Progress in High School Physics Outreach

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Abstract: Outreach is a necessary activity for physicists to disseminate research and expose future scientists to the field. However, high school teachers' lesson plans are usually packed, and ever-changing state standards for teaching take up time. Nevertheless, outreach is a crucial time to develop high school students' understanding of research, physics, representation in the field, accessibility, atmosphere, and career paths. In light of this, we provide a list of points to keep in mind when planning outreach efforts. We conclude with a proposed survey of outreach activities as well as a database for exchanging ideas.

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Introduction

High school classrooms are at the intersection of career development, accessibility, and outreach. To engage with high schools, physicists lead a broad range of activities. Among these are on-campus science outreach days for students at universities and national laboratories, summer research programs for high school educators, and YouTube channels geared toward young audiences and their curricula. Independent of the program type, expanding on these activities would require more time from students and teachers alike, which is a general barrier to scaling up outreach. With packed lesson plans for teachers, rapidly changing state standards, and numerous standardized tests, time is a valuable resource for high school classrooms. It is then important to consider the following points when looking to maximize outreach program efficacy.

1. Understanding the research process is not always a requirement for students.

State standards and standardized tests often dictate whether students will learn about the research process. State standards in particular do not follow an easily understood pattern. The Next Generation Science Standards [1] were meant to remedy this, but as few as 19 states have adopted this framework. This results in a majority of states developing their own standards, which are more sensitive to changes in state legislatures. Before engaging with a classroom or school, it is advisable to understand the standards. There could be a way to incorporate the outreach into their framework. Focusing on how research works - even more than on the content of the physics - could be necessary. For example, states such as Indiana have only recently introduced more science standards related to research [2]. Implementing these standards can take years, and physics outreach programs can aid in their integration to the classroom.

It is important to remember that although high school curricula focus on breath and not depth, integrating exposure to physics research while still being cognizant of a given school's standards can be achieved. In particular, one step would be to provide summaries to a school's science faculty of how a particular topic that is being taught in the classroom can directly connect to a specific field in physics research. In fact, the American Physical Society, APS, has hosted a summer lecture on how to integrate research into a classroom [3]. While the focus was on undergraduate courses, the advice given can be adapted for use at the high school level instead.

2. Some outreach programs are the only time students interact with physicists before graduating.

Proximity to universities, national laboratories, and industries is one factor that influences how often high school students interact with physicists. This leads to an appreciable fraction of physics outreach programs being the only such program in which students partake.

Representation matters as a general rule, and with these instances, it certainly matters. In terms of accessibility to careers, to diversity, and to inclusion in the field, students will form an opinion based on these limited experiences in an outreach program. Understanding explicit and implicit biases (personally and in the field) will empower physicists to approach, plan, and execute outreach programs with increased efficacy. Relevant topics to understand include "stereotype threat" in which students' attention can be diverted from learning or performing to, instead, worrying about how to disprove a negative stereotype about their identities. Word choice can prevent (or exacerbate) this phenomenon.

To maximize the potential of reaching as many students as possible through outreach programs, it is important to target schools and districts where the means or ability to visit and interact with professionals at universities and laboratories is limited. One way is to consider interacting with inner city schools. This can be done through contacting an already established liaison within these regions such as K-12 STEM+ Pre-Collegiate Program from Chicago which is associated with the Illinois Institute of Technology [4]. They have been bridging gaps in education by providing resources to predominately underserved communities and increasing female representation in science. To become involved nationally, the Associated Universities Inc. Office of Education and Public Engagement, OEPE, would be a useful contact [5]. They and several other organizations have the means to connect with the districts most in need of scientists involved in outreach.

3. Educators' ability to seek out and take on new programs is limited.

With educators preoccupied with localized school requirements as well as state standards and tests, they do not always have the time to reach out or to take on new outreach programs. To better reach out to them, statewide teacher conferences are an effective option for networking. In Indiana, the Hoosier Association of Science Teachers, Inc. (HASTI) [6] draws hundreds of K-12 educators to one location annually. Oral presentations or setting up a booth are both easy ways to get involved and meet educators. To better integrate into their curricula, it is advisable to understand the local needs of educators' classrooms. This could require physicists not to entirely plan out their outreach activities so that they can adapt to classroom dynamics and curricula.

A Proposal for Physics Outreach Initiatives

With the thoughts in mind that we have presented, we propose a survey of current outreach efforts as well as a database for searching and sharing these outreach initiatives.

References

[1] Next Generation Science Standards. https://www.nextgenscience.org/

[2] “Integrated Chemistry & Physics Resources.” Indiana Department of Education. https://www.doe.in.gov/standards/integrated-chemistry-physics-resources

[3] American Physical Society. https://www.aps.org/

[4] “K-12 STEM+ Pre-Collegiate Program. K-12 STEM+ Pre-Collegiate and Youth Leadership Programs.” Illinois Institute of Technology. https://alumni.iit.edu/k-12-stem-program

[5]AUI Office of Education and Public Engagement. http://epe.aui.edu/about-oepe/

[6] Hoosier Association of Science Teachers, Inc. http://www.hasti.org/