CREATIVITY IN WORKSHOP: OVERLAP AND UNDERLAP CARD TECHNIQUE FOR CONCENTRATION UNITS OF SECOND SEMESTER GENERAL CHEMISTRY

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ABSTRACT

Creativity in the classroom is the goal for peer leaders of the Peer Led Team Learning Program (PLTL) in the Chemistry Department at the University of Texas at El Paso. The goal is to enhance the learning experience for students taking general chemistry in their workshops or classrooms. These ideas allow students to engage in classroom discussions with their peer leader. The ideas can be themed on concepts such as molecular geometries, kinetics, or acids and bases. In second semester general chemistry, a call to utilizing creativity in the classroom has demonstrated a way for peer leaders to efficiently teach students how to convert the following four main concentration units via kinesthetic interaction: molarity, molality, mole fraction, and percent by mass. What this means is that, by arranging cards as fractions in which the concentration units are represented as ratios, they will be maneuvered by grabbing each card and placing them either over or under another card to get the desired unit. Thus, to reach a desired unit in the numerator and/or the denominator the concept of overlap and underlap is the key to employing these stacks of cards to see how the units relate to one another. This allows students to think about what is needed in the numerator and the denominator. Students gain the opportunity to physically manipulate conversion factors and improve or review their understanding of dimensional analysis. *[African Journal of Chemical Education—AJCE 10(1), January 2020]*

INTRODUCTION

Students who take the first two semesters of general chemistry tend to grapple heavily on basic concepts that are essential for future chemistry classes and other science related courses. There is an overwhelming amount of information, rules, and exceptions that students are expected to retain. They come in for granted not realizing how vital it is to carry their knowledge of their first semester of general chemistry to their second semester of general chemistry. Students do not understand how much work they need to put in to pass their second semester of general chemistry if they come in after earning a C or a B in their first semester. They need the guidance to a path that will lead them to success in understanding course material and that is what the Peer-Led Team Learning program at the University of Texas at El Paso offers.

The program provides a peer to peer interaction so that students taking the course can feel comfortable asking questions and confronting their peer leader rather than just waiting to speak to a professor who can have a tight schedule for appointments. Peer leaders are students who have already taken the course, have earned a B or better and have a strong understanding of general chemistry. Students can take advantage of having a one to one tutoring session with their peer leader to review any topic needed. In workshop, which takes place in a lab or classroom setting, a peer leader spends about two hours with their students going over activities. These activities are created by the peer leaders who have practiced at demonstrating that these pursuits can encourage student engagement in their learning experience. These activities can be like the following that will be discussed with index cards and concentration units.

METHODOLOGY

When discussing topics such as colligative properties of a solution, students need to be familiar with the main concentration units dealing with this subject matter. Those are molarity, molality, mole fraction, and percent by mass. In addition, students are expected to be able to convert from one concentration unit to another using conversion factors such as milliliters to liters, molecular mass or atomic mass, density, etc. Since a population of students struggle with converting from molality to percent by mass, for instance, this method can help students visualize how the units relate to one another. This is based on the idea of dimensional analysis that is taught to students who take their first semester of general chemistry.

Overlap and Underlap, and Unit One Cards:

This intuitive activity uses index cards that have a unit written such as X moles of solute, to encourage students to engage in learning or reviewing how dimensional analysis works. There are many cards with various types of units. To use these cards, one must have two cards placed vertically on top of each other as shown in figure 1, in order represent them as a fraction; one card over the other will symbolize numerator over denominator, respectively. The 1 L of solution card is called a unit card, because the cards contains a value of one and an arbitrary unit. Therefore, unit cards are cards with a number one and a unit, such as, 1 kg of solvent is a unit card.

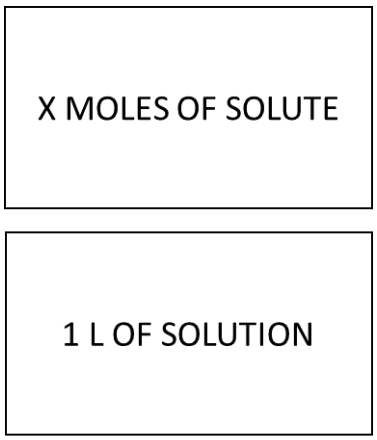

Figure 1.

These two cards are pulled from certain stacks that pertain to individual components of a solution, one stack for solute, and another pile for solvent. There is also a collection for

conversion factors such as volume in milliliters to liters, moles to grams, pressure conversions, etc. See figure 2.

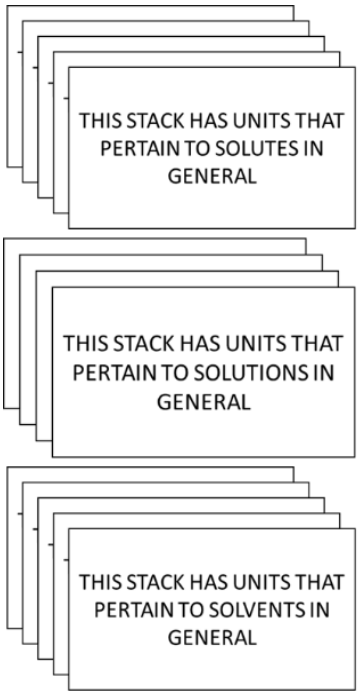

Figure 2.

If the student was told to transform the ratio of "X moles of solute" and "one liter of solution" to have "X grams of solute" in the numerator, the student would need one card that has "one mole of solute" and the other to have "X grams of solute." That student would recognize that the ratio between the "one mole of solute" to "X grams of solute" is molar mass. Thus, molar mass is the conversion factor to turn "X moles of solute" to "X grams of solute." To do that, the student would place the card that states "X grams of solute" next to the card that scripts "X moles of solute" and the card with "one mole of solute" next to "one liter of solution." See figure 3. This layout of cards is multiplication. The unit of moles of solute would cancel. Thus, the concept of overlap and underlap is the overall theme of this schematic. The two movements could be used at the same time in any perspective. For example, in the perspective of the "X moles of solute," if the unit "X grams of solute" is the unit in desire then the student would overlap the "X grams of solute" on "X moles of solute." In other words, cover the "X moles of solute" with "X grams of solute." The other way can be used. In the perspective of the "X grams of solute," the "X moles of solute" would underlap the "X grams of solute." "X Moles of solute" would go under the "X grams of solute." Therefore, in the denominator, "one mole of solute"

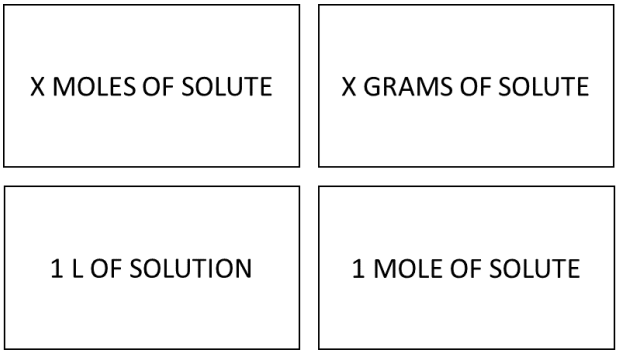

Figure 3.

would underlap “one liter of solution” and, as seen, “X moles of solute” and “one mole of solute” would cancel. This occurs, because they are both consistent and homogenous units as shown in figure 4:

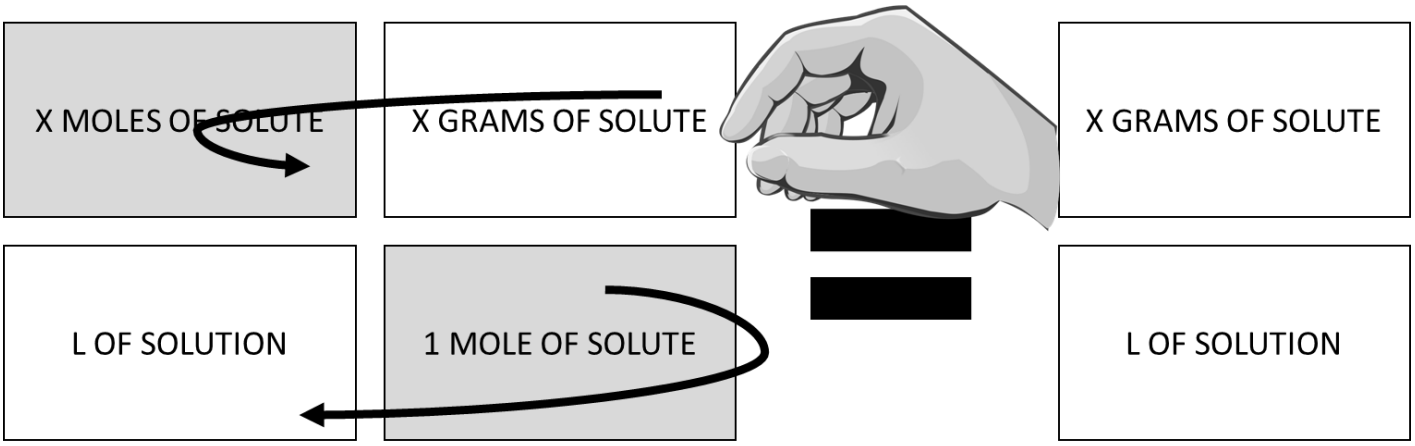

Figure 4.

Definition Cards

In figure 1, 3, and 4, the conversion factor “one mole of solute” is some “grams of a solute” is called a definition. A definition card it states an exact amount of a compound. One example of a definition card is the number of grams of something in one mole of that substance. Other examples of definition cards are the following conversion factors: one milliliter of solution is one cubic centimeter of solution, 1000 grams of solvent is one-kilogram of solvent, or one atmosphere is 760 torr. Those are all definitions because they state an exact amount of how much of something is compared to a value of one paired with a random unit. When using definitions, to convert from one unit to another, multiplication will be used, such as in figures 1, 3, and 4.

Variable cards:

This activity is meant to be an interactive one where students can use their hands to see how units relate to one another, in terms of numerator over denominator, and improve their skills in

dimensional analysis; these are fundamentals that students need to carry with them throughout their academic career in the science field. Thus, reasonable values need to be considered when relating to units. For example, if the student was given a task to convert the density of a solution to the molarity of solution, the student could use a card that has some variable X, Y, or Z to arbitrarily assume a realistic value pertaining to the appropriate unit, so that the chemistry makes sense. In other words, a card that does not have one unit of anything or is not a definition card will be called a variable card, because it has a variable with a unit to deduce an arbitrarily value. See figure 5.

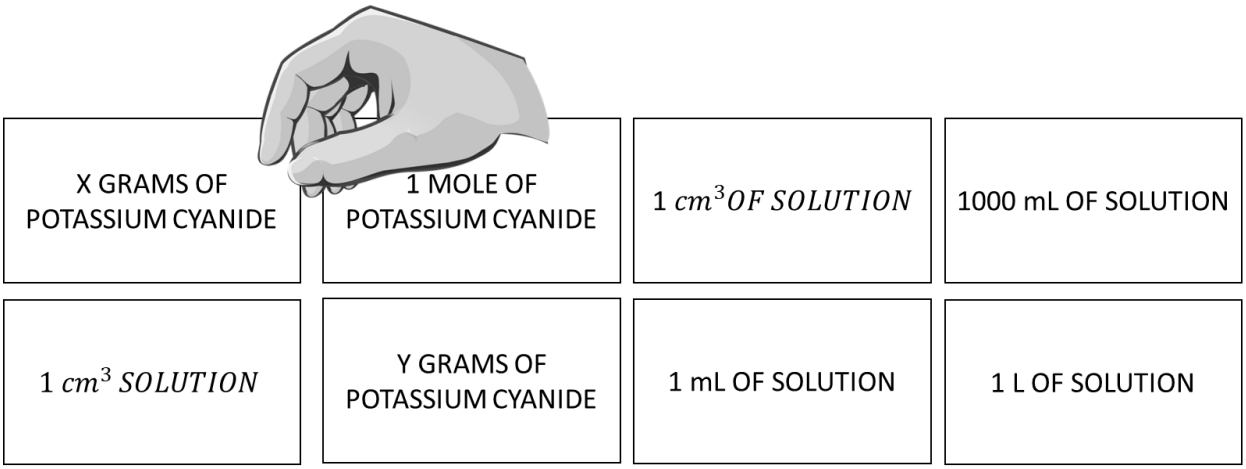

Figure 5.

CONCLUSION

The concept of overlap and underlap is used to convert from one unit to a desired one. There are three main types of cards: definition cards, unit cards, and variable cards. The definition cards state how much of something is in one unit of anything. A unit card is simply one unit of anything. A unit of anything is usually called a basis. Lastly, the variable card is used to have an arbitrary realistic value with certain units so that the student can make a judgement on

what value they should obtain, based on the appropriate units and compared to their initial assumed value. The activity is a creative tool to help students understand or review their dimensional analysis and to visually see how various units are related to each other. In result, students whom are taking their second semester of general chemistry and learning concentration units can go over this activity with their peer leader to review their dimensional analysis. In addition, peer leaders of first semester general chemistry, which is the introductory class to chemistry; can use this activity in their workshops with their students whom first learn what dimensional analysis is.

REFERENCES

Chang, R. (2010). *Chemistry.* New York: McGraw Hill.