

AAS Beyond Academe Task Force¹

Final Report and Recommendations

Statement of Task

Approved by the AAS Board, March 30, 2019

The desired outcome of the Task Force would be a well-researched and documented report containing data, analysis, and recommendations for undergraduate and graduate astronomy programs to consider in the areas of coursework, experiences and other possible actions that will better prepare graduates for finding and thriving in careers beyond the so-called ‘ivory tower’. Input is sought from employers of astronomy-trained individuals outside of academe (referred to as ‘industry’) and those who have successfully followed a non-academic career track. Department chairs and curriculum committees could use this advice to create programs of study that better and more intentionally prepare all students for careers beyond the classroom, particularly those students who are acutely subject to the economic impact of their career choice. The other audiences for this report are the AAS itself and any student considering a program of study that includes astrophysics. There are many professional options for individuals with PhDs, MS, and undergraduate degrees in astronomy and astrophysics. However, we could do better as a field to advise universities how to prepare students to take advantage of a broad range of career options.

Motivation/Background

Most astronomy students and many astronomy postdocs do not become professional research astronomers or professors.

Based on a survey of graduating classes for 2014, 2015 and 2016 combined, the annual number of bachelor’s and PhD degrees earned in astronomy has continued to increase². For the undergraduate astronomy majors only about 32% go to graduate school in physics or astronomy, with an additional 10% going to graduate school in other fields. It is also noteworthy that around 58% of these graduates found initial employment in the private sector, with 41% in STEM related activities and 17% in non-STEM activities. Over the same period, the number of astronomy PhDs has increased to around 160-180 per year (2017 saw 180 graduates, not including physics PhDs with dissertation subfield of astrophysics), with about 55% of astronomy PhDs taking on postdocs in the academic, government or private sectors after graduation³. This percentage is lower than in the prior survey due to an increase in the proportion accepting potentially permanent positions, mostly in the private sector. For those PhDs with potentially

¹ Membership of the BAA Task Force is provided in Appendix 1

² Nicholson and Mulvey (2020) Roster of Astronomy Departments with Enrollment and Degree Data 2019 <https://www.aip.org/sites/default/files/statistics/rosters/astrost19.3.pdf>

³ Mulvey and Pold (2019) Astronomy Degree Recipients: One Year After Degree <https://www.aip.org/sites/default/files/bach1yrafterdeg-a-16.1.pdf>

permanent positions in the academic sector, the majority have the title of Assistant Professor. Based on a 2018 survey of the faculty job market in physics and astronomy, for the 39 stand-alone astronomy departments, there were 37 new hires in the 2017-18 academic year and 54 recruitments in the 2018-19 year⁴. Those PhDs working in the private sector were primarily working in the fields of software and data science, engineering, and business.

More recently, the COVID-19 pandemic has impacted hiring into academic positions. In spring 2020 and 2021, the Employment Committee conducted a pair of JobRegister-based studies of the impact of COVID-19 on recruitment for Astronomy positions. The 2021 report showed a precipitous (~50%) drop in advertisements for faculty positions (from 2019-20 to 2020-21), while most other advertisement rates (e.g., for postdoctoral fellow positions) remained roughly constant.

Many university departments are reviewing their academic programs and asking whether their programs are preparing their students for career options beyond the traditional but limited academic paths. As the number of students pursuing undergraduate and graduate degrees in astronomy continues to grow rapidly and the number of degrees earned also grows⁵, this issue is of increasing importance for our discipline⁶. At the request from the Beyond Academe Task Force and the Employment Committee, the latest AAS Demographics Survey included several questions relating to training offered in departments in support of non-academic careers and broader career support at the universities. When released, that Survey will provide additional insight into existing programs and their effectiveness.

When seeking employment in the private sector, astronomy students perhaps suffer in comparison to those in other STEM disciplines, including physics, because the skills and value that an astronomy or astrophysics degree holder brings to the table are not as well known to employers. Entering an astronomy program may be a daunting choice, even to students who have absorbed the message about the value of a STEM education and about subsequent employment opportunities. Prospective students might see the field of astronomy as interesting, but maybe too esoteric and likely to be viewed by employers as having no direct application in the modern workplace. As in the case of physics students, astronomy students may have experience and knowledge that are valuable assets beyond a career as an astronomy professor. But employers themselves may be even less familiar with what an astronomy degree means than a physics degree. Furthermore, astronomy students are likely no better than physics students in appreciating and marketing the value of their experience and skills. For this reason, the Beyond Academe Task Force considered mechanisms for informing not only students but also educators about the prospects for astronomy students for careers beyond the university research path.

Goals of the BAA Task Force

⁴ Porter, Tyler, Nicholson, and Ivie (2020) Faculty Job Market in Physics and Astronomy Departments <https://www.aip.org/statistics/reports/faculty-job-market-physics-and-astronomy-departments>

⁵ Nicholson and Mulvey (2020) Roster of Astronomy Departments with Enrollment and Degree Data 2019 <https://www.aip.org/sites/default/files/statistics/rosters/astrost19.3.pdf>

⁶ [Kamenetzky, Kastner, Avestruz et al. \(2020\) Astronomy-driven Careers in the 2020s, Bulletin of the American Astronomical Society, Vol. 51, Issue 7, id. 5](#)

- Collect information from recent and current surveys of both the Astronomy and Physics communities as input into our discussions. As noted below, new surveys of the appropriate sectors of the community will be the responsibility of the appropriate standing committees.
- Create a strategic plan of action for AAS, especially the Employment and Education Committees, to engage students, Departments, and non-academic employers (government, NGOs, industry, etc.) to evolve the culture around non-academic jobs and expand options to prepare students for such positions.
- Identify sources of data needed to understand current best practices in the academic environment and the needs/desires of non-academic employers for skills not normally provided in degree programs.
- Support the establishment of a new committee to implement the strategic plan and/or revise/augment the Charters of the Employment and Education Committees. Identify resources that will be needed to accommodate this broadened purview.
- Make recommendations on possible roles for AAS governance in oversight of activities that support preparation of students for non-academic careers.

Existing Efforts of the AAS Employment Committee

The AAS Committee on Employment (AAS EC) is charged with “facilitating the professional development and employment of astronomers at all career stages and on all career paths, and to promote balance and fairness in the job market.” Major components of the AAS EC’s efforts/initiatives have been directed at increasing awareness of the diversity of career paths open to members and former members. Recent efforts/initiatives include:

- AAS Winter Meeting events/activities
 - Beyond Academe: Exploring Astronomy-Powered Career Paths: panel discussions/Q&A; “Careers Explorations Roundtables” (informal, facilitated group discussions)
 - Software & Data Carpentries Workshops
 - Career Consultant: workshops and one-on-one sessions
 - Supporting the Astronomers Turned Data Scientists splinter meeting
 - Supporting a workshop on improving scientific presentation skills
- Maintaining and generating relevant resources at the [AAS Careers website](#).
 - Reorganizing the website navigation so information is accessed with fewer clicks.
 - Updating the Internships & Summer Jobs page.
 - Created the [Astronomy-Powered Careers webpage](#), which includes:
 - A new [Careers Infographic](#) (see Figure below), adapted from similar infographics made by the American Geosciences Institute (AGI).
 - A fillable survey form to populate the infographic with new Career Profiles.
 - Links to existing career profiles.
 - Drafting new text for the [About a Career in Astronomy](#) webpage.
- Monitoring the AAS Job Register. Data from this monitoring project was used in the Astronomy-driven Careers in the 2020s decadal survey whitepaper [cited above] and in two reports to the AAS Board on the impacts of COVID-19.

- Suggesting relevant topics for webinars by external presenters (Alaina Levine, Desiree Dickerson, “Careers in...” series).
- Surveying employers who have used the Job Register about their hiring practices and suggested Diversity, Equity, and Inclusion (DEI) hiring resources, resulting in a [summary report to the AAS in April 2022](#).
- Creating a [DEI Annotated Resource List for Hiring and Workplaces](#) for distribution at AAS meetings and the benefit of recruiters/employers.

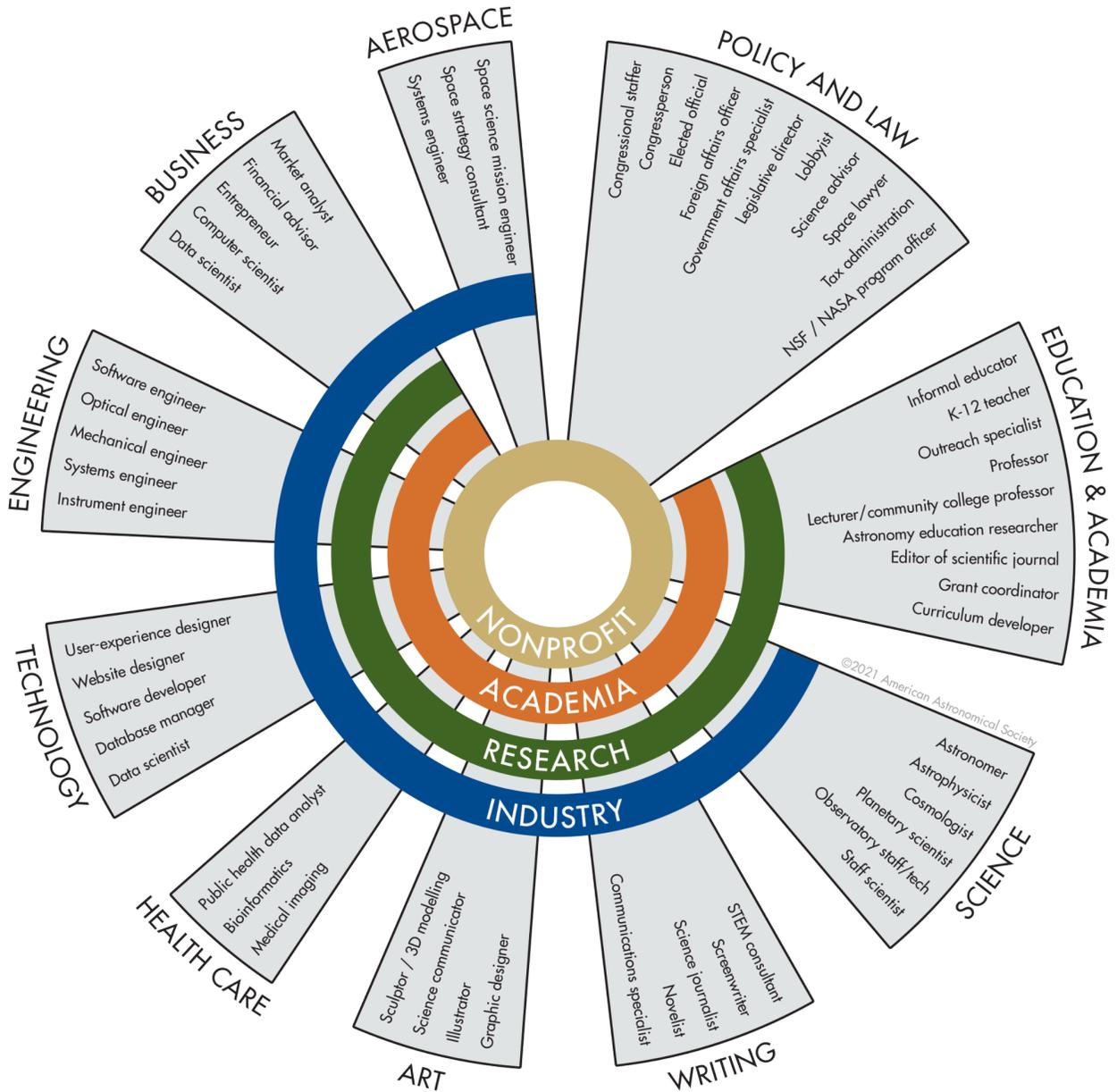


Figure: Infographic illustrating the diversity of job opportunities for graduates in Astronomy and Astrophysics in both the academic and non-academic sectors.

Existing Efforts of the AAS Education Committee

The AAS Education Committee is charged with oversight of the educational activities of the AAS. While the committee does not have a charge explicitly aimed at helping undergraduate and/or graduate student members learn about job opportunities outside of the academy, a number of activities do indirectly or directly support that goal:

1. Administering the [AAS Education & Professional Development \(AAS-EPD\) Mini-Grant Program](#).
 - a. This program invited proposals from US-based AAS members to provide education-related mentoring and professional-development experiences for fellow members.
 - b. Explicitly mentioned as eligible for funding via this program is “Career development for junior members seeking education employment after graduation”. Other career development workshops would certainly be considered.
 - c. Examples of relevant recently funded workshops either explicitly on career paths, or involving skills building for outside of academy jobs are:
 - i. A Data Science Foundation & Roadmap for Astronomy Instructors (D. Muna, Eureka Scientific, 2018)
 - ii. Professional Development through Access to Diverse Viewpoints: Creating a More Inclusive Career Panel (D. Bouquin, Harvard-Smithsonian Center for Astrophysics, 2018)
 - iii. Infusing Undergraduate Astronomy Education with Computing and Big Data (B. Lundgren, University of North Carolina, Asheville, 2019)
2. Hosting articles relevant to this topic on the [AAS Education Blog](#), including those from faculty making changes to curricula to align with diverse career interests. For example, in the first year of the blog the following articles:
 - a. [The First Two Miles: Building Research-Ready Programming Skills in the Classroom](#) (Imad Pasha, Yale University)
 - b. ["SDSS Resources for Infusing Astronomy Education with Computing and Big Data"](#) by EPD Grant awardee Britt Lungren (University of North Carolina, Asheville)
 - c. ["Professional Development Through Access to Diverse Viewpoints: Creating a More Inclusive Career Panel"](#) by EPD Grant awardee Daina Bouquin (Harvard-Smithsonian Center for Astrophysics).

Recommendations for Additional Actions

This list of recommendations is provided in three categories of actions: short-term, mid-term, and long-term.

Short-Term Actions (within first 2 years):

In the category of short-term actions, the AAS and AAS Employment Committee (AAS EC) already offer programs and resources in support of astronomers looking for career development beyond the academic track. We encourage continued effort and some enhancement by:

- Creating an AAS group, the **Corporate Engagement Advisory Committee (CEAC)**, that reports to the Board and advises the Employment and Education Committees on careers beyond academe. This Committee will have purview over all aspects of corporate engagement, including on establishing programs and activities that enable the transition for students into private sector careers while engaging corporations and industry to understand the skills they need from new employees. A proposed charter for such a committee is provided in Appendix 2.
- Expanding the purview of the Employment and Education Committees to include the additional activities as outlined below.

The AAS Board:

Identify and recruit contributors and leadership for a **Corporate Engagement Advisory Committee**. Members do not necessarily have to be members of the AAS, but it would be useful to recruit representatives from our AAS corporate members. This advisory committee ideally also includes representatives from departments who either have made curriculum changes to respond to the needs of students beyond academe or are in the process of making those changes. This advisory group would foster a culture of explicit encouragement and support for astronomers who are considering pursuing non-academic career paths.

The role of this advisory body would be to provide advice to the Employment and Education Committees on the implementation of the strategic plan and provide further ideas regarding employment beyond academe. In addition, the advisory group would develop lasting connections between astronomy programs/organizations and non-academic businesses and industry and scientists working in these fields.

Corporate Engagement Advisory Committee (CEAC) roles and responsibilities:

- 1) Build a list of companies, their departments and points of contact using the AAS exhibitors list and post them on the AAS careers webpages. Establish relationships with non-academic employers so that they routinely come to AAS to post their job advertisements on the AAS job register. Provide links on the AAS careers webpages to available data, internships and other training opportunities, networks to join, training materials, points of contact as subject matter experts, etc.

Timeline: within 1 year upon Committee establishment

- 2) Identify a list of the various non-academic job opportunities that are available to graduating astronomers and post them on the AAS careers webpages; the AIP list of job opportunities in Physics overlaps significantly with the options for Astronomers and Astrophysicists and would be a good place to start.

Timeline: within 1 year upon Committee establishment

Employment Committee roles and responsibilities (prioritized):

- 1) Expansion of the Employment Committee to (EC) include a new **Subcommittee on Employment beyond Academe** comprising 3 additional new members of the EC, following the same process and rotation cycle as for current membership. These new members would optimally be employed in non-academic positions or be highly cognizant of the issues involving non-academic careers. This Subcommittee would have responsibility for coordination with the new **Corporate Engagement and Advisory Committee** and implementation of appropriate action items relative to the purview of the EC. Appropriate changes would need to be made to the EC statement of task, with approval from the Board.

Timeline: within 6 months of approval of BAA TF recommendations.

- 2) AAS, through the Employment Committee, already offers professional development workshops (live at AAS meetings, as webinars, recorded webinars, and other documentation online). We suggest in addition to the live workshops at meetings, to include a non-academic career evening or other networking event, where early career undergraduate and graduate students, early career astronomers, as well as astronomers interested in alternative career paths, can mingle and discuss opportunities with industry and government representatives and recruiters, the workshop panelists, and teachers. This event should also feature tables where exhibitors, organizations, and conference attendees can share available resources related to non-academic career preparation as well as non-academic career opportunities. Coordination with the corporate partners in establishing and designing such events is critical to their success.

Timeline: upon approval of BAA TF recommendations

- 3) Continue to work with NASA and AGU to develop AAS participation and presence in the [Mentoring365](#) program, with NASA support.

Timeline: immediately

- 4) At the annual society meetings, host sessions that consist of oral or poster presentations to all interested parties by university attendees to share examples of what they are doing now to prepare their students for careers beyond academia, as well as panel discussions to get feedback on expected challenges and ideas from the community.

Timeline: within a year of approval of BAA TF recommendations

- 5) At the annual society meetings, establish mechanisms to collect input and ideas from the community for additional activities and engagements that help students as they consider non-academic careers. In particular, engage AAS affiliate members and alumnae who are no longer in academia, as well as non-academic corporations and organizations; and Astronomy department leadership/faculty (those deciding curricula and program requirements) and professional development leads from degree-granting institutions. This could be achieved by adding a Careers booth, crowdsourced input/sticky notes, or inclusion of relevant questions on feedback surveys.

Timeline: within 2 years of approval of BAA TF recommendations

Education Committee role and responsibilities:

- 1) Expansion of the Education Committee to include a new **Subcommittee on Preparation for Employment beyond Academe** comprising 3 additional new members of the Education Committee, following the same process and rotation cycle as for current membership. These new members would optimally be employed in non-academic positions or be highly cognizant of the issues involving non-academic careers. This Subcommittee would have responsibility for coordination with the new **Corporate Engagement and Advisory Committee** and implementation of appropriate action items relative to the purview of the Education Committee. Appropriate changes would need to be made to the Education Committee statement of task, with approval from the Board.
Timeline: within 6 months of approval of BAA TF recommendations.

Mid-Term Actions (within 5 years)

AAS Corporate:

Consider creating an AAS staff position, collectively funded by “pledges” from the astronomy-driven corporate community, that is dedicated to developing/curating connections between astronomy-trained graduates and industry (aerospace, data science, science communications, ...).

Corporate Engagement Advisory Committee role and responsibilities:

Provide linkages and support for symposium of department chairs discussed below.

Employment Committee role and responsibilities:

A limited survey of AAS corporate members, potentially including Alumnae Affiliate members, to collect information about what they look for in new hires, success stories or patterns of success (what has worked) of hires with astrophysics backgrounds.

Provide video clips and tip sheets from actual recruiters and managers in various industries on what they are looking for, and how to market an astronomy degree for their field. We suggest the Employment Committee collects and maintains these clips on AAS Career webpages. Furthermore, we suggest the addition of career profiles of astronomers active outside of academia, with a consistent set of questions, posted on AAS careers webpages.

Timeline: within 3 years of approval of BAA TF recommendations

Education Committee role and responsibilities:

Interviews of university faculty currently (or recently) making changes to their curricula to align better with diverse skill requirements specific to non-academic employment. Build a database of lessons learned and best practices that can be posted to the appropriate webpages.

Timeline: within 3 years of approval of BAA TF recommendations

Joint Education and Employment Committee roles and responsibilities:

- 1) Hold workshops of department chairs (and corporate leadership/corporate talent acquisition) on best practices in areas that would support a career pivot to non-academic positions. Such workshops could be held every few years, perhaps as an add-on to the annual AIP Department Chairs meeting. One goal of this workshop might be to create a document such as that in item 2 below. This workshop will focus on discussion of current activities and collection of information from the Chairs in the following areas:
 - a) Trainings for students in marketable, transferable soft and technical skills (e.g. statistics, specific hands-on, real-life skills such as building, debugging, instrumentation design, experiment design, coding, cooperative group work).
 - b) Partnering activities with other departments who already offer such courses or whose students would also benefit from them.
 - c) Departments/institutions/faculty connect students to career development centers at their institutions and point them to AAS resources (workshops, etc.) for resume creation, interview practice, etc.
 - d) Departments/Institutions/Faculty connect students to alumni in industry - facilitate informational interviews, maybe even resume reviewing or practice interviews.
 - e) Departments/Institutions/Faculty set up internship partnerships with industry or find existing programs at the institution and assist/encourage astronomy student participation.
 - f) Departments/Institutions/Faculty seminar series that explicitly brings in alumni from outside of academia to talk about what they do.
 - g) Offer courses and experiences that are adapted to the 21st century world of data, computations, collaborative team efforts, communications, management, and scientific research used in many fields, not just astronomy. (department action)
 - h) Coach students about how to market these experiences and course work effectively to a broad range of potential employers. (department action)

- 2) Based on the outcomes of the workshop of department chairs create a report with recommendations and best practices for training and hiring students interested in careers beyond academia. This report would include a list of recommendations to support students in a career shift toward a non-academic professional path.
Timeline for workshop and report: within 3 years of approval of BAA TF recommendations

Long-Term Actions (within 10 years):

For this initiative's continued productivity and impact, we recommend a set of long-term measures:

Education Committee role and responsibilities:

Periodically collects information and reviews training activities within the departments and universities that prepare students for non-academic degrees.

Joint Employment Committee, Education Committee and Corporate Engagement Advisory Committee roles and responsibilities:

- 1) Works with universities and departments on implementing the best practices identified by the Department Chairs workshop report (see mid-term actions, above). Works in parallel with AAS Committee on Employment to identify and develop direct connections with astronomy-driven industry partners to enable astronomy-trained graduates to move seamlessly into non-academic careers. Investigate possible expansion of internship opportunities in non-academic environments and possible coop programs within university offerings.
- 2) Builds a database (periodically updated) of astronomy-educated, non-AAS members in non-academic career tracks, and interviews or surveys them, inviting them to take part of the professional development workshops and career events, in coordination with Employment Committee.
- 3) Periodically compiles and disseminates to AAS members and astronomy degree-granting departments pre-existing graduation and data on employment outside of academia available for astronomy students, including astronomy students in physics and astronomy departments from the AIP (including records of employment shortly after graduation) and from the NSF.
- 4) Periodically compiles and assesses the work of other non-profit organizations in this area.

Appendix 1: Task Force Membership

Doris Daou, NASA (chair)
Megan Donahue, Michigan State University (AAS Past-President)
Kari Frank, Northwestern University
John Grunsfeld, NASA (retired)
Rachel Ivie, American Institute of Physics
Julia Kamenetzky, Westminster College (Chair, Employment Committee)
Joel Kastner, Rochester Institute of Technology
Steve Mackwell, NSF
Andrea Schweitzer, Western Governors University
Paula Szkody, University of Washington (AAS President)

Input to the Task Force was also provided by these members of the Employment and Education Committees:

Tania Anderson, Space Telescope Science Institute
Sanlyn Buxner, University of Arizona (Co-Chair, Education Committee)
Meredith Danowski, Ball Aerospace
Chelen Johnson, SOFIA Science Center
Kelsey Johnson, University of Virginia
Karen Masters, Haverford (Co-Chair, Education Committee)
Amelia Malling, GLAS Education
Kate Meredith, GLAS Education
Lee Anne Willson, Iowa State University

Appendix 2: Proposal for the formation of an AAS Corporate Engagement Advisory Committee (CEAC)

We propose that a Corporate Engagement Advisory Committee (CEAC) be chartered by the AAS Board with a focus on enhancing interactions between AAS and astronomers working in the private sector. Recent surveys have shown that the majority of astronomy students find careers in the private sector rather than in academia. The CEAC would seek to identify ways for AAS to engage broadly with those astronomers in the private sector and increase their participation in AAS programs and activities.

We propose that the Committee would

- advise the AAS Board on establishing programs and activities that enable the transition for students into private sector careers while engaging corporations and industry to understand the skills they need from new employees;
- advise the AAS Board on programs, issues, and policies that affect the community of astronomers working in the private sector;
- provide a strong voice within AAS for astronomers in the private sector; and
- facilitate partnerships between AAS and private sector employers on programs and activities of common interest, including
 - Membership
 - Careers
 - Policy
 - Development
 - Education
 - Awards

We propose the following Composition & Structure for the CEAC:

- The CEAC would comprise a minimum of 10 and maximum of 14 members, who are predominantly leaders from a mix of large, small, conventional, and entrepreneurial businesses, non-profit organizations, and academia. At least 50% of membership of the Committee would be scientists working in non-academic organizations.
- The Committee would have at least one member who is a current student, and at least 2 members who are early career scientists working in non-academic careers.
- The Chair of the Committee would be appointed by the Chair of the Board and would be a member of the non-academic community. The Chair would provide a report to the Board on the activities of the Committee annually at an annual Board meeting.
- The initial members of the Committee would be selected by the Beyond Academe Task Force.
- Members of the Committee would serve a term of 3 years, renewable for up to one additional 3-year term, with terms staggered to maintain continuity. New members would be elected by a majority vote of the existing committee members who have no clear conflicts of interest.

We propose the following for the cadence of CEAC Meetings

- The Committee would meet virtually at least once every 2 months, with a face-to-face meeting at the annual AAS winter meeting.

With respect to the roles of the CEAC in the area of the Beyond Academe Task Force, we see the following specific goals and objectives as potentially falling under the purview of the CEAC, many in collaboration with the Employment and Education Committees:

- Identifies a list of the various non-academic job opportunities that are available to graduating astronomers and post them on the AAS careers webpages; the AIP list of job opportunities in Physics overlaps significantly with the options for Astronomers and Astrophysicists and would be a good place to start.
- Builds a list of companies, their departments and points of contact using the AAS exhibitors list and post them on the AAS careers webpages. Provide links on the AAS careers webpages to available data, programs to apply for funding, networks to join, training materials, points of contact as subject matter experts, etc.
- Provides linkages and support for periodic Department Chairs workshops that discuss lessons learned and best practices for preparing students for non-academic careers, perhaps as an add-on to an AIP Department Chairs meeting.
- Works with universities and departments on implementing the best practices identified by the Department Chairs workshop report. Works in parallel with AAS Committee on Employment to identify and develop direct connections with astronomy-driven industry partners to enable astronomy-trained graduates to move seamlessly into non-academic careers. Investigate possible expansion of internship opportunities in non-academic environments and possible coop programs within university offerings.
- Builds a database (periodically updated) of astronomy-educated, non-AAS members in non-academic career tracks, and interviews or surveys them, inviting them to take part of the professional development workshops and career events, in coordination with Employment Committee.
- Periodically collects information and reviews training activities within the departments and universities that prepare students for non-academic degrees.
- Periodically compiles and disseminates to AAS members and astronomy degree-granting departments pre-existing graduation and data on employment outside of academia available for astronomy students, including astronomy students in physics and astronomy departments from the AIP (including records of employment shortly after graduation) and from the NSF.
- Periodically compiles and assesses the work of other non-profit organizations in this area.