Lesson 8: Conservation of Mass

Objective: Students will be able to choose the correct reactants and products that demonstrate the conservation of mass and justify their decision with evidence.

Learning Goal: The Law of Conservation of Mass states that atoms are not created or destroyed in a chemical reaction (mass of reactants must equal the mass of products).

Vocabulary: The Law of Conservation of Mass, mass, subscript, coefficient, chemical equation

Engage:

1. Teacher asks students about energy in a chemical reaction (teacher has students discuss the following questions in groups). What happens to energy in a chemical reaction? (energy is released or absorbed) What causes the release or absorption of energy? (chemical bonds are forming or breaking to form new substances) What has to be produced in order for you to know a chemical reaction occurred? What do you think happens to mass in a chemical reaction? Does the mass of reactants differ from the mass of products? Does the mass change (increase, decrease, stay equal)? If yes, where does it go? If no, how do you get a new substance?
2. Connection to final project: When you choose your chemicals for your self-warming/cooling device will the mass increase or decrease after the reaction?
3. In groups, students are then asked to make a hypothesis to answer the question: What happens to mass in a chemical reaction? Hypothesis takes the form of: If I mix baking soda and vinegar to produce a chemical reaction, then the mass of my reactants will be _____than the mass of my products. Students are reminded of examples of chemical reactions: wood burning, cake baking, food digesting, iron rusting, etc. to use as a guide for their hypothesis.
4. The class will then use baking soda and vinegar (or another simple reaction) to design an experiment to test their hypothesis. (This can be done as a demonstration if time or supplies are an issue. Students should still be asked to prepare a procedure and the teacher can use 3-4 groups' procedures as a demo to show differences and compare for accuracy.)

Explore:

5. Teacher reviews procedure for experiments with students (teacher guides students with amounts to mix), and ensures students have a procedure that includes finding mass of reactants and mass of products.
6. Students (or whole class if done as demo) are given materials to carry out their experiment (Teacher may or may not guide students to capture the gas produced depending on procedures students come up with. It may be beneficial for some students to not capture the gas to lead to a class discussion of measurement error.)
7. Students record their results in data table, obtain two or three other groups results, and analyze results for trends and patterns in mass of reactants and products
8. Students use results to make a conclusion about the mass in chemical reactions.

Explain:

9. Teacher shows the balanced chemical equation for the reaction of baking soda and vinegar.
10. Teacher labels (or asks students to label) reactants and products, teacher then introduces students to the subscript and coefficients in the chemical equation and their definitions.
11. Teacher has students count the atoms on each side of the equation and relates this to being "balanced".
12. After the students count the atoms, teacher asks, "Based on the same number of atoms being present in reactants and products, what do you think should always happen to mass in a chemical reaction?"
13. Teacher again points out that chemical bonds are being broken and formed but the atoms are not lost or gained, they are just rearranged.

14. Teacher now performs baking soda and vinegar experiment to show students how mass is conserved and reminds students that the Law of Conservation of Mass is a scientific law (has not been proven otherwise to date).

Elaborate:

15. Students review their results and discuss reasons why some of their data does not show the conservation of mass.
16. Class shares reasons why the mass of product may not be equal in an experiment. Example: wood burning: gas (smoke) escapes into the air); measurement errors, etc.
17. Students given reactants and products of chemical equations (used in exo/endo experiments) on index cards and asked to match reactant and product to ensure conservation of mass is shown.
18. Students are then given unbalanced chemical reactions of varying difficulty depending on class.
19. Teacher goes over the steps to balancing chemical equations as a whole class
20. Students balance the chemical equations, and include a count of atoms as justification of the conservation of mass

Evaluation:

21. Student handout on balancing chemical equations serves as assessment.
22. Students asked to put the Law of Conservation of Mass in their own words.

Continued practice assignment: Students are given 10 cards each with a reactant and a product written on them and asked to count the atoms and match the correct reactant with the resulting product. Students must also show count of atoms as evidence of atoms being equal.

Website with steps to balance equations and handouts with equations to balance:

www.chemistry.about.com/cs/stoichiometry/a/aa042903a.htm

www.chemicalformula.org