

### 3.7: Conservation of Mass - There is No New Matter

It may seem as though burning destroys matter, but the same amount, or mass, of matter still exists after a campfire as before. Look at Figure 3.7.1 below. It shows that when wood burns, it combines with oxygen and changes not only to ashes, but also to carbon dioxide and water vapor. The gases float off into the air, leaving behind just the ashes. Suppose you had measured the mass of the wood before it burned and the mass of the ashes after it burned. Also suppose you had been able to measure the oxygen used by the fire and the gases produced by the fire. What would you find? The total mass of matter after the fire would be the same as the total mass of matter before the fire.

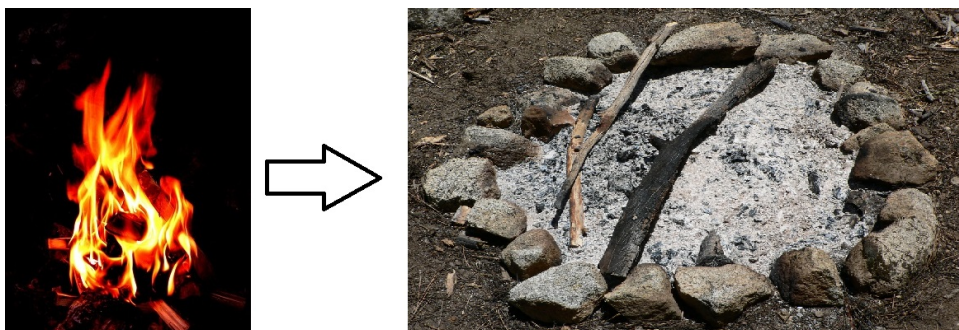


Figure 3.7.1: Burning is a chemical process. The flames are caused as a result of a fuel undergoing combustion (burning). (CC BY-SA 2.5; Einar Helland Berger for fire and Walter Siegmund for ash).

#### Law of Conservation of Mass

The law of conservation of mass was created in 1789 by a French chemist, Antoine Lavoisier. The **law of conservation of mass** states that matter cannot be created or destroyed in a chemical reaction. For example, when wood burns, the mass of the soot, ashes, and gases equals the original mass of the charcoal and the oxygen when it first reacted. So the mass of the product equals the mass of the reactant. A reactant is the chemical reaction of two or more elements to make a new substance, and a product is the substance that is formed as the result of a chemical reaction (Video 3.7.1). Matter and its corresponding mass may not be able to be created or destroyed, but can change forms to other substances like liquids, gases, and solids.



Video 3.7.1: This is a nice little demonstration showing the Conservation of Mass in action.

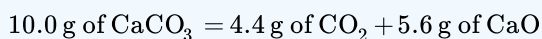
If you witness a 300 kg tree burn to the ground, there are only ashes left after the burn, and all of them together weigh 10 kg. It may make you wonder where the other 290 kg went. The missing 290 kg was released into the atmosphere as smoke, so the only thing left that you can see is the 10 kg of ash. If you know the law of conservation of mass, then you know that the other 290 kg has to go somewhere, because it has to equal the mass of the tree before it burnt down.

#### ✓ Example 3.7.1

If heating 10.0 grams of calcium carbonate ( $\text{CaCO}_3$ ) produces 4.4 g of carbon dioxide ( $\text{CO}_2$ ) and 5.6 g of calcium oxide ( $\text{CaO}$ ), show that these observations are in agreement with the law of conservation of mass.

### Solution

Mass of the reactants = Mass of the products



10.0 g of reactant = 10.0 g of products

Because the mass of the reactant is equal to the mass of the products, the observations are in agreement with the law of conservation of mass.

### ? Exercise 3.7.1

Potassium hydroxide (KOH) readily reacts with carbon dioxide (CO<sub>2</sub>) to produce potassium carbonate (K<sub>2</sub>CO<sub>3</sub>) and water (H<sub>2</sub>O). How many grams of potassium carbonate are produced if 224.4 g of KOH reacts with 88.0 g of CO<sub>2</sub>? The reaction also produces 36.0 g of water.

#### Answer

276.4 g of potassium carbonate

The Law is also applicable to both chemical and physical changes. For example, if you have an ice cube that melts into a liquid and you heat that liquid up, it becomes a gas. It will appear to have disappeared, but is still there.

### Summary

- Burning and other changes in matter do not destroy matter.
- The mass of matter is always the same before and after the changes occur.
- The law of conservation of mass states that matter cannot be created or destroyed.

### Contributions & Attributions

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