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 \(\PageIndex{1}\) 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 \(\PageIndex{1}\): Burning is a chemical process. The flames are caused as a result of a fuel undergoing combustion (burning). Images used with permission (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 when two or more elements chemically interact to make a new substance and a product is the substance that is formed as the result of a chemical reaction (Video \(\PageIndex{1}\)). Mass and matter may not be able to be created or destroyed, but it can change forms to other substances like liquids, gasses, solids, etc.
Video \(\PageIndex{1}\): This is a nice little demonstration showing the Conservation of Mass in action.

It's important to know the law well because if you're in a situation where there's a 300 kg tree that is burning down, when it is done burning down, there are only ashes left and all of them together weigh 10 kg. Well, it makes 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 could see was the 10 kg of ash, and if you knew the law of conservation of mass then you would know that the other 290 kg had to go somewhere because it had to equal the mass of the tree before it burnt down.

Example \(\PageIndex{1}\)

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

\[
\begin{align*}
\text{Mass of the reactants} &= \text{Mass of the products} \\
10.0\, \text{g of } \text{CaCO}_3 &= 4.4 \, \text{g of } \text{CO}_2 + 5.6 \, \text{g of } \text{CaO} \\
&= 10.0\, \text{g of reactant} \\
10.0\, \text{g of products}
\end{align*}
\]

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 \(\PageIndex{1}\)
Potassium hydroxide ($\ce{KOH}$) readily reacts with carbon dioxide ($\ce{CO2}$) to produce Potassium carbonate ($\ce{K2CO3}$) and water ($\ce{H2O}$). How many grams of potassium carbonate is produced if 224.4 g of $\ce{KOH}$ reacted with 88.0 g of $\ce{CO2}$). The reaction also produced 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 if you heat that liquid up, it becomes a gas. It looks like it disappeared, but it 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.

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