Why is Astrobiology important for the USA and NASA?

In 1945 Vannevar Bush, principal force behind the creation of NSF wrote "There is a growing mountain of research. But there is increased evidence that we are being bogged down today as specialization extends. The investigator is staggered by the findings and conclusions of thousands of other workers—conclusions which he cannot find time to grasp, much less to remember, as they appear. Yet specialization becomes increasingly necessary for progress, and the effort to bridge between disciplines is correspondingly superficial."

Bridging between the disciplines, from the physical sciences to the life sciences, is the task accepted by astrobiology. The confluence of studying a meteorite from Mars, discovery of extrasolar planets and development of a concept to seek Earths around other stars led NASA to put together its astrobiology program. The three events came from different groups substantially out of contact with one another, but connected by three giant goals, to question how we came about, interested in finding whether life existed elsewhere, and like all of us, concerned about the future for humanity.

These three questions place astrobiology on the front line of trying to bridge the barriers between the disciplines. Astrobiology programs take graduate students who specialize in one discipline, and give them an additional load of interdisciplinary learning – and it works! At the first Astrobiology Graduate Student conference held in Tucson in 2004, there was a clear difference between the cross-disciplinary abilities of graduate students from the University of Washington and Penn State, where Astrobiology graduate education had been in place for some years, and students who worked in NASA-related science fields, but came from places without interdisciplinary education. Students have kept the graduate conferences alive until this year, when the 2006 budget modification has made it no longer possible for them to meet.

But of course, such an education requires a cooperative effort by the teachers, both between researchers in a variety of fields at the student's home institution, and efforts to add to this from other similar institutions. NASA astrobiology has used two means to add this second component. The first has been a biennial cross-disciplinary meeting AbSciCon, coming up for its 4th meeting in Washington DC this March. The second has been the NASA Astrobiology Institute, NAI, a suite of teams selected through proposals for 5-year terms as members of this virtual institute. Team members are involved in both astrobiology research, education and public outreach. Much of the astrobiology funding supports graduate students and postdoctoral researchers, people who are at the start of their career. Likewise, if their funds vanish, they will have no choice but to go into other work, and the chance of every getting them to return is negligible.

At the alternate year meeting for NAI last year, there were no parallel sessions separating people into their separate core disciplines. It was expected that every participant could make sense of every session, regardless of the topic. On the first day, there were brief refresher lectures to help prepare for this. And the participants stayed for the entire meeting. NAI members have been expanding the number of schools where astrobiology

education is possible, but U. Washington and Penn State were early into this, and the other university members of NAI are moving forward on this too. NAI membership currently consist of 10 university teams, 3 teams from NASA centers and 3 teams from non-federal research institutes.

The complete NASA astrobiology program cost $65M this year or 0.4% of NASA's annual budget. The program includes an exo-evo-biology grants program, two programs for development of instruments for astrobiology-related NASA missions, and the Institute. Of course NASA is not a science agency, even though many of its successes have been in science. And because NASA is not a science agency, if it delays its science missions, it thinks that it can turn off and turn on science funding as needed. But science does not work like that. To turn on a future researcher takes a continuing effort that goes from middle school to high school, to college and to graduate school. And there needs to be a few years in a postdoctoral position too. Creating researchers is a more-than 20 year task, and if the young people see that the country is not quite sure what it wants – well, there are always good places for competent people in business, and it does not take all that hard education. If the country wants to create scientists, it needs a steady course.

There are two signs that astrobiology has been succeeding. The first is the growth of international astrobiology. When the United States started its program it was alone. Now there are national astrobiology programs in Australia, Spain, Britain, Germany, Russia, and a European Astrobiology Network. There are two international journals for astrobiology. Many students want to become astrobiologists, for example at the Vatican Observatory International Summer School in Astrobiology largely taught by members of two NAI teams, Washington and Arizona, there were 174 applicants for 25 positions. Similarly, for the last opportunity to propose to become members of NAI there were about 35 proposals for four possible positions, positions now in doubt because of the revised 2006 budget.

The scientific problems facing NASA, problems about the interaction of life and life's homes in the universe are a sample of those similar problems facing the people of Earth. The issues of keeping the Earth climate stable are similar to the issues that researchers tried to deal with in Biosphere II – and failed. That was before astrobiology. Astrobiology also seeks to understand how life managed on the early earth, despite monstrous temperature variations from –50 to +130 F. It seeks to understand the periodic extinction events that seem to arise from a variety of causes, but which have also made the Earth much less habitable from time to time. Today, from the writer's institute team alone, we have started to explore the issues for creating an Earth sunshade to control global warming. We have also just begun to explore the issues of greenhouses for the Moon.

Astrobiology teaches students how to break down big issues into smaller ones so that the pieces are susceptible to the work that one graduate student can do while obtaining a Ph.D. We have yet to hear of an unemployed Ph.D. in astrobiology. Although there are no astrobiology departments at universities, astrobiologists offer a combination of

specialization that allows them to fit into a specialized academic department with a versatility that makes them very useful to have around.

When Vannevar Bush noted the problem with specialization, 60 years ago, he thought that devices might play a key role in allowing people to go beyond their narrow field. Today, even with the search engines of the internet, we see that the problem is not in access to information, but in providing the broadly educated that can use it. Astrobiology does that, and both the United States and NASA are at peril to leave this discovery for others to benefit.

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