COMPILATION: modeling an atom with internal structure (valence model: bridge from Unit 5 to Unit 6).

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Subject: bridging activities for units 5 & 6

Hi Chem Modelers.

Guy Ashkenazi, the Chem Ed Researcher from Israel who has played a major role in the development of the chemistry curricular materials, worked with me to lead the Chem 2 workshop at ASU in Summer 2017. He has worked for a few years to revise the Lego activities that form sections 7 & 8 of the current Unit 11 Teacher notes. When he conducted the lesson in the workshop the teachers reacted very favorably to it. This version of the Lego activity is streamlined, yet provides opportunities for students to check out a NIST database to obtain information the teachers would ordinarily have to tell students. We think it does a better job of showing how the Legos can be used to develop possible formulas of hydrocarbons and of developing structural formulas to distinguish molecules with the same molecular formula.
So, we would like to propose a possible re-sequencing of activities in the Chemistry Core units. Currently, we develop the Dalton model in unit 4 and use reacting volume and %-mass composition data to deduce formulas of some compounds. Then, in Unit 5, we develop the mole concept which allows us to determine the empirical formula of ZnCl2. Then, in Unit 6 we examine the electrical nature of matter (sticky tape) to develop the Thomson model of the atom, which we use first to develop formulas of ionic compounds. We think that it could be useful to insert the bridging set of activities between unit 5 & 6. Using the Lego activity helps to develop the concept of "combining power" (valence model), further examples of how atoms combine in fixed ratios. Next students would use the information in Mendeleev's 5th table to complete the worksheet with the formulas of hydrides of the representative elements. These two activities expose the ascending-descending (1-2-3-4-3-2-1) pattern of combining. An examination of the melting points of the hydrides of the 3rd period reveals that the hydrides of Na, Mg and Al melt at much higher temperatures than do the hydrides of Si, P, S and Cl. This leads us to suspect that there are differences in the structures of these compounds and provides an incentive to understand the cause of these differences. This development should take no more than 4 class periods and should nicely set up the sticky tape lab in unit 6. Here are some of the advantages we see in using this sequence:

1. It provides a stronger rationale for the need to develop a model of the atom with internal structure.

2. In its current placement in Unit 11, the Lego activity interferes with the natural flow from the men-in-well model to the Lewis model.

3. It offers students the chance to examine structures of molecular compounds - something that may not happen if classes don't get to Unit 11.

4. It would be helpful in the treatment of the chemical reactions and stoichiometry (what do molecules look like and how do atoms rearrange during reactions).

5. From a modeling perspective it isn't necessary to invoke electrons to draw conclusions about structures of molecules; Kekule's chemical structure theory predated the discovery of the electron by more than 30 years.

We hope that some of you would check out the materials (found in the Chemistry Core Units folder on the AMTA member website) and respond to this idea on the listserv. We're considering setting up a webinar to discuss this in greater detail, but we haven't set a date or time yet. Please contact me if you have difficulty accessing this set of materials.

Have fun!