

Assessing student learning in the science classroom



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1a. Central focus of the segment

For the lessons I will be teaching, my central focus will be “ Analyze chemical reactions and adjust the number of reactant and product molecules in order to balance the reactions such that the number of atoms present in the reactants is equivalent to the number of atoms present in the products.” The school I am working with uses the Alabama College and Career Ready Standards (ALCOS) as their standards. Thus, my central focus was based mainly on ALCOS 5b. The students would use mathematics and computational thinking to support the claim that atoms, and therefore mass, are conserved during a chemical reaction. The entire first lesson is a PowerPoint which is led by students answering questions and filling in blanks in their copies of the slides. The lesson begins with a video about baking a cake and how it is similar to a chemical reaction where the ingredients are the reactants and the cake is the product, which is tied into the conservation of mass during a reaction. The first lesson then introduces the concept of stoichiometry and reviews chemical formula by asking students to correctly identify the chemical formula of molecules. The rules for chemical formulas are reviewed and then the students begin to learn about balancing reactions. The concept of conservation of mass as it relates to the atoms in the reactants must be present in the products is established by asking students to explain what it means that “ reactions must balance.” Example reactions are shown to model balancing reactions, as well as Lewis structures of the reactants and products to relate to their prior knowledge about Lewis structures, valence electrons, and filling orbitals through bonding. Snap blocks are used to model the reactants and products to

provide a manipulative for the students to model reactants and products balancing as well as how the reactants rearrange to form products. The second lesson picks up at the end of the first lesson. First, another example of a chemical reaction, a firecracker explosion, is used to remind students that chemical reactions rearrange reactant atoms to form products, but all atoms must be conserved. Next, the final slides of the PowerPoint are reviewed as well as the final question of the first lesson. The students then work in small groups to practice balancing chemical reactions on a worksheet using Snap Blocks as manipulatives.

1b. Linking skills, knowledge, and context

The lesson's learning target (i. e. learning objective) and the central focus support the student's understanding of the scientific concepts found in ALCOS 5. The central focus takes all of the concepts found in standard 5b and focuses it on the conservation of atoms during a chemical reaction. The learning targets (i. e. learning objectives) then take that central focus, and bring in the other scientific concepts in the standards in support of that central focus. The ALCOS standard here relies on both computational and mathematical thinking to support the claim that atoms are conserve during a reaction. Examples of the computational and mathematical thinking is given throughout lesson 1. In the review of molecular nomenclature, the computational and mathematical relationship between the coefficient and subscript are defined and highlighted as they identify the total number of each atom present as well as the number of each molecule present.

Likewise, when balancing the reactions, computational and mathematical thinking is used to count the number of each atom present in the reactants <https://assignbuster.com/assessing-student-learning-in-the-science-classroom/>

and products. To balance the reaction, the Snap Block manipulative is used to provide a geometric (mathematical) model for the atoms and molecules, which provides an alternative mode of mathematical thinking. To balance the reaction, students must compute how many molecules are needed either algebraically or using the Snap Blocks. The Snap Blocks are key in demonstrating evidence that additional molecules need to be added in order to balance reactions as well as demonstrating evidence that atoms must be conserved. In lesson 1, the reaction $C + Cl_2 \rightarrow CCl_4$ is key. With Snap Blocks, when C and Cl_2 are built, it becomes clear that CCl_2 cannot be built from those two molecules. More molecules of Cl_2 must be needed! The discussion of the Lewis structure for $C + Cl_2 \rightarrow CCl_2$ and $C + Cl_2 \rightarrow CCl_4$ ties into previously learned knowledge about Lewis structures, valence electrons, and bonding as evidence to explain why $C + Cl_2 \rightarrow CCl_2$ is not possible. The example of baking a cake in lesson 1 is a real-world example of a chemical reaction analogy. Likewise, the different types of reactions briefly discussed in Lesson 1 are typical of common reactions in nature. In lesson 2, real-world examples of combustion, substitution, and rusting reactions are given to show that all atoms are conserved in the reactions.

1c. Explaining how lessons build and link to other skills

One of the important things this lesson sequence does is to show students that all of science is connected. This is done by having learning targets that build and add to what has already been taught. For example, my central focus across the lessons was that the number of atoms must remain constant for the reactants and products. To explain this, students had to

recall prior knowledge on Lewis structures, valence electrons, and bonding. When atoms bond together to form molecules, the atoms' valence electrons are shared in order to fill the valence orbitals. This is an underlying principle of balancing reactions. The reaction will not occur if atoms are left with unfilled orbitals. Thus, additional reactants are needed in order to ensure every atom that had filled orbitals prior to the reaction has filled orbitals after the reaction. As an extension, more products will be produced. The consequence is that the reactions must balance. Furthermore, the first lesson has a section reviewing the nomenclature for molecular formulas to remind students how to count the number of atoms present for a number of molecules. This was previously covered, but was reviewed in order to identify and clarify any misconceptions as this language is critical to balancing reactions.

2a. Summary of Students' Prior Knowledge

Pre-assessment was used in Lesson 1 to evaluate the students' knowledge of chemical formula nomenclature through informal surveying. Formative assessments are used throughout the lesson to assess student learning and knowledge. For example, in lesson 1 I ask students to explain how the Lewis structure informs why $C + Cl_2 \rightarrow CCl_4$ and not $C + Cl_2 \rightarrow CCl_2$ in order to identify how much students know about how Lewis structures, chemical bonding, valence electrons, and orbitals are related. From prior observations of this class and communication with my mentor teacher, I know the students have studied Lewis structures, electronegativity, valence electrons, orbital shells, and chemical bonding. Students have a wide array of mathematical skills - some are strong and some are weak. This was <https://assignbuster.com/assessing-student-learning-in-the-science-classroom/>

evidenced by some students having difficulty reading graphs, understanding the differences between inversely and directly proportional variables, and discussions with my mentor teacher.

2b. Summary of student assets

In the school I am working at, “ 45. 1% of the student body receives a free or discounted price lunch” (Context for Learning, p. 1). Based on this information, nearly half of the students in my classroom most likely come from low-income households. Additionally, the school I am working at has a high amount of diversity, two of the students in my class are ELLs. Students come from a variety of cultures and backgrounds, which provides a wide knowledge base adding depth to classroom discussions. From lesson 1, when I ask students to give real-world examples that can be analogies for chemical reactions the students are allowed to draw on their knowledge base to interact with the academic language. Also in lesson 1, some students were able to easily explain the making a cake analogy because they had previously made a cake and all students understood that cakes should be moist. In lesson 2 I use the example of a firecracker explosion because all students have likely seen fireworks and explosions are cool. The students who have IEPs in my class, as the Context for Learning says, have learning disabilities or are ELLs. These students often need additional explanations and one-on-one help, but do not require a differentiated central focus.

3a. Selecting learning activities based on prior knowledge and other assets

For my learning tasks and materials, my knowledge of

personal/cultural/community affected my choices quite a bit. As mentioned <https://assignbuster.com/assessing-student-learning-in-the-science-classroom/>

in 2a-b, much of my class is very diverse and comes from different backgrounds. One aspect of this diversity is mathematical ability, as mentioned in 2a. Since part of ALCOS 5 requires the students to use “mathematical and computational thinking to support the claims that atoms... are conserved during a chemical reaction,” I knew that this could be a challenge. To differentiate for students of various mathematical abilities and learning styles, in both lessons I used Snap Blocks as both visuals and manipulatives to model atoms and molecules for balancing reactions. Furthermore, in lesson 1, I used a PowerPoint presentation that allowed me to visualize the atoms and molecules we were studying, both for molecular nomenclature and for balancing reactions. In lesson 1 I took time to color-code the counting for molecules and atoms and the relationship between coefficients and subscripts. Again, this visualization is a component of universal design for learning. For ELLs, visual aides are especially useful since verbal explanations may be rife with colloquialisms or other language that is difficult to decode. In lesson 2, I had students work in small groups to practice balancing reactions. By working in small groups, students of various abilities could work together and help each other to solve the problems. Also in lesson 2, time was allotted for the class to share their balanced reactions and how they balanced the reactions. This practice enabled the whole class to see other groups’ ways of thinking and provide additional insight and strategies for balancing reactions, such as mathematical methods. By having students explain how they balanced the reactions, the students practiced using academic language in a verbal manner and further enhanced their comprehension. Finally, in lesson 1 I use Lewis structures to show why balancing is required and how unbalanced reactions can lead to molecules

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where valence electrons do not fill orbitals, which is a concept that was previously learned.

3b. Selecting learning activities for the whole class and individuals

When designing my lessons, I consider universal design for learning, which “ stipulates that teachers present information in a variety of ways, allow students options for learning and demonstrating their knowledge, and incorporate practices that maximize student engagement” (Miller, 2009). From my context for learning document, we see that any of the students come from very diverse backgrounds. “ 45. 1 % of the students receives a free or discounted price lunch,” (Context for Learning, p. 1) which shows that half of the students in my classroom most likely come from low-income households. Also, the school I am working at has a high amount of diversity where “ the ethnicity of the student population is 60. 5% African-American, 27. 8 % White, 9. 0% Hispanic, and 2. 0% Asian” (Context for Learning, p. 1). Considering such a diverse group of learners, my lesson plan incorporates strategies and supports to encourage learning and demonstrating their knowledge. In lesson 1, I use an example of baking a cake since all students are familiar with eating cake. Because not all students are familiar with how to bake a cake, I showed a video on how to bake a cake. This allowed the students to connect a finished cake with the ingredients and cooking process. Also in lesson 1, after introducing the concept of chemical reactions to students, I ask students to come up with their own examples. This allows students to activate their prior knowledge and draw on their unique backgrounds.

My supports and strategies also incorporate the needs of groups of students. One of those groups includes students who struggle with math. Instead of relying solely on algebraic methods of balancing chemical reactions in lesson 1, I introduce Snap Blocks. The Snap Blocks are visual and manipulative aides that allow the students to handle the atoms and molecules and work to balance the reactions using physical objects. To balance the reactions, the students simply need to make sure that the number of Snap Block is consistent between the reactants and products. By placing all the Snap Blocks in front of the students, the only math required is counting. Likewise, this is beneficial for students with IEPs and ELL students. Using visual aides is beneficial because it allows a visual representation of complex concepts, like atoms and molecules, which we cannot see. For ELLs, visual aides are especially useful because the visual aide makes it simpler to comprehend vocabulary. Throughout lesson 1 I use a PowerPoint presentation with visual representations of atoms and molecules as well as Lewis structures to show how the valence electrons are satisfied when balancing reactions. In lesson 2, I have students draw their Snap Blocks to allow the students to visualize their work on the page instead of having to rely solely on mathematics. Lastly, I include a challenge reaction, the decomposition of trinitrotoluene (TNT), for high-achieving students to balance if they finish the worksheet before the rest of the class. This reaction requires that the students balance four atoms, while all the other reactions only require three.

3c. Anticipating misconceptions

In the lesson plans, the central focus is “ Analyze chemical reactions and adjust the number of reactant and product molecules in order to balance the <https://assignbuster.com/assessing-student-learning-in-the-science-classroom/>

reactions such that the number of atoms present in the reactants is equivalent to the number of atoms present in the products." In students prior learning this year, they had learned about electronegativity, chemical bonding, valence electrons, electron orbitals, and molecular nomenclature. This information was conveyed by my mentor teacher regarding previous lessons and units as well as my previous observations of the classroom. I know that not every student will be able to recall every piece of knowledge about these concepts since they may have missed some lessons or simply did not learn it very thoroughly. The students are not expert chemists and it is likely that they only remember bits and pieces without thorough comprehension (National Research Council, 2000). Since molecular nomenclature is essential to balancing chemical reactions, lesson 1 begins with a review of molecular nomenclature. Lesson 1 has a few multiple choice questions which I use as a formative assessment to determine the students' prior knowledge before a more thorough review. The questions are designed to activate prior knowledge while the review is simply a refresher. From my mentor teacher, I was told that students commonly believe that the subscripts in molecules can simply be changed in order to balance reactions. Part of the review of molecular nomenclature is to remind the students that the subscript denotes the number of a particular atom in a molecule and changing the subscript would change the molecule. Furthermore, in lesson 1, I use Lewis structures to show that when reactions balance all the valence electrons form bonds that result in filled orbitals. If the electron orbitals are not filled, then the reaction cannot be possible. Likewise, subscripts cannot be changed since it will result in unfilled orbitals. Using prior knowledge, my goal is to justify with evidence why the subscript cannot be changed.

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4a. Identifying the language function

Analysis is essential for student learning in science. The central focus for my lessons is “ Analyze chemical reactions and adjust the number of reactant and product molecules in order to balance the reactions such that the number of atoms present in the reactants is equivalent to the number of atoms present in the products.” The students need to be able to analyze the number of each type of atom in the reactants and products and deduce how to adjust the number of molecules of reactants and products to balance the reaction. This analysis provides deeper understanding that atoms and molecules cannot simply flit in and out of existence and always exist in form where their valence electron shells are filled.

4b. Learning activities enabling practice with the language function

Lesson 2 provides the students with a learning task that enables practice with the language function. In lesson 2 the students the students complete a worksheet where they practice balancing chemical reactions by adjusting the number of molecules of the products and reactants to ensure that the number of each reactant atom and each product atom are the same. The students are asked to visualize the representation of the molecules, which helps to solidify the notion that the reactant atoms and product atoms are the same. Furthermore, by working in small groups, the students can work together and help each other figure out how to balance the reactions. If some students figure it out first, then they can explain it to others, which helps to improve comprehension.

4c. Additional language demands

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For the vocabulary in both lessons, the students will have seen almost all of the words before. Still, for teaching science, direct vocabulary instruction is especially beneficial for low-income students and English learners, both of which are in my class (Context for Learning, p. 1-2), and should include presenting terms and descriptions in rich contexts (Marzano, Rogers, & Simms, 2015, p. 13). Vocabulary associated with molecular nomenclature, such as atom, molecule, coefficient, and subscript, is reviewed with visual aides to provide a rich context. Also, the concepts of chemical reactions is introduced with real world examples (baking a cake in lesson 1), likened to making a product in a factory in lesson 1, and students are invited to think of additional chemical reactions in lesson 1.

Balancing reactions is both a new term and concept for the students. In lesson 1, I introduce the concept when discussing reactions and ask the students to think about “ what does it mean that reactions must balance?” While the students are familiar with the concept of balance as it refers to kinetic motion, balance in chemistry is foreign. Thus, by having students try to explain it in their own terms with a chemical reaction written on the board, students are required to analyze the phrase and begin to develop a definition. After the definition is established, reactants and products must have the same quantity of each atom, I will present visual representations of the quantity of each atom in the products and reactants. Additional visual examples will be used to reinforce the concept and Lewis structures are used in lesson 1 to justify with evidence why reactions must balance.

At the end of lesson 1 and throughout lesson 2, students work in small groups to practice balancing reactions. In lesson 2, the students then share <https://assignbuster.com/assessing-student-learning-in-the-science-classroom/>

their answers and their methods for balancing the reactions. This allows the students to not only practice the academic language, but to explain different ways of thinking to the class.

4d. Supporting language use

In lesson 1 we have seen multiple language tasks which lead up to and help the user complete the language function in the central focus. That language task is to analyze. The students are to analyze chemical reactions, which requires them to be able to decode molecular nomenclature in order to identify and quantify the atoms in the reactants and products. Because of this heavy reliance on decoding molecular nomenclature, the beginning of lesson 1 is a review of molecular nomenclature and the students are required to answer multiple choice questions which should jog their memories, since this material was previously taught. While lesson 1 is almost entirely a PowerPoint presentation, the students are given a copy of the slides which they can fill in as we work through the presentation. In the beginning of the PowerPoint presentation, I define stoichiometry and have the students say the word out loud with me. I break down the word phonetically on the slide to make it easier for the students to decode. Also, progress through the PowerPoint is dependent upon students being able to correctly answer questions as they arise. For example, while introducing the concept of balancing reactions, I ask the students to identify the atoms present in both the reactants and products, and then how many of each atom is present to see if the reaction is balanced. The goal is for me to first model the language, scaffold the students' use of the language, and finally in lesson 2 give the students practice using the language on their own. In <https://assignbuster.com/assessing-student-learning-in-the-science-classroom/>

lesson 2, the students have to balance reactions on their own, in small groups, and then explain their solutions and methods to the class, which provides even further practice with the academic language. Finally, the exit slip is a final opportunity to engage with the academic language of balancing reactions.

5a. Assessing student learning

Both lessons are full of informal, formative assessments. From the beginning of lesson 1, where students have to consider the process of baking a cake, I am assessing if students can establish a relationship between the ingredients and the cake. This is a real-world analogy to a chemical reaction. In the review of molecular nomenclature in lesson 1, I ask multiple choice questions and poll the class to assess their knowledge of molecular nomenclature. By tallying their responses and recording it on the board, I can visualize their knowledge and identify any misconceptions. During the review, I ask students to define the coefficient and subscript and what they tell us about the molecule and then review the multiple choice questions to fix any misconceptions before moving onto balancing reactions. While discussing balancing reactions in lesson 1, I ask the students many questions to model how to begin analyzing a chemical reaction to assess if it is balanced. These questions serve as quick checks to ensure that the students are following along and comprehending the process of balancing reactions. In lesson 1, when balancing at the reaction $C + Cl_2 \rightleftharpoons CCl_4$, the students quickly identify that the reaction is not balanced, but I ask them how to balance the reaction and wait until someone comes up with adding another

Cl_2 molecule to change the formula to $\text{C} + 2\text{Cl}_2 \rightleftharpoons \text{CCl}_4$. Following up, I ask students why $\text{C} + \text{Cl}_2 \rightleftharpoons \text{CCl}_4$ and not $\text{C} + \text{Cl}_2 \rightleftharpoons \text{CCl}_2$. I show the Lewis structures and wait for students to identify that the C in CCl_2 has unpaired electrons which is not favorable since atoms want all of their electrons paired in order to have filled orbitals. CCl_4 , on the other hand, has no unpaired electrons and is favorable, which provides further evidence for why reactions need to balance. In lesson 2, I use a video of a slow-motion explosion of a firecracker and ask students to predict what is going to happen during the explosion and write down their predictions on the board. After watching the video, we all revisit their predictions and see which were true and try to explain why to further their comprehension that the solid firecracker becomes gases during the explosion, but no atoms are lost. Lesson 2 also has a worksheet that allows the students to practice balancing reactions, which gives them practice and requires them to figure out how to balance reactions on their own. The reactions on the worksheet include combustion and oxidation (rust), both of which are common in real life. Finally, the exit slip at the end of lesson 2 serves as an assessment of the students' ability to balance reactions. Both reactions are examples of combustion, which was previously covered on the worksheet, and are typical of combustion reactions seen in real life.

5b. Adapting lessons

There are only four students in my class who require additional differentiation. Two of the students have IEPs and two of the students are ELLs. The ELLs are proficient in conversational English, but sometimes

struggle with vocabulary. As such, all four students receive more frequent check-ins during individual work with additional explanations to ensure comprehension. Otherwise, no additional adaptations were used as these students are capable of completing the same work as the rest of the class.

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