in the oceans of Europa. The remainder of our graduates work in industry or as entrepreneurs, including Dr. Sanjoy Som (PhD 2010 Earth & Space Sciences & Astrobiology Certificate), Director of the Blue Marble Space Institute of Science, and founder of SAGANet, a grassroots Astrobiology community network, which hosts blogs, podcasts and Classroom Astrobiology materials for teachers.

At its inception, this pioneering and innovative program offered a graduate certificate in Astrobiology, and 17 PhD students from 7 departments have graduated with this certificate. In Summer 2012 the UW Astrobiology Program became one of two Astrobiology graduate

programs in the nation offering a Dual-Title PhD in a student's home department discipline and Astrobiology. This degree was implemented at UW as coordinated program tracks in eight participating academic units (Aeronautics & Astronautics, Astronomy, Atmospheric Sciences, Biology, Earth and Space Sciences, Environmental and Forest Sciences, Microbiology, Oceanography), spanning four Colleges (Arts & Sciences, Environment, Engineering, Medicine). At the time of its implementation, almost all students eligible to transfer into the dual-title PhD degree did so, preferring this interdisciplinary dual-title PhD degree over the home department degree with an Astrobiology Certificate. Since 2012, 17 students have graduated with the dual-title PhD from Oceanography, Earth and Space Sciences, Astronomy and Biology. When the dual-title PhD was implemented in 2012, the Astrobiology Graduate Certificate was correspondingly modified to require only coursework that can be completed in two years, allowing it to be paired with a Master's degree. This has expanded the reach of Astrobiology to those getting graduate degrees in STEM teaching, as well as PhD students in departments that are not yet part of the Astrobiology participating departments. We have since graduated Wolf Clifton, a Master's student in Museology, with a Certificate in Astrobiology.

The UW Astrobiology Program has a current enrollment of 31 graduate students, and more than 25 faculty members from multiple astrobiology-affiliated departments support UWAB's research, course work, graduate advising, and program management. Three faculty members – Professors Buick and Catling in Earth & Space Science, and Professor Meadows in Astronomy– are officially appointed as members of their home departments as well as the UW Astrobiology program. The UW Astrobiology program is managed by a faculty Director (currently, Professor Meadows) who is appointed by the Dean of Natural Sciences and advised by a steering committee of astrobiology faculty, research scientists, postdocs and students.

Program Funding

The stability of program funding has improved since the 2010-2011 review, but continues to be a concern. At the time of that review, State Funding provided a stipend for the 1.5 months of the Director's time, and ~$13K on which to run the activities of the program. This was a shortfall of ~ $120K compared to the actual cost of running the program with program administrator salary, field workshops, research rotations and colloquium travel. Of most concern to the Program review panel was the lack of permanent funding for the Astrobiology Program Administrator, who is required to support this academic program. Instead of State or University support, this position was supported through RCR matching funding from the Director's NASA Astrobiology Institute Virtual Planetary Laboratory (VPL) research funding, a competitive award of five years duration that needed to be recompeted against stiff competition. Should that external research funding not be secured, then the Astrobiology Program would lose the matching funding that supported the Program Administrator and the student research rotations, severely compromising our ability to run the Program. That NASA grant funding was happily obtained again in 2012, but we now face a similar situation with the current period of performance on that grant completed, and a proposal to NASA submitted in 2017, with the outcome still pending.

Through negotiation for her Director's renewal package in 2016-2017, Director Meadows was

able to secure funding from the College of Arts and Sciences for the duration of her Directorship to support a half-time Astrobiology Program Administrator. This provides security for the Astrobiology Administrator position through the next four years, especially if the current VPL proposal is not successful, but still leaves us with no true permanent funding for administrative support and research rotations for this vibrant, interdisciplinary academic program.

Success of the Dual-Title PhD Option

The Dual-Title PhD program, implemented in 2012, and now spanning 8 participating UW departments and schools, is the most comprehensive and rigorous in the world. By converting from a graduate certificate to the dual-title PhD, our students are now given the appropriate credit in the broad scientific community and at educational institutions for having completed rigorous interdisciplinary course work and research. For this program, students complete all the academic requirements for their home department, in addition to interdisciplinary training that includes Astrobiology classes, colloquia, research experiences, field workshops and professional development. There are 17 course credits in Astrobiology classes that are co-taught by a multidisciplinary cadre of faculty, including a class in Professional Development. This class covers several non-research aspects of being a scientist, and includes a ``lab'' class on interdisciplinary proposal writing. Students must also complete a one-quarter-long research rotation in a field outside the student's home discipline, and students give a formal presentation at the end of the experience to the UW Astrobiology community. Professional networking is also built into the program via student lunches with our colloquium speakers, which expose them to a broad swath of the external astrobiology community, and by providing encouragement to students to choose research rotation locations and advisors that might support the next stage of their careers. Students also complete a series of three field workshop experiences that expose them to different facets of being an astrobiologist. Previous examples include participation in a scientific ocean-going research cruise studying photosynthetic microbial populations off the Washington coast, a field workshop to Yellowstone to study extremophile environments and remote-sensing life detection, and a visit to JPL to learn about the Mars Curiosity Rover and other astrobiology relevant NASA missions, and interact with the mission-brainstorming Team X and other JPL personnel on robotic spacecraft instrument design and a discussion on NASA career paths. Throughout their coursework, students are coached and challenged to communicate and connect across disciplines, and are also offered opportunities to undertake formal training in communicating with the public via an ongoing collaboration with the Pacific Science Center Communications Fellows program. In addition to the academic coursework requirements, students must undertake a dissertation project that is relevant to the field of astrobiology, and be able to defend that relevance, to receive a Dual-Title PhD in Astrobiology.

The UW Astrobiology Dual-Title PhD program has provided extremely successful career outcomes for its participating students, producing STEM leaders on the national and international stage, and burnished the reputation of the University of Washington as a leader in interdisciplinary STEM training. Since 2012, we have graduated 17 students with the Dual-Title PhD, including 9 women and 5 minorities. Of these graduates, six are already university faculty: Aomawa Shields, Clare Booth Lucy Assistant Professor, UC-Irvine; Jeff Bowman, Assistant Professor, UC-San Diego, Tyler Robinson, Assistant Professor, Northern Arizona University; Rika Anderson, Assistant Professor, Carleton College; Thomas Tobin, Assistant

Professor, University of Alabama, Nathan Kaib, Assistant Professor, University of Oklahoma). Six are now postdoctoral scholars at universities (Caltech, University of Bern, MIT, UC-Riverside, U. St. Andrews, UW). Three are research scientists at government or private labs, including Giada Arney (PhD 2016, Astronomy & Astrobiology), who was hired into a permanent Civil Servant research scientist position at NASA Goddard Space Flight Center only 6 months after graduation, and is now a Team Lead for studies of the feasibility of using extremely large telescopes in space to detect life on exoplanets. An additional two graduates work in the aerospace and IT industries.

Dual-Title Astrobiology PhD Students(clockwise from left) Earth and Space Sciences dual-title PhD student Jana Meixnerova on a research field trip to Mono Lake, Dr. Aomawa Shields delivering her TED talk, astronomy dual-title PhD student Jacob Lustig-Yaeger on board the research vessel Thomas G. Thompson, Director and students at JPL Mission Control.

More broadly, our dual-title PhD in Astrobiology is successful because it attracts exceptional students, and produces leaders in interdisciplinary research. The uniformly high caliber of students attracted to our dual-title degree is widely acknowledged anecdotally among the participating departments, and strongly reinforced by their success in obtaining recognition of their excellence through nationally-competed scholarships, both during their graduate careers and as postdoctoral scholars. Our currently enrolled dual-title PhD students have obtained UW ARCS Fellowships, NSF Graduate Student Research Fellowships, NASA Earth and Space Science Fellowships, NASA Astrobiology Institute Lewis and Clarke Fellowships and Early Career Collaboration Awards, and Society of Women Engineers Scholarships. Four of our dual-title PhD graduates have also obtained NASA Postdoctoral Fellowships, two obtained NSF Postdoctoral Fellowships, and two are National Academy of Sciences Kavli Frontiers of Science Fellows. Our students also roll their sleeves up and wade in to the astrobiology community, participating in, and leading community efforts to write and publish the Astrobiology Primer, a concise guide to the entire field, and proposing and leading multiple scientific sessions at the

biannual Astrobiology Science Conference. Dual-title PhD students are also extremely active and in demand in conveying the excitement and stimulating interest in science, for both students and the general public. All our dual-title PhD students in faculty and instructor positions teach astrobiology to their undergraduates, engaging students in STEM with the excitement and interdisciplinarity of the search for life beyond the Earth. Several of our graduates also engage in high-profile public outreach, captivating audiences that might not otherwise be receptive to STEM: Dr. Aomawa Shields is a TED Fellow and leads an outreach program targeting minority girls, and Dr. Giada Arney recently gave the Carnegie Public Lecture on astrobiology.

In summary, the dual-title PhD program has been extremely successful. It is one of only two available in the nation, enhancing UW's national and international reputation, and it pioneers massively interdisciplinary training in the STEM fields. On implementation, almost all or our eligible enrolled students immediately transferred to it, and it has enhanced our recruitment efforts by attracting top quality students who state that the dual-title degree is their principal reason for choosing UW. Students who aren't eligible for the dual-title PhD on enrollment have been very vocal in requesting that their home departments be added to the Astrobiology participating departments, and this year we hope to expand to include Chemistry and Psychology. The program has already graduated 17 students who have remained in the STEM fields, and many as early-hire faculty members and NASA mission leaders. Our students have obtained fundamental training in interdisciplinary science, which is at the forefront of many scientific endeavors. These students are top class scientists and communicate across fields, synthesizing results from many different disciplines, and engaging students and the public in the excitement of the big picture questions that only interdisciplinary science can address.