provocative opinion

Teaching Chemistry Like the Foreign Language It Is

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"I was lost from day one!"

"All we did for two weeks was math."

"It was always Greek to me."

"It's too hard, and I'm not smart enough."

"What's the point to studying, I forget most of it the next day!"

"I've never been good at chemistry."

"I read the book, came to all the classes, and did all the homework, but still did poorly."

Have you heard one or more of these statements lately? Do you hear them frequently, such as every time you teach general chemistry? As a student, I remember hearing similar comments and perhaps even making a few myself. Many of these verbal "throwing up of the hands" exasperations can be avoided if we, as teachers, would teach general chemistry as the foreign language it is.

Most foreign languages have alphabets that are very different from each other. Before one can learn a second language, he/she must master the new symbols. These new symbols, the characters of the alphabet, are the building blocks for words, sentences, thoughts and dreams. Why is it then, that our chemistry classes do not begin on day one with a presentation of the 103-symbol chemical alphabet, its translation into English names, and a show and tell of as many elements as possible? Most foreign language teachers would agree that some type of association makes it easier to retain new symbols. Is there another foreign language more beautiful than pure samples of the chemical elements?

After a class or two of learning the chemical alphabet, and of translating from chemistry to English and back, a student is ready to begin the formation of chemical "words". Learning the names of chemical compounds is simple when only two elements are involved, but when three or more elements become associated, the language of chemistry becomes more complex. Even so, with a few simple rules, lots of examples and lots of homework, most students can learn to name a great number of chemical compounds.

After four classes, our "foreign language" students are ready to attempt intelligent conversation by combining their newly learned vocabulary into sentences, learning some basic grammar along the way. Chemical reactions are not only fundamental to the study of chemistry, but also they vividly and dramatically illustrate the beauty of this wonderful language! Most students associate colorful, exothermic, and odor-producing chemical reactions with chemistry, and how right they are! Why not spend several classes demonstrating several wonderful reactions, learning to write equations using appropriate symbols, making sure they are "grammatically" correct (e.g., balanced), and once again repeatedly translating from English to chemistry and back to English?

Two weeks have now gone by, our "foreign language" students know the chemical "alphabet", some properties of the elements, many important chemical words, and they can combine these words into meaningful sentences. In addition, they can translate back and forth between English and chemistry. These same students, who ranged from being deathly afraid, to being nervous about chemistry at the beginning, have rapidly gained a strong foothold into the study of this foreign language. They see for themselves that yes, they *can* learn chemistry, it does make sense, it can be interesting and relevant. They very quickly learn many basics upon which chemistry is built. For most students, this lessening of fear, and building of interest and confidence, is critical to the enjoyable study of chemistry.

Unfortunately, many chemistry classes heighten fears and turn students off during the very first class by beginning with a review of mathematics, or a discussion of what is matter. How many chemistry textbooks begin in chapter one with a discussion of the chemical elements? Usually, this fundamental information is buried in chapters three, four, five, or beyond.

The analogy between chemistry and a foreign language has obvious limits, but bear with me as I compare a general chemistry lab with a traditional foreign language lab. If asked, many students might respond that both are uninteresting, and frequently a waste of time, but a necessary evil of the course.

Is there really any question why students respond like this, when many general chemistry lab experiments remain unchanged after 50 years? How exciting is the determining of percent water in a hydrate? Or measuring the density or boiling point of a liquid? Or finding the change in temperature of mixing? Or obtaining the molecular weight of an unknown by freezing-point depression? Today, in the late 20th century, how interesting or relevant is the qualitative analysis procedure to students who will never be chemistry majors? Is it truly beneficial to ask students to perform experiments that happen to illustrate lecture topics, or experiments where the answers are well known before entering the lab?

It is here that a typical general chemistry lab and a traditional language lab find the common ground of dull repetition that only occasionally leads to brief periods of learning.

Why not begin the laboratory portion of the course with an experiment that utilizes a material of great importance to society, an aluminum can, throw in "recycling" for interest, and have students perform several simple reactions involving the production of alum and hydrogen gas, the latter two products being, potentially, very useful well into the 21st century? Follow this with an experiment dealing with the determination of phosphates in laundry detergents, examining the full environmental impact on rivers, lakes, and streams by the look "clean and bright" advertising campaign. How about determining alcohol levels in beer and wine using the beautiful acid dichromate oxidation of ethanol reaction? Has there been a more appropriate time for a drug-related experiment? Not to mention that colori-

metric analysis, oxidation/reduction, and distillation are great chemistry! Throw in an experiment on vitamin C, one of the hottest controversies in nutrition during the past 10 years. Not only are these types of experiments interesting to most general chemistry students, but also the students have the chance to experiment with colorful reactions, learn important lab techniques, and get hands-on experience with the scientific method by designing and carrying out several individual research projects.[1]

Interesting? Oh, yes! Exciting? You bet! Plenty of chemistry? Absolutely!

So why don't we get on the ball, bring general chemistry labs away from the old, repetitious language lab mentality of the 1950's and 1960's and toward the traveling-year-abroad ideas of the 1970's and 1980's, where students actively engage themselves in inportant and relevant topics that just happen to be in the foreign language that they are studying?

No teacher can deny the importance and benefit of interesting material to the study of any subject or foreign language. As a foreign language, chemistry demands hard work in the form of many hours of repetitious examples and problems, but why not ease the burden by beginning at the beginning, using the chemical alphabet to teach students how to speak the language. The mathematics and fine points of chemical "grammar" will more readily follow if a student's confidence and interest are high.

[1] Thompson, Stephen "Chemtrek"; Kinko's Copy: Ft. Collins, CO, 1985.