**Embedded “5E”**

**Assessment:**

**Step 1: Engage**

1. Students are given five minutes to work in small groups or pairs to answer the question, "What happens to the atoms and bonds in a chemical reaction? Come up with a response to share with the class."
2. During this time, the teacher would walk around to observe their conversations and NOT offer any suggestions or hints to the students.
3. After five minutes, each group is given the opportunity to explain their reasoning to the class. Discussion is encouraged by the teacher.

**Step 2: Explore**

1. The teacher gives each pair or group a small test tube with a clear, colorless liquid (silver nitrate) and a small coil of copper wire. They are not told what the substances are initially. Students are asked to make a prediction of what they expect to happen when the wire is added to the liquid and write that prediction down in their notebooks.
2. The teacher will make sure that each student has some prediction written in his or her notebook at this point, but not offer any help or suggestion as to whether or not the prediction is correct.
3. Once students have all written predictions, they are allowed to put the wire into the liquid and make observations. They write/draw their observations in their notebooks.
4. The teacher makes sure that each student is drawing or describing what he or she sees happen in his or her notebooks. Also, students are asked questions to stimulate their thinking. Specifically, they might be asked things like, "What happened to the copper wire? Why do you think the solution changed color?"

**Step 3: Explain**

1. Students are supplied with modeling clay to demonstrate what they think happened to the copper wire and now‐identified silver nitrate. They are given a few guidelines:
   1. Use a different color of clay for each particular element.
   2. Include starting and ending substances.
   3. Include chemical formulas for everything. (written on paper separate from the clay)
2. Students are given several minutes to discuss with their partner(s) what they think happened and time to mold the clay and make representations.
3. During this time, the teacher monitors what the students are making with the clay (to ensure no inappropriate use of clay) and asks questions to get a better idea of what the students "see" when they picture a chemical reaction. The teacher may ask questions like, "Which element are you representing with the blue clay? How do you think the atoms are connected in your silver nitrate model?"
4. After students have completed their models and are satisfied with what they have, the students then share their representations with the rest of the class. The teacher encourages discussion among the different pairs/groups by asking more specific questions such as, "What happened to the copper in the reaction? Where did it come from and go to? And the silver and nitrate ions? Did anything happen to the actual atoms during this chemical reaction? What about the bonds between the atoms?"
5. After students have had a chance to discuss their models and ask/answer a few more questions, the teacher mentions one final twist. The teacher tells the students to remember the Law of Conservation of Mass. And also mentions that the copper nitrate that is blue‐colored is actually copper (II) nitrate. Students are encouraged to look in their notes to remind themselves what the "(II)" means and to see if that changes their minds about what they've already made.

**Step 4: Elaborate**

1. Students are given a few minutes to discuss their models and to make any changes that they think are necessary. Once they are satisfied with their models, the students choose a spokesman to explain their thinking to the rest of the class.
2. At this point, the teacher should reveal to the students what the correct formulas for all reactants and products are and lead a discussion as to how close some or all of the models were (or weren't!) to the correct answer. A final equation summing up the changes is then written on the board with a picture of the corrected model below it. Students copy the corrected equation and picture into their notebooks.
3. Students are then asked to work in their groups to come up with a clay model to represent a different chemical equation. This will allow the teacher to determine whether the students have the general concept down. This will also be copied into their notebooks.

**Step 4: Evaluate**

1. Really, evaluation has taken place at each step previously described. But an overall summative evaluation would be on an individual level. Have the students individually answer questions surrounding the main ideas of the lesson and revisit the original question, "What happens to atoms and bonds in a chemical reaction?" The students would answer the few questions and make sure that their drawings of the clay models were clear and understandable. The teacher would then collect the notebooks with all of the drawings, formulas and explanations and use the attached rubric (or something else?) to assess what the students actually learned from the process.

**Part I. Use complete sentences to answer the following questions in your lab notebook.**

1. What happened to the bonds in this chemical reaction? Which bonds changed and which stayed the same?
2. What happened to the atoms in this chemical reaction? Be sure to describe all of the different elements when answering this question.
3. Where did the copper you placed in the test tube go, and where did the silver “fuzz” come from?
4. What did you learn from participating in this activity?

**Part II. Draw a complete picture of this chemical reaction.**

You must label each atom and show how the atoms are bonded together, especially in either silver nitrate or copper (II) nitrate. You need the

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| **Points** | **Requirements** |
| 2 | Correctly answered #1 and identified specific bonds |
| 2 | Correctly answered #2 and described all elements in reaction |
| 2 | Correctly answered #3 |
| 3 | Used complete sentences answering question #1-3 |
| 2 | Wrote a thoughtful, respectful response to #4 |
| 5 | Correctly identified all atoms/elements and their relative position to each other |
| 2 | Placed the correct substances as either “before” or “after” |
| 2 | Wrote the complete and correct formulas beneath each substance shown and included numbers of atoms /compounds present in the reaction |

correct numbers of atoms in the correct places for full credit. Below each atom or compound, you must write the numbers of atoms/compounds and the correct chemical formula as well. You must show both before the reaction and after the reaction, and draw an arrow pointing from the before to the after.

**EXAMPLE:**

[[Draw an example using any relatively simple equation.]]

**Scoring:**

**Reflection/ Teaching Tips:**

**Purpose for the assessment:**

I wanted to give students an opportunity to use their hands and "play" with the modeling clay as something different to do. It was also intended for me to have a better idea of what they actually are seeing when they picture a chemical reaction. Because students may be able to tell me what I want to hear as far as what happens in a reaction. But showing me is a different story.

**Possible ways to use the assessment:**

This would be used after naming rules had been introduced but before chemical equations and balancing equations had been taught.