

Department of Chemistry
P.O. Box 210041
Tucson, AZ 85721-0041
FAX: (520) 621-8407



Professor Vicente Talanquer
Telephone: (520) 626-8169
e-mail: vicente@u.arizona.edu

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Clifford Le Master, Editor in Chief
The Chemical Educator
7154 West State Street #301
Boise, Idaho 83714

Dear Professor Le Master,

I think the problems described by Roy W. Clark in his letter to the editor are based on a misunderstanding of the goals and premises of the activity described in my paper "Recreating a Periodic Table."

- The activity should not be approached with the idea that any of the twelve foreign elements correspond to the real elements in our periodic table. I do not think there is a single sentence in the paper that leads the readers to such a conclusion. I chose to call the activity "A periodic table for a parallel universe", rather than "for a different planet", precisely to avoid that misunderstanding. I wanted the students to think how they would build a periodic table from scratch in an "imaginary world" composed of different elements with different chemical and physical properties. Thus, for example, there is no reason to assume that the least dense gas in this world is hydrogen or that it should be diatomic. We should not either think of the inert gases as our noble gases; these are only non reactive substances. I think the nature of the task should be clear to the readers from both the discussion of the activity and the analysis of Figure 1 where the expected results are summarized. The periodic table presented in this figure is very different from the actual Periodic Table in our universe.
- To clarify some of the other problems pointed out by professor Clark, I would like to describe how the activity should be approached:

- a) The first crucial step is to organize the twelve elements in different chemical groups based on their chemical and physical properties. The information in table 1 allows students to identify five different groups:

1. N, A 2. O, I, P 3. H, D, R 4. U, T 5. F, Y

Most of our students have been able to complete this task without major problems. These groups have nothing to do with the actual groups we recognize in our Periodic Table.

- b) As indicated by professor Clark, one can use the ideal gas law, or Avogadro's hypothesis, to derive the relative atomic masses of the gaseous elements. The simplest hypothesis is to assume that all gases are monoatomic (an excellent opportunity to discuss with students why to begin the analysis based on this assumption). Thus, from table 1, one can determine that Dentrrium is the least dense gas with 1.00 g per 15 L. That means that Nostrrium, with 5.00 g per 15 L, should be 5 times heavier. At this stage one may find convenient to define the "newmole" as the amount of substance that contains as many particles as 1.00 g of Dentrrium at the standard pressure and temperature in the parallel universe. I would not call this quantity a "mole" because we cannot assume it contains the same number of particles as our

mole. (As a side note, I realize now that the published paper does not show the footnote “a” for Table 1. This footnote should say “*All properties have been measured under the same conditions of temperature and pressure. The chemical compositions of possible compounds are expressed in % mass.*”)

- c) Once the relative masses of the gaseous elements have been derived, information in table 1 can be used to estimate the masses of all the other elements. For example, the gases dentrium and fintrium react in a 1:1 volume ratio. We may then assume that the formula for the resulting compound is DF (given that, according to Avogadro’s hypothesis and the assumption that all substances are monoatomic, 1 newmole of D reacted with 1 newmole of F). Given that H and R are in the same group as D, and Y is in the same group as F, one can expect all combinations between these two groups of elements to occur in a 1:1 ratio (using the idea of periodicity). Thus, if dentrium and ysprium produce a compound with 4.34% D and 95.56% Y with a formula DY, the relative atomic mass for Y should be close to $95.56/4.34=22.0$ (given that the relative atomic mass for D is taken to be 1). We have in this way derived the relative atomic mass for a solid element. This type of analysis can be used to derive all of the remaining atomic masses. We do not explicitly have the formulas, but we can use the information provided together with the idea of periodicity to derive them.
- d) The activity does not assume that the laws of physics and chemistry in this parallel universe are different to ours. It is only asking students to assume that the world is composed of other elements with different chemical and physical properties. I do not see any problem in having students think about what would be needed to have pure liquids that conduct electricity. If the fundamental charge in this parallel universe was smaller than ours (or the permittivity of vacuum was larger), ionic compounds could be liquid at reasonable temperatures and pressures. Ionic liquids conduct electricity. It is true that students are not familiar with the idea of ionic liquids, but the activity forces them to reflect on what they know and try to transfer their understanding to build reasonable explanations in other contexts. There are many educators that suggest that this is precisely what “understanding” is about.

I think that professor Clark approached this activity by trying to impose a structure that was never intended for this task. This activity is designed to help preservice teachers reflect about central concepts and ideas that they will be discussing in the secondary school classroom. They are not expected to discuss with their students how X-ray experiments can be used to derive the atomic number. They will be discussing concepts such as periodicity, relative atomic mass, percent composition, empirical formulas, and the mole. For us, this activity has proven to be an excellent mechanism to help students reflect on their understanding about these concepts while uncovering many of their misconceptions. The task makes preservice teachers think “outside the box,” reflect on what they know, and discuss and better understand the origin of important concepts in chemistry. It also makes it very difficult for them to rely on memorization to deal with the problems. It may be that professor Clark and myself have very different educational philosophies or ideas about how to prepare teachers, but that does not make this activity wrong or worthless. Perhaps the paper could be improved to make it clearer to the readers. However, I think the premise, context, goals, and expected results are clearly outlined in the published manuscript.

Sincerely,
Vicente Talanquer