Articulations: A Case for "Physics First"

ARTICLE *in* JOURNAL OF CHEMICAL EDUCATION · NOVEMBER 2002

Impact Factor: 1.11 · DOI: 10.1021/ed079p1393

1 AUTHOR:

Diana S. Mason
University of North Texas
78 PUBLICATIONS **113** CITATIONS

SEE PROFILE

Especially for High School Teachers

by Diana S. Mason

Articulations: A Case for "Physics First"

Last month I addressed issues about the connections between high school and college science courses and how some colleges were considering offering an "organic first" curriculum *(1)*. With articulations in mind, is there anything that can be done at the secondary level to aid this novel approach to chemistry course sequencing in college? I would argue that physics first has many advantages.

Many of you are aware of the movement afoot to offer physics as the beginning high school science course, and I know that some of you already approach teaching the sciences from a "physics first" stance. As in the commentary by Zare *(2)*, a key to furthering one's understanding of the world around us is being able to "visualize" concepts through the use of models; for chemists these models are built upon understanding physical concepts such as opposite charges, electrostatics, density, and gravity. Van Houten's essay (p 1396) quotes Nobel Laureate Ahmed Zewail as saying, "… behind every important and fundamental concept there must be simplicity and clarity of thought. If it's fuzzy and unclear, and one is making it complicated, then I'm not sure we have an understanding of it yet."

This is true, but could it also be true that this lack of understanding might stem from the fact that we're missing a piece of the puzzle or that maybe we just haven't had the concepts presented in a way so that the appropriate connections can be made? Presentation of the sciences in a logical sequence is one method to use to increase understanding. However, systemic curricular changes may be difficult to implement unless you have great administrative pull. Another, more accessible method that can be used to increase the understanding of difficult concepts is by the application of analogies. For example, Kozliak (p 1435) suggests that improvement of students' understanding of thermodynamics can be accomplished by using the familiar context of money, banking, and business.

It was in 1894 that the Committee of Ten (a prestigious national commission) suggested our current alphabetical sequence norm of biology, chemistry, physics in high school science (*3,* p 5). However, it is physics that is rightly identified as the *foundational science* and chemistry as the *central science*. One of the most prominent proponents of the "physics first" vision is physicist and Noble Laureate Leon Lederman of Fermi National Accelerator Laboratory. He and his associates promote the "physics first" view through a project known as ARISE: American Renaissance in Science Education. In his white paper, Lederman not only suggests that physics be taught as the first high school course but also gives prominence to the study of biology in that chemistry is the natural prerequisite for biology. The biology of today is often applications of chemistry that could easily be fed into an "organic first" approach at the college level.

Secondary School Featured Articles

- Feature: *JCE* Classroom Activity: #49. Acid–Base Reactions with Carbon Dioxide, p 1464A.

Science is a way of thinking in which prior knowledge determines the logical connections that will be laid down in one's future. Understanding science subject matter will be easier to accomplish when the proper cognitive building blocks with a large number of "points of integration" (*3,* p 21) between the subjects are presented to our students. It is the study of chemistry that links the sciences together. To become a chemist one studies a discipline in which, as stated by Richard Jones (p 1394), "…mastering the diverse skills of mathematics, critical thinking, and creativity…" are required. Jones argues that these skills, along with classroom experience, also contribute to being an excellent administrator. Chemists who have become prominent administrators are quite common. A few examples include Norman Hackerman (former President of Rice University), Larry Faulkner (President, The University of Texas at Austin), Marye Ann Fox (Chancellor, North Carolina State University). Maybe there's something to this training as chemists that encourages the skills needed to rise to challenges.

Yes, high school students may find the study of biology more appealing and interesting than other science courses, but we must not enter into a curriculum sequence that teaches without understanding, that lends itself to memorization without meaning, and that slows the understanding of biological concepts that require a solid foundation in physics and chemistry. If you are interested in these and other "elements of change" you might consider attending conferences like BCCE (see p 1407 for the highlights of the 17th, forever to be remembered as the "Blackout Biennial"). Making changes and rising to challenges are sometimes difficult, but not impossible. Speaking of which, if you have risen to the challenge of being a member of the Division of Chemical Education for over 25 years, you might want to check out the Association Report (p 1410) for information in regards to your possible dues-exempt emeritus status!

Literature Cited

1. Mason, D. *J. Chem. Educ.* **2002**, *79*, 1289.
2. Zare, R. N. *J. Chem. Educ.* **2002**, *79*, 1290.
3. Lederman, L. M. *ARISE: American Renaissance in Science Education;* FERMILAB-TM-2051, 1998. *http://fnalpubs.fnal.gov/archive/1998/tm/TM-2051.pdf* (accessed Oct 2002).