CAREER DEVELOPMENT IN THE PHYSICAL SCIENCES

From undergraduate studies through retirement

Career Development White Paper Team
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Executive Summary

The Career Development White Paper (CDWP) Team examined the current landscape for physical scientists seeking career development advice and mentorship. We looked at AIP offerings and Member Society (MS) offerings, conducted a literature review on career development, and sought information on what career development might look like in the next ten to thirty years. In doing so, we found what we believe are critical gaps facing physical scientists seeking to advance their careers.

There is little rigorous research on career trajectories in the physical sciences; what does exist focuses on individuals in the academic sector. There have been efforts to promote physical sciences careers, both by Member Societies and by AIP; however, there has been no extended coordinated effort to provide information to broad audiences. Finally, networking capabilities can be limited for physical scientists outside academics, and there are few, if any, mentoring or summer experiential opportunities for students beyond the academic sphere. We believe AIP is well positioned to help address these gaps with

expanded research capacity to better understand the issues surrounding career development in the physical sciences and best practices to address those issues,

increased networking and career resources capabilities to connect physical scientists at all stages of their careers to help them reach their goals, and

coordinated media and idea dissemination to educate the public, parents, students, and career professionals of the possibilities and available resources.

We see synergies among the three as the expanded research capacity can inform both the increased networking and career resources capabilities and the coordinated media and idea dissemination. Likewise, each facet of this approach can build on and learn from the others. Each of these efforts would seek to link career professionals at all stages from all sectors to Member Societies and would seek to increase diversity in the physical sciences.
Introduction

There is no lack of attention to career development within the physical sciences community. But, there is abundant opportunity for AIP to bring a more systematic and rigorous approach to the subject and thereby set a new standard in thought leadership.

Currently, the community’s efforts to assist in career development revolve primarily around the aggregation of job listings and the provision of advice, most often to people who are in the earliest stages of their careers. AIP and its Member Societies (MSs) already have a substantial footprint in providing these services. What is broadly absent is a more holistic approach to career management that leverages a thorough understanding of the community’s institutions and needs. By building such a capacity, AIP can provide scientists and engineers with informed guidance over the full span of their careers, empowering them to formulate an individualized and ultimately satisfying career path.

Accordingly, the CDWP Team recommends AIP pursue three “Big Ideas” in advancing its efforts in this area:

I. **Research Capacity**: AIP can unify and augment its expertise in physical sciences career development to provide information and advice on a wide variety of career development topics.

II. **Networking & Career Resources Capability**: AIP can create the capability to provide tailored advice to individuals and connect them with the most relevant education, employment, and mentorship opportunities.

III. **Coordinated Media and Idea Dissemination**: AIP can coordinate and expand on current expertise in media and publications to refine information for interested individuals, while providing an authoritative information resource.

These “Big Ideas” build on AIP’s existing resources: the *Physics Today* and Society of Physics Students (SPS) online job sites, the SPS Careers Toolbox, GradSchoolShopper.com, and careers-related resources from the Statistical Resource Center (SRC), specifically regular employment reports and an online salary calculator tool for physicists in academia. They also enhance MSs’ current career development efforts, which include jobs listings and job fairs, descriptions of typical careers within a certain STEM field, internship and fellowship opportunities, and so forth. Most MSs provide one or more such services, indicating the uniformity of their interest in career development but also hinting at the saturation of the market for more basic offerings.

Other professional societies beyond the AIP umbrella, along with a review of the available literature on career development, show similar patterns. For example, many of the most high-profile science journals, such as *Nature* and *Science*, provide their own job listings and devote columns to career-related issues in which authors offer advice or share their experiences on a variety of topics. These include diversity and inclusion; maintaining a work/life balance; transitioning into a different field or sector; working in a foreign country; navigating laboratory and university life; becoming a mentor; and making productive use of conferences, to name a few.

The overwhelming sense gathered from investigating the current landscape is that scientists and engineers seeking career guidance will be awash in information but may not have the right information easily accessible when they need it. By organizing its career development work efforts, AIP can amalgamate existing information about careers, produce new information through research, structure the information in an intuitively navigable way, and promote and convey it to those who need it through assorted channels.
Prominent Themes
The White Paper team also identified several prominent themes in career development that would benefit from a more rigorous and systematic approach that AIP could provide through each of the proposed efforts.

Diversity, Inclusion, and Equity
The physical sciences community has long struggled to increase the diversity of its ranks and to create more welcoming education and research environments. In 2015, the science and engineering workforce was still predominantly white (67%) and male (only 28% identified as female), and while over the past two decades the proportion of women working in the physical sciences has increased from 21% to 28%, women represent half of the college-educated workforce. This slow and unsteady progress testifies to the need for a more thorough and consistent approach that leverages all available information about the wide variety of diversity and inclusion programs that exist, as well as the record of successes and failures within the STEM community, so stronger career development pathways can be created. Such a program would also help give members of underrepresented groups more resources and options for networking, mentoring, and advancing in their careers, as well as in seeking redress against bias and harassment.

Entry Points to STEM
The makings of a successful career in STEM typically reach back into both K-12 education and student encounters with science in popular culture. Better understanding of whom these channels reach and do not reach, what expectations they set about science, and how students move from general introductions to science into the realities of a specialized STEM education and resultant career would do much to improve outreach efforts and to ensure they are equitable in whom they bring into the sciences.

Alternative STEM careers
Science policymakers are taking an increased interest in encouraging participation in technical careers that do not require a 4-year college degree. Emerging areas, such as nanotechnology, additive manufacturing, and quantum information science, will require a supporting workforce with specialized skillsets. Yet, such careers are often not given much consideration by scientific societies focused on the immediate needs of their university-trained membership. A broader outlook on the career landscape would aid the scientific community in being more strategic in building workforce development partnerships with other fields while planning for the future.

Leadership Development
The majority of available career development resources focus on students and professionals at the early stages of their careers. However, there is little in the way of guidance to individuals who are taking on additional responsibilities in their laboratories, departments, universities, scientific societies, government advisory committees, and other similar leadership positions. Cultivating resources that guide individuals in project and budget management, committee-based and community-based decision-making, policy, ethics, and other such areas would help smooth the transition into these vital leadership roles, making this important process into less of an ad hoc affair.
Future Requirements
The scientific workforces of 2030 and 2050 will be significantly different from today’s, and students, educators, and employers need to plan now for this future. Rapid technological change and increasing international competition is creating the need for a more agile scientific workforce - one capable of responding to changing conditions over the course of such careers. There will be an increasing need for scientists skilled in using tools such as machine learning to grapple with extremely large amounts of data, and scientists will need to be conversant in the open science practices that many journals and funding agencies increasingly require. In addition, demographic shifts can create workforce gaps as large leadership cohorts reach retirement age; intensive research and communication is required to respond intelligently to such trends.

I: Expanded Career Development Research Capacity
Researchers in both academia and industry often have difficulty obtaining relevant career advice and coaching. In academia, many science supervisors focus overwhelmingly on the academic track for their students; as such, non-academic pre-, early-, and even mid-career professionals feel ignored and isolated in developing their next steps in their career path. Outside of academia, individuals are concerned about the impact to their existing job if their employer realized they were looking for new opportunities. Anecdotal conversations with attendees at a recent non-MS workshop on career development indicated dissatisfaction with the lackluster advice and poor understanding from the society pertaining to the options available for attendees. In other words, there is a lack of data regarding the potential paths an individual trained in the physical sciences could take, and what would be most effective in aiding MS members’ career growth.

Research capacity could be increased by developing a recognized leadership in career research, specifically as it pertains to careers in the physical sciences. While an attempt could be made to track the career development of high school students, the focus here should be from the completion of a Bachelors or Masters; this data would be more manageable and the return on investment higher due to the existing connections AIP has to the academic community. In addition to collecting and analyzing new data, AIP could advise MSs on developing career advice programs for their members and present relevant materials at MS conferences or other relevant public events. In developing this capacity, AIP needs to balance pure academic research with public engagement experience. As AIP develops this research capacity, it will be seen as a thought leader in this area.

The goal for this new research capacity is to act as a unifying resource for the physical sciences on the following issues:

- **Map the physical sciences community**: Questions required to accomplish this include “Where do physical sciences students go after matriculating?”; “Which industries or sectors do they move into?”; “Are there job trends changing employment?” (for example, positions that previously did not require a Masters or PhD but appear to now); “At what point in one’s career, or in what workplace setting, does an individual no longer feel a connection to the physical sciences community?” “What jobs could be classified as being outside the remit of AIP and its MSs?” “Are there significant changes in mobility in the job market as a function of generational shifts in workforce demographics?”

- **Survey the societies**: What are the weaker areas regarding their knowledge of their members and potential members? The likelihood of an overlap with the questions above is high.
 Highlight results: In addition to continuing to publish in peer-reviewed journals, should also provide materials written for policy makers at MS and individuals searching for career advice. As such, the style could more closely resemble Physics Today’s editorial content in tone and delivery, but with more interactive multimedia elements. Public speaking and workshops may comprise a part of this increased research capacity, and it would be expected that the content generated would appear more often in peer-reviewed journals.

 Emphasize the traditional non-academic career paths available to the STEM community. Much of the existing research focuses on academic career paths, and faculty members can readily advise students on academic career paths. Very little information is available on career paths in the physical sciences outside academics.

Conclusion

AIP could develop a comprehensive source of data for all who work in the physical sciences. Ideally, the rigorous research would benefit both AIP and our Member Societies. Research capacity should examine best practices to support physical scientists, inform students, and engage the general public.

II: Networking and Career Resources Capabilities

Increased networking and career resources capabilities aim to inform and support physical scientists, students, and the general public through outreach, professional connections, and career development. These capabilities would provide a wealth of resources highlighting both existing materials through AIP and its Member Societies, and also materials not currently available to physical scientists.

Career support encompasses more than finding a job – whether the job be one for a new graduate or for a mid-career practitioner who wants to change jobs. Physical scientists need career support past the onset. For example, mid-career scientists might want help refining their managerial, budgeting, or project planning skills. A recent graduate might want tips on navigating a new workplace. In addition to supporting physical scientists, the networking and career resources capabilities can help the general public learn more about what physical scientists do. Highlighting established physical science professionals across many sectors, not just those in academic or lab settings, could help attract a more diverse set of students into the physical sciences.

AIP could offer physical scientists professional development opportunities that span an individual’s career: mentoring, job shadowing, support of student groups, virtual meetings, employer tours, and speaking opportunities. This can be accomplished by connecting potential and current members through the MSs, SPS, and Sigma Pi Sigma. Sigma Pi Sigma members span many career sectors allowing newcomers to network with a group of people with interests like their own. This provides individuals with the opportunity to find their place within the physical sciences ecosystem. In addition, programs and opportunities could focus on traditionally underrepresented groups, including, but not limited to, race, ethnic origin, religious beliefs, gender, gender identity, sexual orientation, disability, age, family and socio-economic status, or cultural background. Finally, the networking and career resources capabilities could leverage resources from the coordinated media and idea dissemination efforts and the expanded research capacity.

These aims will be accomplished by coordinating AIP and MS capabilities in three main areas: outreach, mentorship, and professional development.
1) Outreach
Expanded outreach capabilities could encourage a more diverse set of people to engage with the physical sciences.

- Expanded capabilities could include facilitating, promoting, and conducting informal education for K-12 students and teachers, for college students, for members of the physical sciences community, and for the general public. For example, these efforts could be hosted at libraries, museums, planetariums, and in after-school programs. Special programs could be targeted to rural areas or members of underrepresented groups. It would be important to ensure that all efforts follow best practices; the expanded research capabilities could contribute to this. Chapters of SPS already participate in outreach events; this program could be formalized.

- The outreach could also extend to high school counselors and university career offices to promote the variety of career opportunities available to physical scientists. This would expose students to career possibilities and support smaller institutions and MSs with limited career resources.

- Information on non-traditional career paths can be included. This
  - Includes jobs that don’t require a bachelor’s degree
  - Serves as intermediary between professional societies and people they aim to represent
  - Provides industrial, writing, and research experiences for undergraduates, such as internships beyond NSF’s traditional Research Experience for Undergraduates

- Outreach materials can highlight trends within the federal government on STEM workforce initiatives.

2) Mentorship
Mentorship is often thought of as a means to guide young researchers or new employees through their initiation into the lab or workplace. Physical scientists working in isolation may have trouble connecting with a mentor. Providing formal mentorship opportunities throughout one’s career – from undergraduate studies through retirement – can provide benefits to both the mentor and the mentee and can help connect physical scientists to the Member Society that best fits their needs.

- Materials regarding best practices in mentorship could be provided to help identify the broad array of career and career development opportunities and resources. Mentors could serve all communities with a focus on traditionally underrepresented groups. Mentors could support National Society of Black Physicists (NSBP), National Society of Hispanic Physicists (NSHP), Society for the Advancement of Chicano/Hispanics and Native Americans in Science (SACNAS) and connect people to MSs.

- Sigma Pi Sigma members span many sectors and could be an asset in establishing formal mentoring programs that could
  - Promote program and MS awareness
  - Support NSBP, NSHP, SACNAS, and associated MSs.
  - Act as a bridge to program participation
  - Link undergraduates and early career physical scientists to existing support networks
  - Provide resources to mentors and MS to support these groups
  - Connect young, up-and-coming physicists from marginalized backgrounds with established physicists from similar backgrounds in a mentorship role

- In addition, Sigma Pi Sigma members could mentor high school through early career physical scientists.
• AIP and AIP MSs could match K-16 educators and advisers to local physical scientists for mentorship and resources.

3) Professional development

Professional development is important at all career stages. Formal programs could be designed based on researched best practices and could be offered through AIP Member Societies or directly. The possibilities include

• Supporting students and young professionals entering all career pathways while highlighting the benefits of member society affiliation
• Hosting an early career academy for postdocs to help identify the broad array of opportunities available in the academic, private, and government sectors
• Connecting established professionals to federal advisory positions
• Providing support through career transitions, including early, mid-career, and retirement planning
• Hosting a forum to establish interdisciplinary research
  o Interdisciplinary research conferences to assist scientists from related disciplines in networking
  o Dissemination of physical science news across many disciplines
• Encouraging interdisciplinary sabbatical opportunities
  o Creating a sabbatical network of institutions and funding sabbatical opportunities for underrepresented individuals
• Providing career coaching through MSs and SPS/ΣΠΣ
• Organizing professional development and providing career development tools and strategies
  o Career conferences for students and postdocs
  o Career and professional development webinars
  o Workshops
  o Print materials
  o Service opportunities to current and potential students
  o Using established professionals to provide career development for students through mid-career professionals
  o Providing early career specific training, including things like setting up a lab
  o Providing late career transitioning leadership and volunteering opportunities
  o Assisting with information on changing job sectors
  o Supporting job security by offering training and certifications
  o Being a consultant
  o Applying for a patent
  o Orientation for mid-career: job sector trends, policy, policy institutions, leadership training
• Promoting
  o Work/life balance
  o Maternity/paternity leave
  o Mental health

Conclusion

AIP could provide a resource hub, or jumping-off point, for all who work in the physical sciences. Ideally, anyone interested in furthering their career or professional well-being would be able to find current data and resources at AIP or through AIP Member Societies. Networking and career resources
capabilities should model best practices and support physical scientists, students, and the general public through awareness, professional connections, and professional development.

III: Coordinated Career Development Media and Idea Dissemination

Coordinating media and idea dissemination is a crucial component of the effort to better serve AIP MSs and scientists at all stages in career development. Coordinated dissemination efforts can best share the career-related insights and research developed by AIP and MSs, as well as the innovative research resulting from increased research capacity and the increased opportunities for networking and mentoring. Overall, coordinated dissemination will promote awareness of the diverse career possibilities within the physical sciences to broad audiences. It will establish AIP, its MSs, and its networking and career resources capabilities as crucial cogs in the effort to reach scientists and emerging scientists with the information needed to empower them to find fulfilling careers within the physical sciences. Publicizing, marketing, and sharing the resources available, the coordinated dissemination effort can strategically target varied audiences, including students and teachers, communities and colleges, and people at all stages of the career ladder.

In addition, to helping coordinate dissemination, AIP can also develop novel products and programs that will complement and enrich ongoing and new career-related efforts, focusing specifically on fostering the growth of these initiatives into visible and popular programs – either through AIP or MSs. Initial projects could include efforts to share stories of how working scientists and others navigated through their studies and careers, to gather and present information that will help attract people from underrepresented backgrounds to the physical sciences, and to help emerging scientists learn more about the history of the disciplines and fields they plan to enter.

The possibilities are vast. Here are three examples that build on expertise already housed in AIP:

1) **A StoryCorps for scientists**

   Many people interested in pursuing a career in the physical sciences are not sure what most working physical scientists do. One way to expose aspiring scientists to a day in the life of a physicist is to encourage a small but sufficiently representative subset of the physical sciences community to talk about their careers--by providing a recording booth at various events, such as MS meetings and other conferences. AIP could coordinate such an effort following the model of [StoryCorps](https://www.storycorps.org/). AIP could set up a recording booth at various events, including MS meetings and other conferences that attract a wide swath of the physical sciences community. Attendees would be encouraged to visit the booth to be interviewed about what they do. Greg Good, who has spearheaded dozens of oral history interviews for the Center for History of Physics, says that the keys to success are having a clear mission (What is the purpose of this interview? Who will be listening?) and keeping the interviews short, perhaps 10–15 minutes. As a role model he points to the [HERStories video](https://www.aapt.org/hers()tories_vide()o) compiled by AAPT, which recorded video interviews with dozens of women scientists. The aim should be to survey researchers who work in various fields and at various kinds of institutions. StoryCorps should also focus on capturing a diverse group of voices, including those of women, African Americans, and Latinx, to help motivate people in underrepresented groups to pursue careers in the physical sciences.

2) **Helping others learn – and learn from – history**

   Science students often focus on equations, not the history of discoveries. There is a perception that a physical scientist works alone in a lab and makes brilliant discoveries on the first attempt. AIP, through its History Programs and *Physics Today* material can provide necessary context to
historically important events and insights. Furthermore, the lessons that discoveries most often result from the coordinated efforts of many colleagues, perhaps after many failures. Sharing these insights, perhaps through developing additional lesson plans or producing a podcast or video series, provides aspiring physical scientists with an opportunity to obtain an understanding early on of the scientific and interpersonal skills and thought processes that would serve them well in their future careers. These lessons could also serve as professional development for working physical scientists. History is also still being rewritten. Every day we seem to learn about important women and minority scientists who were overlooked in historical chronicles of major physical sciences advances. AIP should help share their stories. Beyond tapping into AIP’s existing infrastructure, there are opportunities for other initiatives: for example, the soon-to-be-established history of science professorship with joint appointments at AIP and the University of Maryland could include outreach efforts.

3) **Sharing career resources**
AIP already collects some career information and produces some career resources. A more comprehensive effort could leverage these existing resources and build on it using the more extensive data and reports from the expanded research capacity. AIP could collect and publicize information on careers, jobs, education, and related topics from AIP and Member Society programs. In addition, AIP’s student programs and Sigma Pi Sigma provide natural entries for more formal and extensive mentoring programs. The coordinated dissemination efforts can become a vital component of a strategy that reaches out to the broader public with vital information about physical science careers. These marketing efforts will help spread news and analysis from different AIP and MS publications, including *Physics Today* and *Inside Science*, to highlight the wide variety of careers in physical sciences. Care will need to be taken to coordinate within AIP and across the federation to stay aware of upcoming projects and new content to collaborate to optimize the delivery strategy of this content and information to the many audiences served by these projects. In addition, AIP could create/monitor/moderate an online bulletin board for career questions. The resources will be available to Member Societies, schools, education groups, and the media to help deliver general science information, interactive content and videos, and career information.

**Conclusion**
Coordinated media and idea dissemination efforts will enable AIP to bring many dimensions of career information to multiple audiences. It will be a crucial part of the effort to establish AIP as a thought leader in careers in the physical sciences. In bringing critical information to numerous audiences, it will amplify the work done by through the increased research capacity and formal networking capabilities, as well as collect, present, and disseminate the related work that has been done and will be done by AIP and MS units in the future.

**Final Thoughts**
There is a gap in research data regarding career paths in the physical sciences. Networking and professional development opportunities focus on early-career scientists and may not reach isolated physical scientists. A more extensive, coordinated effort to provide information on careers in the physical sciences could attract a more diverse set of incoming students.

- **Nearly every science society is experiencing a significant decline** in membership among young and mid-level professionals. Knowing more about the early career path and having that information readily available could help retain these members by providing them with tangible member benefits directly applicable to their situation.
• **The proposed steps will provide resources to physical sciences community** that they actively want and need. For AIP to develop career resources that are attractive to early- and mid-career people, AIP must first understand the issue comprehensively. Then the Institute could develop programs and resources that are truly useful to MS and their members.

• **Acting as a focal point** for career research and development establishes AIP as a thought leader in this domain and may help build research links between researchers at other institutions and universities to do this work.
Appendix A: Member Society Career Development Offerings
American Association of Physicists in Medicine (AAPM) (*partner in the AIP Career Network*)

AAPM Career Services, the online job site for AAPM, has a dedicated “Resources” page housed within it. This includes six sections, each dedicated to a specific career development topic:

- Recorded Career Development Webinars
- Career Guidance
- Career Advice from Alaina G. Levine
- Career Profiles
- Resume/Branding Advice for Job Seekers
- Interview Advice

The items above in *italics* are sourced by AAPM’s Placement Services Subcommittee; the other content is sourced by the AIP Career Network (CN). In addition to what is available online, AAPM places effort on jobs and careers at their Annual Meeting (typically in July) and Spring Clinical Meeting (typically in March/April). At both meetings, this includes an on-site wall of paper job postings and resumes, as well as interview room scheduling - a type of informal job fair that is free to attendees. AAPM also promotes the online Career Services site, including the resources listed above, at these meetings via branded Career Services giveaways (usually pens) and a printed brochure, both created by CN and available near this informal job fair. At the Annual Meeting, AAPM also hosts a mock interview workshop, with volunteers playing interviewers to small groups of younger attendees. AAPM is also working with SPS to develop a medical physics-specific version of the Careers Toolbox for AAPM members.

AAPM Career Services is easily found with prominent top or side navigation throughout the AAPM website.
American Association of Physics Teachers (AAPT) *partner in the AIP Career Network*

The **AAPT Career Center**, the online job site for AAPT, has a dedicated “Resources” page housed within it. This includes six sections, each dedicated to a specific career development topic:

- **Recorded Career Development Webinars**
- **Career Advice**
- **Careers Toolbox for Undergraduate Physics Students**
- **Latest Employment Data for Physicists and Related Scientists**
- **Salary Calculator for Physics Faculty**
- **Career Information for Current Students**

All items above are sourced by AIP Career Network (CN). This includes content provided by CN but also CN securing permission from AAPT to post links to careers-related content from other AIP divisions (SPS, SRC, Physics Today). AAPT also promotes the online Career Center site, including the resources listed above, at their Winter and Summer meetings via branded Career Services giveaways (pens and another item) and a printed brochure, both created by CN and available at their membership booth.

The AAPT Career Center is moderately easy to find on the AAPT website, listed as the sixth sub-link under the “Resources” top menu navigation throughout the AAPT website.

American Astronomical Society (AAS)

They have a **Careers** tab on the front AAS landing page, that takes the user to a nice, well-organized **Career Resources** page – highlighting **Career Profiles**, **Career Workshops**, **Academic Career Advice**, **Nonacademic Career Advice**, **Job-Hunting Help**, **Communicating Research**, **Career Networking**, and **Employment Statistics**.

Also:

- **AAS Career Center**: highlighting information for recruiters, job seekers and AAS meeting attendance.
- **Internships & Summer Jobs**: Lists many summer opportunities and research experiences for undergrads.
- **About a Career in Astronomy**: Gives the lowdown on where the jobs in astronomy are located and what they do.
- **Committee on Employment**: Highlights committee members and contact information

Overall, the site is loaded with information and resources for all stages of careers.
American Crystallographic Association (ACA)
Resources & Links of Interest
Employment Opportunities

Careers is not located on any of the main tabs. However, if you click under “Learn” there’s a link to “Resources & Links of Interest.” The tab includes the following sections: About Crystallography; Educational Links; Online Courses; Teaching Crystallography; and Crystallographers’ Resources. On each page, there is a link under “Quick Links” to “Employment Opportunities.” ACA had three postings when I viewed the site. Overall, they have some helpful links.

American Meteorological Society (AMS)
Education & Careers
All About Careers in Meteorology
Career Guides and Tools
Networking Opportunities
Continue to Grow Professionally
Job Board
Intern Board
Students
Early Career Professionals
Mid and Senior Level Professionals

As soon as you log on to the website, you see the tab “Education & Careers.” Once you click on that page, there are a variety of categories you can choose from. It’s very easy to navigate. The top of the page are for resources for all educators (K-12 and undergrad) and then the bottom half is for career resources. AMS does a great job educating their target population about each field of interest (weather, climate, water sciences), providing data, resources as well as links to relevant job boards. Under their networking opportunities, AMS offers opportunities to volunteer, publish work and more! For professional development, resources provided are conferences, webinars, online training, certifications and literature references. There are resources for those in specific areas of their lives, such as students, early career professionals, and mid and senior level professionals. The only thing that I did not see was resume/CV/Cover Letter building. Overall, the career section of the AMS website is diverse, easy to navigate and relevant to the population.
American Physical Society (APS) (*partner in the AIP Career Network*)

APS has a wealth of careers-related material on their website, including the online [APS Job Center](https://www.aps.org/careers/job-center). Some resources are linked to from the job site via a dedicated “Resources” tab:

- **Job Prospects in Physics**
- **Writing an Effective Resume: An Online Tutorial**
- **APS Careers Website**
- **Salary Calculator for Physics Faculty**

Of the four MSs in the AIP Career Network (CN), APS by far has the most career development material sourced in-house; the final link above was approved for posting by APS at CN’s urging, while the others link to APS-sourced material. From the “APS Careers Website” page, many links can be accessed for career development material across a broad range of career levels. Of note are the interactive [Professional Development Guidebook: Physics Career Advice](https://www.aps.org/products-and-services/education-careers/physics-career-advice), which includes a resume tutorial; information about [Physics Innovation and Entrepreneurship Education](https://www.aps.org/products-and-services/physics-career-advice/innovation-and-entrepreneurship), featuring one-on-one stories about physicists and their start-up ventures; and the APS [Committee on Careers and Professional Development](https://www.aps.org/products-and-services/education-careers/committee-on-careers-and-professional-development), showing member involvement and dedication to the topic of careers. Additionally, APS provides many careers-related sessions and networking opportunities at their large annual March Meeting.

Several career development links and the APS Job Center are easily accessed with a prominent “Careers in Physics” top-navigation link throughout the Society’s website.

**Acoustical Society of America (ASA)**

A search for “careers” led to [here](https://www.acousticalsociety.org/careers).

AIP media services produced a series of career related videos for ASA in 2016. I was able to find some of those videos on YouTube ([Careers in Acoustics](https://www.youtube.com/results?search_query=careers%20in%20acoustics)).
AVS: Science & Technology of Materials, Interfaces, and Processing (partner in the AIP Career Network)

The AVS Career Center, the online job site for AVS, has a dedicated “Resources” page housed within it. This includes five sections, each dedicated to a specific career development topic:

- Recorded Career Development Webinars
- Career Advice
- Salary Calculator for Physics Faculty
- Career Toolbox for Undergraduate Physics Students
- Career Information for Current Students

All items above are sourced by AIP Career Network (CN). This includes content provided by CN but also CN securing permission from AVS to post links to or republish careers-related content from other AIP divisions (SPS and SRC). Beginning in 2017, AVS provides a professional leadership track at their annual meeting (usually in October) which features sessions throughout the conference about careers, including a popular speed networking event. AVS also promotes the online Career Center site, including the resources listed above, at the meeting via branded Career Center giveaways (usually pens) and a printed brochure, both created by CN and made available at their membership booth.

The AVS Career Center is moderately easy to find on the AVS website, listed as the fifth sub-link under the “Education & Outreach” side menu navigation throughout the AVS website; the top-navigation does not feature sub-links or drop-downs.
The Optical Society (OSA)

OSA has an easily navigable website with multiple ways to access their bountiful career development related activities and opportunities.

For any-stage-of-career professionals,
- There is a job fairs page – the OFC Career Zone & e-Career Centers – but no live links to anything, including a job postings list. Perhaps this is in-progress or under maintenance.
- A general career resources page with blog articles
- Opportunity to be a traveling lecturer for OSA student chapters
- Diversity and inclusion support, including grants and support for LGBTQ+, Historically black colleges, caretakers traveling to OSA meetings
- Networking with specialized technical groups [https://www.osa.org/en-us/get_involved/technical_groups/](https://www.osa.org/en-us/get_involved/technical_groups/)
- Professional development [https://www.osa.org/en-us/get_involved/professional_development/](https://www.osa.org/en-us/get_involved/professional_development/)
- Their meetings page has information about networking and short courses [https://www.osa.org/en-us/meetings/](https://www.osa.org/en-us/meetings/)
- OSA awards and grants [https://www.osa.org/en-us/awards_and_grants/](https://www.osa.org/en-us/awards_and_grants/)

For early career professionals,
- There is a page for finding post-doctoral assignments and internships with outside (of OSA) resources and job listings
- Early careers professionals programming
- Ambassadors program

For students,
- Student chapters of OSA - [https://www.osa.org/en-us/get_involved/students/student_chapters/](https://www.osa.org/en-us/get_involved/students/student_chapters/)
- International OSA Network of Students [https://www.osa.org/en-us/get_involved/students/ions/](https://www.osa.org/en-us/get_involved/students/ions/)
- There is a page for finding internships and for companies to seek interns. You don’t have to be a member of OSA to search for student internships, and companies can post internships for free if they are OSA corporate members.
- Student sections of OSA can host a traveling lecturer
- Ambassadors program

For K-12 students and their teachers,
- they have a page of education outreach with lab manuals, demonstration kits, videos, and other items.
- Explore Optics Kits as rewards for good outreach [https://www.osa.org/en-us/get_involved/world_science_day_optics/](https://www.osa.org/en-us/get_involved/world_science_day_optics/)
Society of Rheology (SoR)

Career development on the SoR website mostly consists of networking, opportunities for awards, and service within the society. These are scattered throughout the website. They have an annual meeting which is a career booster/networking opportunity.

For any-stage-of career professionals, they have a member web app (portal-type thing):

https://www.rheology.org/sormbr/

For any-stage or mid-career professionals, there are some opportunities for being recognized by the society in some fashion scattered throughout the website:

- The Society of Rheology Fellowship
- Bingham Award: presented at the annual meeting
- Gallery of Rheology Contest

For new professionals, they have the Arthur B. Metzner Early Career Award

For students, they have two Student-Member Service Opportunities.

- Representative in Executive Committee
- Member in Ad Hoc Inclusion and Diversity Committee

For middle and high school students and their teachers, they have a page of outreach activities based on rheology, made possible by a grant from the AIP Venture Fund and support from the SoR.
Appendix B: AIP Career Development Offerings

We have included things that are explicitly career development and things that tangentially support career development at all stages of careers.

- **Human Resources:** A little bit different than other departments since the focus is largely internal/within AIP
  - Provide **management skill development** for some member societies
  - Encourage professional development and well-being by curating **Training Tuesdays** content and promoting **LinkedIn Learning**
  - Create **career levels** to help staff know what is required to progress
  - Manage **tuition reimbursement** program for those continuing their formal education
  - Support **AIP and SPS interns**
  - Provide **one-on-one coaching**
  - Encourage public speaking and sharing of ideas with **AIP Chatters**

- **Statistical Research Center:** Focus on tracking how those in the physical sciences progress in their careers, from education to first job out of school to a decade after earning doctorates
  - Work with SPS on the **Careers Toolbox**, to help undergraduates and their mentors look ahead at what to expect from the job market upon graduation
  - Keep tabs on recent graduates, first with a survey a year after earning a degree and later with the **PhD Plus 10** study
    - Big challenge: Keeping up with those in the private sector
  - Resources for job seekers/holders, including **Salary Calculator** and lists of **who’s hiring bachelor’s and PhDs**
  - Who’s hiring physics PhDs includes job titles, skills, sectors, fields, and more
  - Understand diversity and representation in physical sciences workplaces with surveys focused on women/minorities and workplace climate

- **Physics Today:**
  - Host the **Physics Today Jobs** site and promote open positions on its website and on social media
  - Report on the state of the physical sciences discipline from many angles, including funding, job market, diversity, academia v industry, etc. See the Teams wiki for a sampling of articles from the PT archives.
    - Recent articles include focusing on **adjunct professors** and **master’s degree holders**, highlighting resources from **SRC** and elsewhere, and examining how advertisements in PT track the **employment boom and bust** over the decades
    - This October, PT will have a special issue dedicated to careers
    - Web team looking at ways to make PT more of a destination for information/reporting on career development
  - Solicit **commentaries** on issues relating to career development, and engage readers on those issues on social media

- **History Programs:**
  - **Grants-in-Aid** (supports mostly PhD candidates to travel and research at archives, record oral history interviews, or duplicate/digitize archival materials)
    - [https://www.aip.org/history-programs/physics-history/grants](https://www.aip.org/history-programs/physics-history/grants)
• 3-year Postdoctoral Fellow position [https://www.aip.org/history-programs/physics-history/postdoctoral-fellows](https://www.aip.org/history-programs/physics-history/postdoctoral-fellows)

• List of Science History communities (to be used for networking, idea sharing, etc. across institutions) [https://www.aip.org/history-programs/physics-history/resources](https://www.aip.org/history-programs/physics-history/resources)

• Early-Career Conference for Historians of the Physical Sciences (held every 2 years to foster communication between science history scholars and early-career scholars) [https://www.aip.org/history-programs/physics-history/early-career-conference](https://www.aip.org/history-programs/physics-history/early-career-conference)

• Grants to Archives (supports science history archival work at smaller institutions; can be used to do important preservation, inventorying, cataloging, hire staff) [https://www.aip.org/history-programs/niels-bohr-library/grants-archives](https://www.aip.org/history-programs/niels-bohr-library/grants-archives)

• Media:
  
  o Science Communication Awards (books, articles, writing for children, broadcast/new media) [https://www.aip.org/aip/awards/science-communication](https://www.aip.org/aip/awards/science-communication)
  
  o Broad dissemination of physics news to the public/increased awareness of the field

• FYI:
  
  o Opportunities digest: [https://www.aip.org/fyi/opportunities](https://www.aip.org/fyi/opportunities) (also in FYI This Week)
  
  o Events This Week section of FYI This Week
  
  o Education and Workforce article dissemination (science policy)

• Public Policy:
  
  o Partners with GR and APS’s GR departments around issues focused on:
    
    
    ▪ Undergraduate research - careers
    
    ▪ Outreach and professional career pathways - [https://www.spsnational.org/programs/outreach](https://www.spsnational.org/programs/outreach)
    
    ▪ UG student funding – multiple pathways
    
    ▪ Faculty training – teaching and industrial avenues
    
    ▪ New faculty & Dept. Chairs - representing
    
    ▪ Department health – careers and education
    
    
  o SPS Statements - [https://www.spsnational.org/about/governance/statements](https://www.spsnational.org/about/governance/statements)
  
  o SPS - Congressional Visits Day – currently suspended
    
  
  o Mather Internships
    
    ▪ [https://www.spsnational.org/programs/internships](https://www.spsnational.org/programs/internships)

• Careers:
  
  o Career networking – Sigma Pi Sigma
  
  o SPS Mentoring program - [https://www.spsnational.org/programs/alumni-engagement](https://www.spsnational.org/programs/alumni-engagement)
  
  o Careers starting at UG vs additional training -
    
    ▪ [https://www.spsnational.org/career-resources](https://www.spsnational.org/career-resources)
    
    ▪ [https://www.spsnational.org/gradschool-resources](https://www.spsnational.org/gradschool-resources)
  
  o Heavily shares AIP SRC data, graduate school information, and skills aimed around careers – GradSchoolShopper
Career toolbox and associated programs - [https://www.spsnational.org/sites/all/careerstoolbox/](https://www.spsnational.org/sites/all/careerstoolbox/)

Finding the right graduate program - [https://www.gradschoolshopper.com/gradschool/](https://www.gradschoolshopper.com/gradschool/)

SPS jobs – focused on internships - [https://jobs.spsnational.org/](https://jobs.spsnational.org/)

Careers information at regional meetings - [https://www.spsnational.org/meetings/zone-meetings](https://www.spsnational.org/meetings/zone-meetings)

SPS Internships - [https://www.spsnational.org/programs/internships](https://www.spsnational.org/programs/internships)

- **SPS/Education:**
  - Broad array skills, professional development, and leadership aimed at current undergraduate students.
    - Ex. - [https://www.spsnational.org/meetings/research-presentations](https://www.spsnational.org/meetings/research-presentations)
  - Materials aimed at Physics, astronomy, and the physical sciences (broadly).
    - [https://www.sigmapisigma.org/sigmapisigma/radiations/hidden-physicists](https://www.sigmapisigma.org/sigmapisigma/radiations/hidden-physicists)
  - Publications and chapter materials are a primary focus as a dissemination tool
    - [https://www.spsnational.org/the-sps-observer](https://www.spsnational.org/the-sps-observer)
    - [https://www.sigmapisigma.org/sigmapisigma/radiations](https://www.sigmapisigma.org/sigmapisigma/radiations)
    - [https://www.spsnational.org/journal-undergraduate-physics](https://www.spsnational.org/journal-undergraduate-physics)
  - Connecting Professionals (Sigma Pi Sigma) with students - SPS

- **AIP leadership (some of these are joint AIP-MS awards):**
  - **Andrew Gemant Award** (recognizes accomplishments of someone who has made contributions to cultural, artistic, humanistic dimension of physics)
    [https://www.aip.org/aip/awards/gemant-award](https://www.aip.org/aip/awards/gemant-award)
  - **Tate Medal for International Leadership in Physics** (recognizes international leadership and service to the profession of physics)
    [https://www.aip.org/aip/awards/tate-medal](https://www.aip.org/aip/awards/tate-medal)
  - **Karl Taylor Compton Medal for Leadership in Physics** (recognizes physicists for statesmanship in science)
    [https://www.aip.org/aip/awards/compton-medal](https://www.aip.org/aip/awards/compton-medal)
  - **The Dannie Heineman Prize for Astrophysics** (recognizes outstanding work in astrophysics)
    [https://www.aip.org/aip/awards-and-prizes/heineman-astro](https://www.aip.org/aip/awards-and-prizes/heineman-astro)
  - **The Dannie Heineman Prize for Mathematical Physics** (recognizes outstanding publications in mathematical physics)
    [https://www.aip.org/aip/awards-and-prizes/heineman-math](https://www.aip.org/aip/awards-and-prizes/heineman-math)
  - **Abraham Pais Prize for History of Physics** (recognizes scholarly achievements in the history of physics)
    [https://www.aip.org/aip/awards-and-prizes/pais](https://www.aip.org/aip/awards-and-prizes/pais)
  - **William F. and Edith R. Meggers Project Award** (funds projects for improvement of high school physics teaching)
    [https://www.aip.org/aip/awards-and-prizes/meggers](https://www.aip.org/aip/awards-and-prizes/meggers)
  - **Fluid Dynamics Prize** (recognizes and encourages outstanding achievement in fluid dynamics research)
    [https://www.aip.org/aip/awards-and-prizes/fluid-dynamics](https://www.aip.org/aip/awards-and-prizes/fluid-dynamics)

- **TEAM-UP**
  - Upcoming 2020 **Task Force Report** including evidence-based recommendations for how to increase African American physics and astronomy bachelor’s degrees
    - Work with partner schools to implement recommendations
  - #TEAMUPTalks **Twitter Chats**

- **Industrial Physics Forums**
Appendix C: Highlights from Literature Review

Mentorship

- Results primarily about mentorship in academia
- Recognized weaknesses: structuring a quality mentorship program, training for mentors, and minority representation and burnout.
- Keys to success: compatibility of mentor/mentee relationship (age, gender, organization position, personality all play a role)
- Mentoring in digital age: web programs such as MentorNet are helpful for those without access to local mentors.


https://slate.com/business/2014/09/most-prestigious-jobs-in-america-the-short-list-has-barely-changed-in-37-years.html puts doctor, scientist, engineer, nurse, firefighter, military officer, police, priest, etc. in high prestige

PT had an article on data science as an attractive career for physicists, Big Bang Theory and image of physicists, Spencer Weart says he studied physics because he liked scifi and because of sputnik:https://www.manhattanprojectvoices.org/oral-histories/spencer-wearts-interview


- Intrinsic and external factors are involved. In the US, it’s very heavy on the intrinsic side, of personal interest and personality traits
  - The studies carried out in Canada, Finland, Germany, Spain, Switzerland and United States of America showed a high level of individualism, which typifies intrinsic motivation for career choice. Youths in individualistic cultural settings were influenced by the combinations of intrinsic (personal interest, personality trait, self-efficacy), extrinsic (job security, high salaries) and to a lesser extent, interpersonal (parental guidance) factors
and are encouraged to make their own career decisions (Mau, 2004; Gunkel et al., 2013). In contrast, studies carried out in Argentina, Burkina Faso, Bulgaria, China, Croatia, Hong Kong, India, Indonesia, Japan, Mexico, Portugal, South Africa, South Korea, Taiwan, and Ukraine showed a high level of collectivism. Youths in collectivist cultures were mainly influenced by interpersonal (honoring parental and societal expectations and parental requirements to follow a prescribed career path) and extrinsic (prestigious professions) (Mau, 2000; Gunkel et al., 2013). The opinions of significant others matter significantly to youths from collectivist cultural settings. Whereas, in individualistic cultures, youths tend to focus on professions that offer higher income and satisfy their personal interests (Wüst and Leko Šimić, 2017; Polenova et al., 2018).

- Maybe we can make the leap that this means that contributing to more awareness of the different careers in science, and representing the variety of people who do science, is part of the career development efforts that AIP does. Or maybe we could commission or fund studies into it.

Popular media resonate in public perception of careers and the esteem related to them:

Moneyball, a book written by Michael Lewis that became a Brad Pitt movie is now the go to description for someone who takes data and applies it to a new arena. There’s moneyball for soccer, and politics (hello Nate Silver), movies, restaurants, policing, etc., etc. I don’t know about proving causation, but I can’t help but think that the affinity of Silicon Valley to try to find an algorithm for everything was buoyed by this rise of Moneyball, and that in turn that has help raised the profile of data scientists, and of the career itself.

Similar to use of Rocket Scientist, Einstein, or even physicist. Media reports undoubtedly gave rise to the popularity of these terms

Interesting notes:
https://www.jstor.org/stable/3183078?seq=1#page_scan_tab_contents

https://www.newyorker.com/magazine/1998/07/20/not-rocket-science

Physicists from the Manhattan project entered popular culture, and the incredible power gave them an incredible profile. Like, what does a biochemist do? The broad public has no idea. But a nuclear physicist – those are the guys who make weapons and Chernobyl, right?

https://en.wikipedia.org/wiki/Nuclear_weapons_in_popular_culture

So this notoriety can be positive or negative, but it is publicity for the discipline. So if David Epstein reads Inside Science or Physics Today for background on graphene, or if FactCheck.org cites FYI or an Inside Science story about global cooling, we’re helping to guide the conversation in many different kinds of careers, and also in general promote a scientific, fact-based, evidence based outlook.
Appendix D: Career Development in 2030 and beyond

Initial Brainstorming
1. Questions
   a. What are the trends? Where is it going?
      i. What are the current crises points that could direct future trends?
        1. Emerging Technologies
           b. Brief Lit
              i. A lot of questions remain: https://www.pnas.org/content/116/14/6531
              ii. Also see: https://www.pnas.org/content/115/50/12624
        2. Sexual harassment
           a. Nearly three quarters of women in U.S. physics undergraduate degree programs report experiencing some form of sexual harassment, according to a study published last week in a physics education research journal. The researchers used survey responses from 471 students who attended a conference for undergraduate women in physics. The authors found that experiencing some form of sexual harassment, ranging from unwanted sexual attention to gender-based discrimination, “correlated to a negative sense of belonging and an exacerbated sense of the imposter phenomenon.” In the concluding section of the paper, they write, “Our findings of the pervasiveness of sexist gender harassment and its significant effect on sense of belonging for female undergraduate physicists should be a wakeup call for all physicists who believe that participation in science should be meritorious.” (see: https://jourrnals.aps.org/prper/pdf/10.1103/PhysRevPhysEducRes.15.010121)
           b. Moves by NAS
              (see: https://www.nap.edu/catalog/24994/sexual-harassment-of-women-climate-culture-and-consequences-in-academic), NSF
   b. Discrimination (i.e., implicit bias)

4. Work-life balance, including mental health

5. Cost of education
   b. Some data: https://nces.ed.gov/fastfacts/display.asp?id=76

6. Age, including burnout and priorities (i.e., family or two-body problem, retirement and being forced out?)

   i. Consequently, the retirement of large numbers of experienced workers could mean the loss of valuable S&E expertise and knowledge. However, the retirement of older workers also makes room for newly trained S&E workers who may bring updated skills and new approaches to solving problems. (See Stephan and Levin [1992]; Jones, Reedy, and Weinberg [2014]; and Blau and Weinberg [2017] for in-depth discussions on age and scientific productivity.)

   ii. The aging of the S&E labor force is reflected in the median age, which has risen from 40 years in 1993 to 43 years in 2015. For proper context, the median age nationally for the U.S. population was 34 years in 1993 and 38 years in 2015. Another indicator, the percentage of individuals in the S&E labor force between 51 and 75 years of age, has risen from about 20% in 1993 to 33% in 2015. Over that period, this proportion rose for both men and women, but the women in the labor force continue to be younger relative to their male counterparts (Figure 3-22). In 1993, the median ages were 38 years for women and 41 years for men, whereas in 2015 the median ages were 41 years for women and 45 years for men.

   ii. Where is the funding heading?
      1. FYI covers a lot of this

b. What are the jobs?
   i. In what sector will these jobs be present?
   ii. Where, physically, will these jobs be located?

b. What are the skills required?
   i. Potential for future automation of careers and tasks (i.e., patents and AI)
1. Implication of open science: [https://link.springer.com/chapter/10.1007/978-3-319-96906-0_18](https://link.springer.com/chapter/10.1007/978-3-319-96906-0_18)

d. What form will Member Societies take in the future, given questions of open access and money streams? How can they provide support in that form?

What are the trends? Where is it going?

In general, we see the following trends (see: [https://www.rand.org/pubs/research_briefs/RB5070/index1.html](https://www.rand.org/pubs/research_briefs/RB5070/index1.html)):

- Employees will work in more decentralized, specialized firms, and employer-employee relationships will become less standardized and more individualized.
- Slower labor force growth will encourage employers to adopt approaches to facilitate greater labor force participation among women, the elderly, and people with disabilities.
- Greater emphasis will be placed on retraining and lifelong learning as the U.S. workforce tries to stay competitive in the global marketplace and respond to technological changes.
- Future productivity growth will support rising wages and may affect the wage distribution; the tie between employment and access to fringe benefits will be weakened.

Firms are moving from vertically integrated organizations to more specialized ones that outsource noncore functions and to more decentralized forms of internal organization. We can expect a shift away from more permanent, lifetime jobs toward less permanent, even nonstandard employment relationships (e.g., self-employment) and work arrangements (e.g., distance work). These arrangements may be particularly attractive to workers trying to balance work and family obligations or to the disabled and older people who would benefit from alternative arrangements.

In a tight labor market, employers can try to recruit groups with relatively low labor force participation. Changes in incentives associated with pension plans and reforms to Social Security may motivate older workers to retire later. Providing child care may make it easier to recruit women with children. Also, changes in technology and in the workplace described above may make it possible to recruit more people with disabilities into the workplace. Immigration policy offers another lever, in particular to target highly skilled aliens, thus raising the overall skill levels of the U.S. workforce.

Rapid technological change and increased international competition spotlight the need for the workforce to be able to adapt to changing technologies and shifting product demand. Shifts in the nature of business organizations and the growing importance of knowledge-based work also favor strong nonroutine, cognitive skills, such as abstract reasoning, problem-solving, communication, and collaboration. In this context, education and training becomes a continuous process throughout the life course, involving training and retraining that continue well past initial entry into the labor market.


In both the United States and the rest of the world, the S&E workforce has experienced strong growth. During the 2007–09 recession, U.S. S&E employment remained more resilient than overall employment. Policymakers with otherwise divergent perspectives agree that jobs involving S&E are good for workers and for the economy as a whole. These jobs pay more, even when compared to non-S&E jobs requiring similar levels of education and comparably specialized skills. Although S&E workers are not totally shielded from joblessness, workers with S&E training or in S&E occupations are less often exposed to periods of unemployment.

Innovation based on S&E R&D is globally recognized as an important vehicle for a nation’s economic growth and competitive advantage, and growing numbers of workers worldwide are engaged in
research. Growth has been especially marked in rapidly developing economies, such as China and South Korea, that have either recently joined the ranks of the world’s developed economies or are poised to do so. Mature developed economies in North America and Europe have maintained slower growth, but the number of researchers in the struggling Japanese economy has somewhat stagnated.

The demographic composition of the S&E workforce in the United States is changing. The baby boom portion of the S&E workforce continues to age into retirement. However, increasing proportions of scientists and engineers are postponing retirement to somewhat later ages. At the same time, members of historically underrepresented groups—women and, to a lesser degree, blacks and Hispanics—have played an increasing role in the S&E labor force; although this has been more the case in some fields (e.g., life sciences and social sciences) than in others (e.g., computer and mathematical sciences, physical sciences, and engineering). Despite the recent increases in S&E participation by women and by racial and ethnic minorities, both groups remain underrepresented in S&E compared to their overall labor force participation. For example, women account for less than one-third of all workers employed in S&E occupations in the United States despite representing half of the college-educated workforce.

What are the jobs?

- Not necessarily related, but degrees of all levels in physics continue to rise annually.
- Is there any chance of college becoming less important? Most research seems to say no, and that a more highly educated workforce is vital for the future.


- Have this updated for 15/16. Employment straight out of college continues to increase.


- Have this updated for 15/16. Postdoc and potentially permanent cross each other.
- Generally, higher rate of potentially permanent employment occurs during healthier economic years.
- There is a version of this that highlights specific historical events. We will look into reproducing this with more current data if we consider this valuable.
- Unsure if proportion of potentially permanent employment will continue to increase.

https://www.aip.org/statistics/whos-hiring-physics-bachelors
https://www.aip.org/statistics/whos-hiring-physics-phds

LinkedIn: 12 jobs you’ll be recruiting for in 2030

Where, physically, will these jobs be located?

- Large movement towards more mobile work etc.
- As has been true for decades, majority of STEM jobs are focused on east/west coast and/or in large metropolitan areas.
- From Bachelors Who’s Hired 2012 to 2016 most common states listed as location of employment were CA (157), NY (80), MA (64), IL (57), WI (56). These combine for about 40% of all employed bachelors in the resource.
- Wisconsin is interesting, but mostly because the company “EPIC” has employed a ton of physics bachelors in recent years. It is unclear whether this will continue, but has not shown any signs of slowing down.
• For phds: largest employers are INTEL, Google, Mckinsey & Co., IBM, KLA Tencor, Epic Systems
• There is a lot of overlap between phd emps and bachelor emps, except more business positions for phds.

Career Development - research from the New America Foundation 2030 project

NAF has spent the last two years visiting large, medium, and soon to be small cities to see what the population thinks their community will be like in the future, and tied it into research does elsewhere.

The vast majority would like a stable paycheck

The research suggests the opposite, that work is becoming more and more flexible, erratic, and based on projects, without any loyal from the company to its employees.

Workers expect their employers to provide training for new roles. Companies expect people to have the skills they are looking for when they are hired (i.e. education will have to be something employees will have to do on their own dime).

Community Colleges, despite being the most cost-effective way to pick up new skills, are looked down upon by both employers and employees. The only place this changes out is if the community college acts as a feeder to local schools.

AI in the early 2020s was seen by employers as a way to find their ‘perfect’ candidate. However, the result was a failure, both by the jobs related companies, and by employers, who soon realized that the ‘wrong’ candidates were being picked for their roles, and ‘subconscious’ bias by the algorithms used put too many companies in breach of the civil rights and racial discrimination act.
Appendix E: The Career Development White Paper Team

- Brad Conrad, SPS & Sigma Sigma Sigma
- Chris Gorski, News & Media Services
- Andrew Grant, *Physics Today*
- Paul Guinnessy, *Physics Today*
- Karin Heineman, News & Media Services
- Rachel Ivie, Education & Research
- Hyun Joo Kim, Creative Services
- Audrey Lengel, Niels Bohr Library & Archives
- Corinne Mona, Niels Bohr Library & Archives
- Kat Overland, Marketing & Communication
- Jack Pold, Statistical Research Center
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Thank you!