Strand: **8.1**	Standard: **8.1.6**	Episode 3	**Big Idea**: What happens to atoms during a chemical reaction?

Title: Molecular Equations and the Law of Conservation of Mass	**Time**: 45 minutes	CCCs: Energy and matter	Practices: **Developing and Using Models**

Episode Snapshot: In this episode students will review the Law of Conservation of Mass and learn how to recognize if chemical equations follow this law. They will review how to write molecular formulas and will learn how to write a full chemical equation, including how to show the number of molecules involved.

Gather

This episode uses the rusting reaction as an example. If you would like the students to experience this reaction you can do it with the class but realize that it will take 45-60 minutes. Take some steel wool and rinse it in vinegar for one minute, then drain it. This removes the protective coating on the wool which allows rust to form more quickly. It is also a source of water, which is needed for the rust reaction, but is not a reactant (for more detail about the rust reaction see this explanation). Evenly divide the wet steel wool between to flasks. Quickly put a balloon over the opening of one of the flasks but not the other. Measure the mass of both flasks. You will need to let the flasks sit for about 45 minutes to an hour. It doesn't take long to see rust start to form on the wool but after a time the balloon will be drawn down into the flask because the reaction is using up the oxygen in the air. After this has happened, weigh the flasks again. The flask with the balloon should not have changed mass since it is a closed system, but the flask without the balloon will have increased in mass. If you do not have time to do the experiment you may show the video of it, however keep in mind that this clip does not show the mass difference very well.

Reason

After seeing the reaction, ask the class why they think the balloon was pulled into the flask. What do they think the reactants and products of the reaction are? They will probably mention water but the simple form of the reaction is this:

Iron + Oxygen = Rust

Ask the class how we can write this in a way that shows all of the atoms that are involved. This should remind them of Chemistry Standard 8.1.1 in which we discussed chemical shorthand. Ask them to substitute the molecular abbreviations for the words in the equation above and they will get this:

$Fe + O_2 = Fe_2O_3$

On their student sheets, ask them to write down how many of each atom is in the reactants and then in the products. Ask the students if this follows what they know of the Law of Conservation of Mass. Ask them to also do this for the baking soda and vinegar reaction.

Discuss their results as a class. Guide them to the idea that while the baking soda and vinegar reaction is ok as it is, something more needs to be done to the rust reaction as we have written it to show that it also follows the Law of Conservation of Mass.

You may now use this bonus experiment to help the students understand that certain ratios of each reactant are required to make the reaction follow the Law of Conservation of Mass (is balanced). In other words, if you have a reaction as follows:

2(reactant A) + 3(reactant B) → Product A

you need 2 molecules of reactant A for every 3 molecules of reactant B to get product A. Simply adding more of only one reactant will not create more product.

Teacher's Note: Please recognize that the students are NOT required to know how to balance equations. They should, however, be able to recognize if a reaction is balanced or not (follows the Law of Conservation of Mass).

Discuss with the students that to show how many molecules of each reactant there are in a reaction, a large number is written in front of it. Thus H_2O is one molecule of water, $2H_2O$ is two molecules of water. In two molecules of water there are a total of 4 Hydrogen atoms, and 2 Oxygen atoms.

Communicate
Have the students work through the practice questions on the student sheet. They will look at several molecules to decide how many atoms of each type are present, then apply this knowledge to determine if chemical equations follow the Law of Conservation of Mass (are balanced).

Students can also complete an exit ticket to demonstrate their understanding.

Assessment:	**Materials, resources, handouts, etc:**
Students complete an exit ticket to demonstrate they can recognize if an equation follows the Law of Conservation of Mass.	- Scales - Flasks - Steel Wool - Vinegar - Balloons - Vinegar - Baking Soda - Graduated Cylinder (50 ml) - Detergent Solution - Droppers - Measuring spoons (⅛, ¼, and ½ teaspoons) - Plastic waste container - Law of Conservation of Mass Student Sheet - Bonus lab: Ratios Experiment Sheet - Exit Ticket