

Applied Science Research for All Part 1 Pre-College Level

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Abstract: The field of applied scientific research is important for the health, welfare and security of all countries in the world. Applied research scientists should be involved in the education of new generations of investigators. Institutions can reward them for such participation. It is well known that science fairs only reward a few winners and hundreds of others are left with no reward and possibly less inspiration to continue in science. In fact, Finland was ranked at the top in the U.N. World Happiness Report primarily because it aims not to leave any student behind, instead of only nurturing high achievers. This paper is intended to interest applied research scientists in the education of new generations of prospective applied researchers by presenting programs that do not leave any interested students behind. As presented in a National Science Teaching Association Commentary, by Steve Oppenheimer read by hundreds of thousands in the education community, and in a National Science Foundation webinar, this paper for the first time brings 2 key programs to applied scientists. One is a journal, whose 25 annual volumes inspire all students. The other is a symposium that does the same. The concept of science research for all students helped Steve Oppenheimer, win a U.S. Presidential Award for mentoring (PAESMEM), presented at the White House by President Obama. The American Association for the Advancement of Science (AAAS) cited Steve's work with K-12 programs, as well as his glycobiology research, in his election as Fellow AAAS. In the journal and symposium there are only rare rejections. Problem submissions are corrected. The late Nobel laureate Francis Crick, who believed in the motto of science research for all, was an early collaborator in these programs. These programs can be easily replicated, especially with the involvement of applied research scientists, who in partnership with the education community, can interest many more students in applied research science. The involvement of Dr. Crick attests to the importance of bringing research scientists into these training programs. Many universities and organizations will count mentoring involvement in evaluating scientists for tenure and promotion.

Keywords: Pre-college Research, Involvement of Applied Researchers, Journal and Symposium

1. Introduction

In an invited Commentary presented in the October 2019 issue of the Newsletter of the National Science Teaching Association (NSTA), NSTA Reports, Steve Oppenheimer presented "The Value of Recognizing the Efforts of All Science Students." [1]. This Commentary was also presented by Steve in the National Science Foundation invited Webinar

on supporting science research in education on August 11, 2020 [2]. The Commentary was read by hundreds of thousands of mostly pre-college teachers. The gist of the NSTA Commentary, and the focus of this paper, is how to inspire many more pre-college students to enter fields of applied scientific research. The reason for submitting this paper to an applied scientific research journal, rather than an education journal, is because the paper is about how applied

research scientists can influence the future of applied research education at early levels when youngsters are not yet sure of their future careers. By the time they enter college, their career choices are often already decided [3]. This paper presents two award-winning programs [4, 5] to the applied science research community, as previously it was only known by some educators. It is important to present this information to scientists if we are to inspire many more youngsters into choosing applied research careers. This approach has been recently lauded in the literature and is one reason for Steve's receipt of a U.S. Presidential Award for mentoring (PAESMEM) and his election as Fellow of the American Association for the Advancement of Science (AAAS) [6]. Good pre-college science experiences help youngsters choose science majors in college [3].

Finland has been ranked at the top in the U.N. Happiness Report, apparently in large part due to its education system that aims not to leave any student behind, rather than only nurturing high achievers [7].

2. Experimental Procedure

An award-winning [4, 5] pre-college journal is described that recognizes all participating students who have completed their reviewed research work, not just the advanced few. A poster symposium is also described that recognizes all completing participants with medals and certificates. Scientists with expertise in applied research, along with teachers and editors review the student-authored materials. If there are problems with submissions, teachers and students are contacted to make needed corrections. Rejections are very rare. Nothing is rejected unless there was harm to animals or humans that occurs very rarely, and is cited in the journal front material or the work is not repairable. Most abstracts are professionally edited and copies of the journal are distributed to all student authors free of charge. All 25 annual issues [8-33] of the journal are made available online to anyone in the world, free of charge.

3. Results and Discussion

Hundreds of K-12 students each year through their teachers (who do the first review), submit their research abstracts to Steve Oppenheimer (steven.oppenheimer@csun.edu) by email. An examination of the thousands of abstracts in the 25 annual volumes of the journal [8-33] will reveal that many or most are in the area of applied research. Young students love practical research that solves real world problems. Steve looks them over and sends them by email to the expert associate editor Mindy Berman, who gives them rigorous scrutiny and editing, sending them to the other associate editor Dr. Helen Chun who provides a 4th expert review (4 reviews: teacher, Steve, Mindy and Helen). Mindy contacts the teachers of abstracts that need modifications. Each volume of the journal is carefully designed by our award-winning designer Alvalyn Lundgren. The secret to the 25 years of success is this team of editorial

experts and the principle that no child is left behind.

The current 25th Anniversary issue (in press) of the journal, in addition to hundreds of usual abstracts, features work from Dominique Evans-Bye's classes. Dominique is one of a few of hundreds of U.S. Presidential Award winners (PAESMEM) that is a pre-college (high school) teacher... maybe the only one in decades. The Presidential Award is the nation's top award for science student research mentoring. Most winners are college level mentors as is Steve Oppenheimer. Of hundreds of Presidential Award winners, only Dominique was chosen by NSF to present a webinar on research in the classroom [2]. She selected Steve to co-present, indicating that Steve was a major reason for her success, starting in his programs decades ago. In the early days of these programs (1980s- 1990s) the late Nobel laureate Francis Crick worked with Steve on these programs, visiting the campus for about 10 years, working with and inspiring pre-college teachers and their classes. Dr. Crick was a big believer in science research for all. If Nobel laureate Francis Crick believed in these programs, many more applied research scientists might consider involvement. Professional advancement may be enhanced by such involvement. Institutions now-a-days often consider such participation in addition to research productivity.

The annual poster symposium that presents medals and certificates to all student presenters, who have gone through our multi-step process, leaves no student behind. A large cadre of advanced undergraduate students visit each poster and discuss it with the child. California State University, Northridge Vice Provost Matt Cahn said of a recent symposium: "This is one of those transformative opportunities that we hope all students have."

Former students who participated in the journal and symposium report that their siblings "fight" to become involved in the journal and symposium. Rewards like a published abstract and medal and certificate represent university recognition, inspiring many of the youngsters to continue in applied science. While science fairs often only reward a select few advanced students ("winners"), the programs reported here reward all completing participants. That's one reason why the National Science Foundation and White House in reviewing Steve Oppenheimer's application for a U.S. Presidential Award said that his motto of saying that all interested students can do good science research was realized based on well documented data [6].

Applied research scientists can replicate these programs, helping to insure that applied scientific research will continue to flourish for decades to come. While the NSTA Reports Commentary and NSF Webinar were viewed by mostly pre-college teachers, it is the scientific community that will help assure that many more youngsters will consider careers in applied science research. By the time students reach college, their career choices are often already in stone [3]. These programs can be replicated by schools and school districts. But without the involvement of applied research scientists, program quality can not be guaranteed, and university recognition often will not occur. University recognition is so

important an inspiration for pre-college youngsters. Decades ago Dr. Crick played a key collaborative role to help enhance these programs to the success they enjoy today. Both the journal and poster symposium praise the children for their enthusiastic effort. In fact children dance with joy (reported by teacher Terri Miller) when they see their project in print. Terri also concluded, based on decades of observations that these programs enhance students' self image, seeing themselves as real scientists. Praise for effort (34) is a key to how these programs inspire youngsters.

4. Conclusion

In order to motivate many more students to enter careers in applied research science, applied research scientists should be involved in their education. The programs described here provide a model for such involvement. A key concept that helps assure success is that all interested students should be guided to do applied science research where students are recognized for their good efforts.

The value of recognizing the efforts of all interested science students is essential to inspire many more students to seek careers in applied research science. Career choices are often determined way before college and that's a major reason for involving the youngest students in good science opportunities. These programs have been widely recognized by the National Science Foundation, the White House, the National Science Teaching Association, and the American Association for the Advancement of Science. The 10 year collaboration with the late Nobel laureate Francis Crick attests to the importance of these programs in training new generations of applied research scientists.

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