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The SACNAS biography project

Jason Shaw

Department of Mathematics

University of Colorado

Boulder, CO 80309

William Yslas Vélez

Department of Mathematics

University of Arizona

Tucson, AZ 85721

The United States is currently facing a severe shortage of mathematicians, scientists and engineers. This shortage is so severe that we have to import scientific talent in order to meet the needs of industry. Even though there is a tremendous need for scientifically trained citizens, U.S. students are avoiding these careers.

When students are first introduced to mathematics and the sciences, it may seem difficult for most of them to imagine themselves ever becoming mathematicians, engineers or scientists. For example, how does it seem possible for the study of algebra and geometry to be in any way connected with the motion of the planets, or the structure of a building? It's all just equations and memorization. It might not even be imaginable to children that they could have a job someday where they studied tsunamis for a living, or get paid to figure out why certain stars in the sky are brighter than others.

If each neighborhood had a resident mathematician, scientist or engineer that could explain their career to the neighborhood students, we would see a change in the career paths of our students. If children could talk to someone just like themselves, someone that came from their cultural group, their economic level, then we would see these students aspiring to be just like the neighborhood scientist.

Since the typical neighborhood will not likely have these role models and the entertainment media has not portrayed these professions in such a way as to make them visible and/or appealing, it is often up to teachers to motivate their students to aspire to these professions. But even here there are problems. It is difficult for a teacher to get a mathematician to come in and explain exactly what she does in her office all day, or a biologist to explain why the mapping of the human genome will have such an important societal impact. On a more human level, it is also important for students to see the career paths of these professionals. Students don't have the foggiest idea as to the training that is involved, the opportunities for travel that these professions entail, and the excitement that is part of the discovery process.

Students need information about the problems that science is currently addressing. But there is also another important dimension. How have others pursued their careers? What were the barriers that had to be overcome and the challenges that were faced? Minority populations and students from low-income families have other concerns. How does someone pay for so much education? Are there any scientists whose situation was similar to theirs? Females are oftentimes unaware of the many women who have had successful scientific careers.

For the vast majority of our students, neighborhood role models in the sciences will not exist for years to come. For teachers it will be a continuing problem to find these role models to visit the classroom. And that brings us to the subject of this paper. We propose two different, but linked, activities.

1. Introduce teachers to a resource of virtual role models, a website that contains a collection of biographies of mathematicians, scientists and engineers.
2. Present an activity for students to plan out a scientific career.

THE SACNAS BIOGRAPHY PROJECT

The Society for the Advancement of Native Americans in Science (SACNAS, www.sacnas.org) was established by a very small group of concerned Chicano and Native American scientists in 1973. The purpose of this organization is to encourage Chicano/Latino and Native American students to pursue advanced degrees in engineering, mathematics and the sciences. From this modest beginning SACNAS has become one of the premier minority organizations in the country. In 2002, the National Science Board recognized this organization with its Community Service Award in recognition of its dedication to increase the number of minority students pursuing degrees in the sciences.

In 1996, under a grant from the Sloan Foundation, the SACNAS Biography Project (www.sacnas.net/biography/default.asp) was undertaken to serve as an on-line resource for K-12 educators. The purpose of this ongoing project is to enable educators to expose their students to professions that might not be visible in their students' everyday lives, such as scientists, engineers and mathematicians. By profiling Chicano/Latino and Native American professionals in these fields, the project allows educators to use the internet to bring these role models into the classroom, complete with stories about their lives and how they came to become molecular biologists, mechanical engineers, mathematicians, oceanographers, etc. By bringing these professionals into the classroom virtually, it is hoped that the stories that they bring with them will touch a nerve in a student, get them to start thinking about the possibilities available in the world, and to have them see the world from the fascinating viewpoint of a mathematical scientist. The main point of the project is to help our children to begin dreaming about their futures. At the time of the writing of this article, there were over 70 biographies posted on the website.

The website has been set up to be used in many different ways. The biographies are listed in alphabetical order, by scientific subject, by ethnicity of the scientist, and by a listing consisting of just the women scientists. For example, if the student is interested in a particular scientific subject, he/she may peruse the biographies written on those within

the field. It may be a way for the student to see what exactly is required for each discipline, what needs to be done and how it has been done by those profiled. This is an excellent way for a student to be exposed to some of the variety available within each field, and what the student may expect to see while pursuing this field during the undergraduate, graduate, and finally the post-graduate phase of his/her career. And if a female student wishes to see what pathways women have followed in science she will be able to see how obstacles particular to women in science were handled by those before her as well.

Many of the biographies have two versions, the middle school level and the high school level. The middle school level version is a shorter version. Many of these biographies begin with a story, a story that is linked to the academic life of that individual. This is done both to inspire and to intrigue the reader, by giving a specific idea of what they might expect to one day do within this field. The high school level version is meant to be a more mature approach, giving the reader some insights into what they might expect in the soon-following college years (undergraduate, graduate, and beyond), as well as a more technical job description. The biographies on this level range from showing how one person might go from discipline to discipline before landing on his/her current profession, to how a person might know from the very beginning the path to take, and what he/she encountered as hurdles along the way. It is a good way to see the perseverance and seriousness necessary to enter scientific disciplines, as well as the ample rewards reaped for such efforts. Some inspirational stories are told that could possibly apply to a particular student's life in a very personal and profound way. Both versions attempt to describe the difficult transitions that school presents. It will be surprising to the students that these prominent scientists didn't just breeze through their schooling. Many difficulties were encountered along the way.

All of the biographies on the SACNAS website have web links to the scientists featured, to institutions where the scientist studied or worked, and to the scientific topics that are associated to that scientist.

The SACNAS website also has a link to resources (called "Resources") that could be invaluable to both educator and student. Following this link will lead one to many other biography projects on the web that highlights minority and women scientists. There are also links especially for K-12 educators, consisting of information about mathematics and science, minority students, professional development, and financial aid opportunities available to educators and minority students alike. Lastly, there is a general glossary of the terms found within the biographies, which are often highly specialized and unknown to a general audience. This makes it possible for the student to read the biographies with deeper comprehension, while introducing them to scientific terms at the same time. Some of the terms are complete with web links that further the knowledge of the reader. The abundance of knowledge and information available within these resources will certainly lead to deeper investigation about the scientists and their disciplines, as well as give a much needed starting point for educator and student alike for both professional development and financial assistance.

HOW THE SACNAS BIOGRAPHY PROJECT CAN BE USED IN YOUR CLASSROOM

The imagination of the educator is the only limit in how the biography project can be used in the classroom. The set up of the website allows much freedom in how it can be used. For instance, a printout of one scientist per week could be made, making that scientist the chosen "Scientist of the Week." Since the biography is linked to the scientist's home web page, the students can gain a closer look at what a scientist actually does. The home pages of these scientists also contain a wealth of information regarding the projects and interests the scientist is currently involved in, which could serve as a launching pad for the imagination of the student. Also, the web links in each biography offer opportunities that could lead to further discoveries on the part of the student. The web links lead to encyclopedia articles, interesting websites on the subject, or even to basic definitions that could help both enlighten and intrigue the student. But the web links are not limited to information about the profession of the scientist. They can give interesting facts about where the scientist is from, where she went to school, or even historical events that occurred that somehow affected the scientist's life in a meaningful way.

Further student research could be conducted on the scientist's discipline in general, state of residence, alma mater, or on the scientist herself. The personal home web pages of the scientists and the web links within the biography make the process of discovery something that can be taken to any level the educator wishes, or any depth the student desires.

The home pages of the scientists featured often display their extensive curriculum vitae. This document describes not only the many scientific papers that are published but also a record of lectures given throughout the world, the committee work that sets public policy, and the amount of funding that is so critical to today's science. This document allows the student to see the immense complexity that is present day science.

THE FUTURE SCIENTIST BIOGRAPHY ACTIVITY

We are attaching to this article a Future Scientist Biography. We encourage the reader to create their own versions for their students. This activity will allow students to focus their career goals by means of a fictitious future scientist biography written about them. Notice that there is also a place on the biography for names of families. It is important for students to see their success in a family context. It is also important for the parents to read their student's biography so that they can envision these goals for their children. By having parents read over the student's biography, perhaps the parents will see the importance of taking as much mathematics and science as possible in high school.

Though the idea is a basic one, it will urge the student to start thinking about their future actively, crystallizing thoughts about themselves into a concrete goal sheet to aim for. The scientists' biographies on the website can be used to their full potential, enabling the student to dream of a future within a certain subject, with their dreams fueled by the events chronicled about the scientists' lives.

Knowing what to expect even on this basic level can give them an advantage in their studies, for knowing a little of what to expect can make the difference between success and failure. Without proper role models in your life, it can be a very hard transition from high school to college. We hope that this activity can help the student succeed. Using the biographies of their virtual role models as actual models when filling out their career “dream sheet” enables them to see the future for themselves before they reach it.

Envisioning themselves as a civil engineer like Emir Jose Macari, a mathematician like Manuel Berriozábal, a molecular biologist like Leticia Márquez-Magaña, can give them a future to shoot for, knowing that these very human people have already done it themselves.

_____, Ph.D., _____

(name) (scientific area)
I was born in _____, _____. When I was in high school, I
(city) (state)

decided to take as much mathematics and science as my high school offered. I took four years of mathematics, including algebra I and II, geometry, trigonometry and pre-calculus. I also took biology, chemistry and physics. Some of my friends took easier courses and there were times when I felt pressure on me because I had to study a lot, but I wanted to be well prepared for college. I graduated from _____
(high school)

in four years in _____.
(date)

I decided to immediately go to college after high school. Part of my senior year in high school was spent in investigating scientific careers. I looked up the SACNAS web site and read several of the biographies of scientists that were featured there. I was particularly impressed by the biography of Dr. _____.
(name of SACNAS scientist)

That biography got me interested in _____. I also looked at several
(scientific area)

universities that were linked to this website and finally decided to apply to three of them. These were _____, _____, _____.
(name of university) (name of university) (name of university)

I chose to attend the last of these universities and so I began my college career.

College was very different from high school. The classes were much more demanding, and I had to study many more hours than in high school. The first year courses in calculus, chemistry, English, and computer science covered so much new material that it was hard to keep up. But it was also very exciting and I enjoyed the classes. After the first year my studies became easier as I learned how to study better and joined study groups. By working hard, I graduated from college in four years in _____.
(date)

In my senior year in college I had to make some very important decisions. Should I apply for a job or go on to graduate school? My professors encouraged me to apply for graduate school. During my undergraduate years, I had been given the opportunity to tutor, to teach, and to apply my knowledge to several research projects. I had learned about the many activities that a scientist is involved in and I wanted to learn even more. So I applied to five universities, with one of them being in Europe. I finally decided to accept the offer from _____. The offer that I accepted paid for my tuition and

(name of university)
fees and it also provided me with a scholarship of \$16,000 per year.

Graduate school was exciting and the time passed by so quickly. Two years later, in _____, I completed my Master's Degree and three years after that, in _____, I was
(date) (date)

awarded a Ph.D. _____, are very proud of my
(names of two family members)
accomplishments.