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USING „REAL LIFE“ EXAMPLES TO ENHANCE LEARNING IN A GENERAL CHEMISTRY LECTURE

Below are a few of the „real life“ examples that have been used successfully over the years to help students remember and understand some of the concepts taught in general chemistry. Each example tries to reinforce the chemical ideas as well as provide a way for students to remember these ideas. They are taught with the idea of having fun and trying to relate life experiences that the students may have had or heard about with the chemistry in discussion.

Stoichiometry and cooking

Trying to grasp the idea of a stoichiometric coefficient is difficult, let alone saying or spelling. One thing that might help is calling the stoichiometric coefficient a "mole ratio number". After all, it is used to ratio numbers, in particular, moles. The other thing that helps is relating this to something they know, such as cooking. The example used is with making pancakes, something that most students know and have eaten, although not the correct cooking recipe for the actual ingredients. It is given in this way:

$$1 \text{ cup flour} + 2 \text{ cups milk} + 2 \text{ eggs} + \text{"treats"} \rightarrow 6 \text{ pancakes}$$

What can be done is to understand the concept of mole ratio numbers. For instance, if one needs 12 pancakes, then 4 cups of milk are now needed as well as 2 cups of flour. For fun, I might say you have kids and they had friends over for a sleepover, and now you need 18 pancakes, and thus 6 eggs and 3 cups of flour. To add to the fun, I explain what is meant by "treats". These are things a parent might put in the pancakes to make them more exciting, such as chocolate chips, fruit, M&M's, or whatever one likes. I imply that my kids' friends love my pancakes because of these treats. I explain that if you have your in-laws over, you never use "treats", and the students all laugh. However, besides having a laugh and having fun, the students actually learn to grasp the concept of stoichiometric coefficients.

Hund's rule and bathroom etiquette

Hund's rule is something the students will understand over time, but a fun trick to help them understand the concept is using the example of bathroom etiquette. In addition, it is always fun to have some bathroom humor in a lecture. The picture below (Fig. 1) uses electrons with spins, shown as check-marks, to help illustrate Hund's rule:

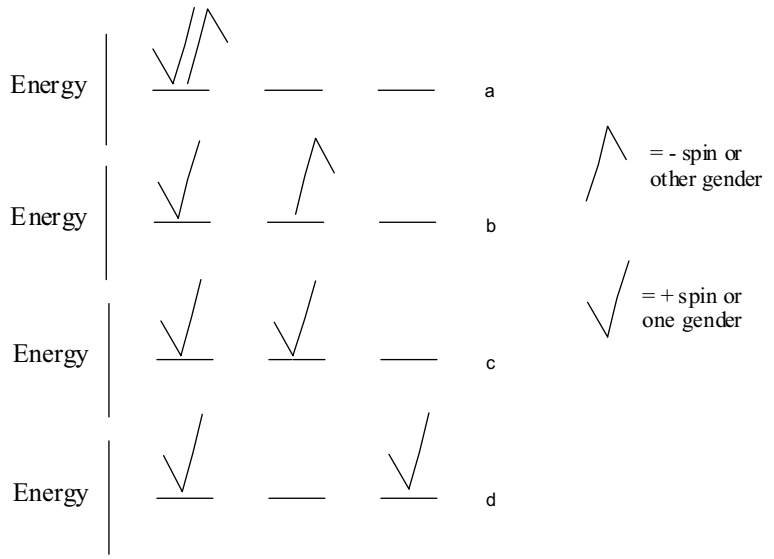

Fig. 1. The energy-orbital diagram showing the application of Hund's rule

In this example, the spins are thought of as people, with a particular check-mark for each gender. Using all three examples (a-d), shows Hund's rule. For instance, part a does not follow Hund's rule nor does it follow the bathroom etiquette rule of only one gender in the same bathroom, let alone the same stall! Part b is not allowed, as you must have the same spin or same gender in a restroom. For fun, Europe is mentioned where they have coed bathrooms, separated by walls of course, and the students enjoy learning about other cultures. Both parts c and d follow Hund's rule, having the same spin in degenerate orbitals, and thus both allowed. However, it is fun to point out that men in a public restroom facility will only follow part d, and much laughter is heard. Students will remember this throughout the semester and for years to follow.

Dimensional analysis and air travel

Dimensional analysis or factor-label method is a technique that is vital for general chemistry students and yet some have a difficult time with this technique, especially when there are two or more steps that are involved. For two step metric problems, getting to the base unit is critical, and allows the problem to be solved. To give a real life perspective to this, airline travel is used. The concept of the base unit is now the airline's hub. For instance, traveling from the east to the west on Frontier airlines, one must first fly to their Hub in Denver, and from there go to their destination. On Delta, one must fly to either Cincinnati or Atlanta before reaching their destination. Each airline has a Hub, and that is its base, the same as grams or meters is the base unit in the metric system. After hearing this, most students have a better perspective and understand dimensional analysis more clearly. Plus, to add some fun, mentioning that the executives of these airlines took chemistry, and thus figured out the idea of Hubs, always getting a laugh.

Avagadro's number and six packs

The idea of Avagadro's number is strange to students. The number is so large that it is a difficult concept for students to grasp, even noting that it relates to the mass number of elements from the periodic table. Mentioning the idea of quantifying something to a systematic unit helps, especially when dealing with food and beverages as with buying beer or eggs. Note, students love the idea of discussing beer; it is something they know and understand, plus it gives them a laugh. Mentioning that the base unit for beer is a six pack, and for eggs it is a cartoon of a dozen helps. This gives the students a reference to Avadagro's number and puts this large number in some perspective.

Hybridization and mutts and corn

The Valence Bond Theory uses hybridization to explain bonding. This is an important theory and one that is difficult for many students to grasp. Having orbitals mix within a central atom is strange and foreign to students. Thus, the idea of hybrid corn and mutts helps give the students a better appreciation of the idea of hybridization. Many students, especially in the Midwest, have seen signs of hybrid corn or vegetables in the fields. Explaining why agriculturalists do this is important, as it might reduce the need for water and fertilizers, or grow the corn faster, and many other reasons. Bringing into the conversation dogs and mutts is more reassuring to students, as they all know about dogs. Mentioning the new hybrid dogs such as goldendoodles and as to why this hybrid makes the idea of hybrids more meaningful(hypoallergenic and lack of shedding). Of course, discussing the old fashioned mutt of a dog jumping the fence and interacting with another dog gets more laughs and further establishes the hybrid meaning. To truly enlighten the idea of hybrids, bringing up the fact that children are all mutts or hybrids makes the students really laugh, yet continues to connect the chemistry with the students' world.

Energy-profile diagrams and sledding

In terms of kinetics, the energy profile diagram provides a wonderful "real life" example to a chemical concept. Once the students have been taught about the energy profile diagram, this scenario truly reinforces the ideas by using something recognizable. Fig 2 shows a simple energy profile diagram for an endothermic reaction. Using the real life example of kids sledding fits this picture beautifully. The base line of the curve represents the bottom of a hill, whereas the top part of the hill (activated complex) represents the top of the hill. For kids to make it up to the top of the hill, takes energy. Similar to energy needed to break bonds or intermolecular forces. Thinking about breaking a sweat while carrying a sled up a hill should help the students grasp this concept. At the top of the hill, where the short lived activated complex might exist, kids are too excited to look around and wait, and thus once at the top of the hill they immediately sled down the hill. Mentioning how kids do not care who is in their way, they just quickly get on their sleds and hurry down the hill. As this part of the curve is exothermic, releasing energy, sledding allows for that to be true as well as the kids are screaming and happy going down the hill. Being a parent, and a father, putting in some fatherly stories dealing with dragging the kids up the hill, or not, videoing the kids, and other stories, adds to the fun and laughter in the classroom. As with the other examples, the students will obtain a better understanding of this diagram and remember it for exams and for years after the class.

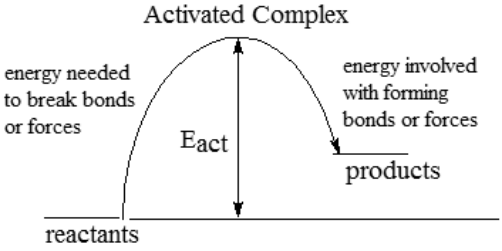

Fig 2. The energy profile diagram of a generic endothermic reaction

London forces and K-mart blue light special or a teenager's party

The concept of London forces is a strange idea for students. Having something that is nonpolar become polarized due to the polarizability is odd to say the least, and then add that other molecules are induced to form dipoles and interact with each other, increases the difficulty of this concept. In addition, the students need to know that having Avagadro's number of molecules allows the force to exist forever. Yet, it is an important type of intermolecular force and thus must be discussed and learned. Using a "real life" example helps with the concept, and again, makes it fun and more memorable. The K-mart blue light special is a perfect way to help explain how a molecule might suddenly become polarized. Most students know K-mart and probably know about the blue light special. Once the light goes on and the special is announced, customers run and attack the special, not caring who or what is in their way, thus the customers have been induced, similar to molecules being induced in London forces. Giving an example of an old woman knocking an infant in a stroller, not caring what or who is in the way brings a roar of laughter from students.

Another real life example of people being induced is with teenagers. Students certainly know about teenagers, as many of the students are teenagers, so this example is very realistic and something they can easily relate to personally. When a teenager's parents leave for a night or weekend, occasionally, the child of those parents might throw a party! The teenager of the home might invite a few friends over to "party." Now, typically, many more people will show up, as they have been induced to go to the party. Giving an example from a lecturer's past certainly brings a roar of laughter, and the students will understand and remember London forces.

Conclusion

Using "real life" examples in a general chemistry glass not only enriches the discussion and allows for laughter, but reinforces the chemical topic and aides in the students' understanding. These are simple ideas, but these techniques get the message through to the students. The students will remember these ideas and perform better on exams. Furthermore, they will remember these concepts for years after their chemistry class is over.

Acknowledgements. The work was supported as part of a sabbatical from Kent State University. The author is grateful to many of his past students for their years of listening to these examples and providing many nice comments. The author is also grateful to faculty at a recent ACS meeting who mentioned that these examples were good and should be published.

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