Public Understanding of Chemistry

Public Understanding of Chemistry: Chemistry and its social-political-economic context continue to change. Chemistry and chemistry-based technology that impact our lives make for the complexity and controversy of life and set the stage for thinking about public understanding of chemistry. The Public Understanding of Chemistry section will try to address chemistry in real life context with original contributions (articles/position papers/policy briefs) and/or published articles and columns in reputable sources (used with permission).

VERY LITTLE ABOUT CHEMISTRY!

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I know very little about chemistry. My terminal degree is in public administration, which aligned with my ambition to solve community problems, particularly those involving high risk youth. I'm pretty sure it was my disinterest in learning the periodic table of elements that thwarted my parents' dream of their youngest daughter becoming a medical doctor. I readily admit that much of my most recent thoughts about chemists have been strongly influenced by Walter Hartwell White (a.k.a. Heisenberg on the popular AMC series *Breaking Bad*). Walter is a high school chemistry teacher who fails to interest his students in the study of change while radically transforming into a master meth cook to fund his cancer treatments.

A perusal of an edition of *The Chemist* leaves me awed. From the comparison of CA 242 with twelve other cancer antigens for use in the diagnosis of pancreatic, gastric, and other gastrointestinal cancers to green chemistry techniques for carrying out organic synthesis, I am profoundly grateful for the work chemists do to enhance our quality of life and the quality of our natural environment. I also appreciate what chemists have to teach us about creating a great mix.

My appreciation has grown in recent years for chemists and chemistry because they have become more important to my livelihood. After almost twenty years as a program director/ research faculty for university community service and research efforts in colleges of nursing and urban and regional planning, I am now employed as a grant facilitator for a research university with high research activity, as classified by The Carnegie Foundation for the Advancement of Teaching. I share my own personal experience as an exemplar of many professionals working in the social and behavioral sciences. My tenure as research faculty came to a gradual end in part due to a tightening of soft money for public sector service initiatives between 2007 and 2009 – years in some way defined by the recent Great Recession. Since 2012, my career has gained new life as a grant

facilitator and I have been fortunate to work on a number of STEM (Science, Technology, Engineering, Mathematics) education pipeline/ broader impacts initiatives designed to better prepare, recruit and retain underrepresented minorities for STEM degrees.

At the federal level, the increased focus on STEM performance and accountability has resulted in increased financial support, making STEM funding programs a great target for grant facilitators. The 2011 federal budget for STEM includes $3.7 billion invested into STEM education [1]. Additionally, $4.3 billion was earmarked for the *Race to the Top* competition with STEM as the sole competitive preference priority. About $1.1 billion has as its primary goal targeting populations underrepresented (such as African-Americans, Hispanics, and females) in the STEM fields, according to a recent White House report [2].

Significant numbers of today's women and underrepresented minority chemists and chemical engineers (40 percent) say they have been discouraged from pursuing a STEM career [3]. U.S. colleges are cited as the leading place in the American education system where discouragement happens (60 percent) and college professors as the individuals most likely responsible for the discouragement (44 percent). Not only are underrepresented populations facing barriers to STEM graduation, but only 33 and 42 percent of white and Asian American students who begin their studies aspiring to complete a STEM major are successful [4]. The K-12 experiences of these students cannot explain these low completion rates. Surprisingly, students at more prestigious institutions are often more likely to be discouraged in early STEM courses and to switch majors [5].

Designing a transformative and cutting-edge STEM education pipeline proposal generally requires some inclusion of problem-based learning. Engaging underrepresented minorities in the application of STEM science, how STEM is "done" in real life, is a principal strategy for increasing interest and engagement. The most important modern conception of STEM education might be the notion of integration—meaning that STEM is the purposeful integration of the various disciplines as used in solving real-world problems [6]. Although the chemist may self-identify as a chemist, she/he must have an in-depth understanding of other science disciplines, technology, and math to create "real life" applications that solve problems [7].

It is the integration and alchemy of disciplines converging that often create new innovative perspectives and new ways of solving old problems. The learning and social sciences have something to contribute to the U.S. STEM education problem and social and behavioral scientists can help develop more competitive STEM education grant proposals. Understanding education from a complex adaptive systems approach requires interdisciplinary and trans-disciplinary collaborations that include government, concerned citizens, industry, communities and academia [8]. In this conversation, social and education scientists are critical to developing new, more productive models of STEM education, particularly for underrepresented minorities.

In addition, like an experienced chemist recognizing dangerous combinations in the laboratory, an experienced social/ behavioral scientist can prevent experiments in STEM education from doing harm to a vulnerable populations. In my field-work and research in youth and family violence involving grandparents and abandoned, abused and neglected children, I was always aware of the capacity for our interventions to backfire, causing more physical and emotional harm to vulnerable individuals. In my field, well-intended interventions developed for one population may be inappropriate and even profoundly counterproductive when applied to cases involving a different population [9].

In the quest for increasing sponsored funding for STEM education, university scientists are developing new models of education. In some cases (far too many), STEM faculty are creating mentoring and education programs for underrepresented minorities without the benefits of experienced social and behavioral scientists – scientists who have first-hand experience working with at-risk populations. Engaging experienced social and learning scientists may be the best defense in preventing potential harm to at-risk populations derived from failed mentor matches or failed education experiments.

Post Script

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IMAGE ACKNOLEDGMENT: The image was created by Alberto Fernandez.