**When you burn wood in a fireplace, the wood is the fuel that keeps the fire going. Cars are powered by fire inside their engines; gasoline is the fuel that keeps those fires burning.**

# What Happens When Fuels Burn?

Most people burn fuels every single day. Fuels are substances that release energy when they burn. They are very important to us because we use the energy from burning fuels to do many things, such as run cars and buses, heat homes, and cook food. For example, gasoline is the fuel used in most car engines. When it burns, the energy it releases makes the car move. To prepare for a long trip, you fill your gas tank with gasoline—but after you drive for a while, the tank is empty and you need to fill it up again. What happened to the gasoline? Where did it go?

When we burn something—whether it is a log, a match, or the gasoline in our gas tank—what we are actually doing is causing a chemical reaction. Burning gasoline may not seem like the kinds of chemical reactions that you have seen before. After all, chemical reactions cause substances to change into other substances as the atoms of the reactants rearrange to form the products. When gasoline burns, it doesn't seem to change into a different substance. Instead, it seems to disappear, leaving you with an empty tank. If burning gasoline actually causes a chemical reaction to happen, then why doesn't your tank fill up with a different substance? Can a chemical reaction cause something to change into nothing?

**Antoine Lavoisier was a French scientist who did many experiments to find out whether matter could disappear or be added during a chemical reaction.**

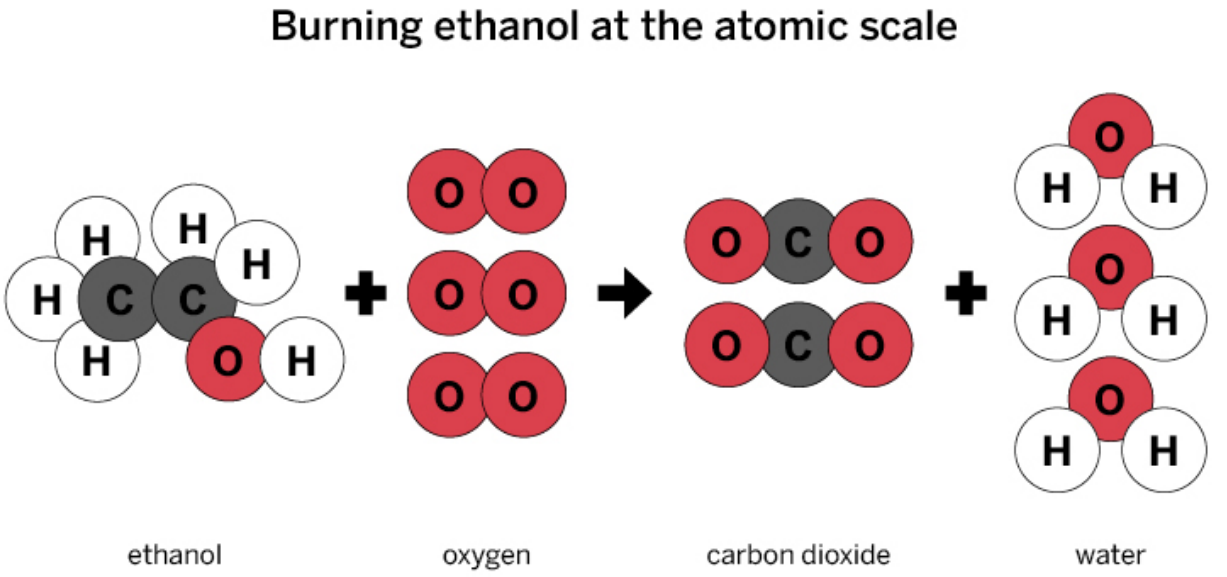
Scientists began to wonder about this question back in the 1700s. Around this time, a French scientist named Antoine Lavoisier (an-TWAN la-VWA-see-ay) began studying what happened to the masses of substances before and after a chemical reaction. Mass is a measure of how much matter makes up an object. First, Lavoisier measured the mass of two reactants before mixing them to cause a chemical reaction. After the reaction had happened, he measured the mass of the products. Every time, Lavoisier found that the reactants and the products had the same mass! Through these experiments, Lavoisier helped come up with the idea we now call the Law of Conservation of Matter: matter cannot be created or destroyed during chemical reactions. This is because the atoms that make up all matter cannot be created or destroyed during chemical reactions. This law tells us that all of the atoms that go into a chemical reaction must come out in the form of one substance or another. Chemical reactions cause atoms to rearrange into new and different groups, but the atoms themselves never stop existing, and new atoms never appear out of nowhere.

So what does the Law of Conservation of Matter have to do with burning gasoline? It means that even though your gas tank is empty, the atoms that formed the gasoline must still exist somewhere in some form. The only reason that these atoms seem to disappear is because the substances that form when gasoline burns are invisible gases. You can't see them, but they are there, and sometimes that isn't a good thing.

# Carbon-Containing fuels

Gasoline is just one of many fuels that contain carbon. One of the most common fuels in use today is ethanol, a substance made up of groups of two carbon atoms, six hydrogen atoms, and one oxygen atom. Ethanol is made from corn and used as a substitute for gasoline. Like gasoline, ethanol is a colorless liquid at room temperature. When you burn anything, including ethanol, you are mixing it with oxygen. However, just having oxygen around isn't enough to make something burn; this reaction only happens at a high temperature. Burning reactions release energy in the forms of heat and light, but these chemical reactions result in more than just energy. See the diagram below to learn more.

The chemical reaction that happens when ethanol and oxygen mix produces two substances: carbon dioxide and water in the gas phase. Since both of these are invisible, colorless gases, it seems like nothing is left of the liquid that was in your gas tank. However, the atoms of the reactants haven't disappeared at all—they've only rearranged to form the products. The carbon dioxide and water produced by this chemical reaction enter the atmosphere whenever we burn ethanol or other carbon-containing fuels. In the recent past, humans have increased the amount of carbon dioxide in Earth's atmosphere by burning such fuels, resulting in widespread changes to Earth's climate. In response to these effects, scientists are working to find fuels that can release energy without producing carbon dioxide.




**When ethanol burns, it mixes with oxygen, and the atoms of these reactants rearrange to form two products: carbon dioxide and water in the gas phase.**

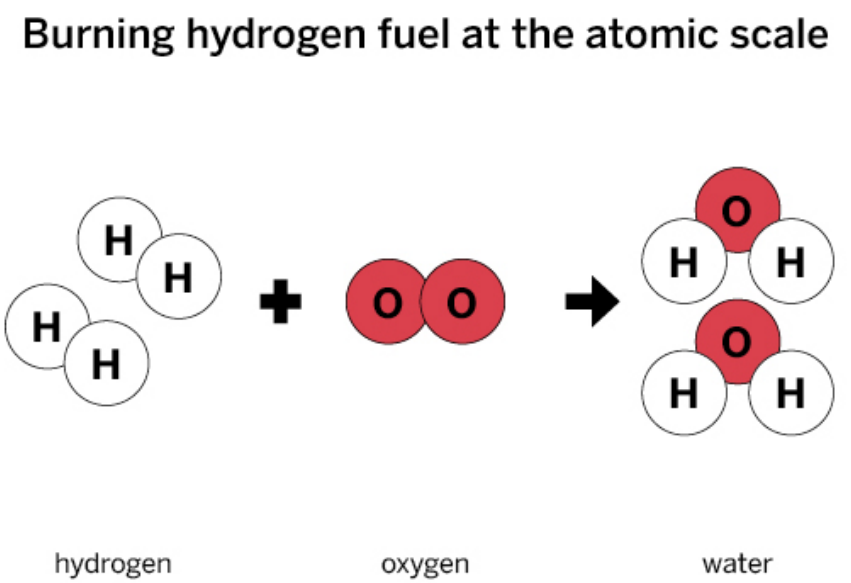
# Hydrogen Fuel

Like gasoline, hydrogen is a fuel that can be burned to power cars and buses. However, unlike gasoline, hydrogen does not contain carbon. It is a substance made up of hydrogen atoms. When you burn anything, including hydrogen fuel, you are mixing it with oxygen. Still, having oxygen around won't cause something to burn on its own; this reaction only happens at a high temperature. Fires are hot and bright because burning reactions release energy, but energy is not the only result of these chemical reactions. See the diagram below to learn more.

The chemical reaction that happens when hydrogen and oxygen mix produces only one substance: water in the gas phase. Since this is an invisible, colorless gas, you can't see it, which makes it seem like nothing is left behind by burning hydrogen fuel. However, the atoms of the reactants haven't disappeared at all—they've only rearranged to form the product.

The water produced by this chemical reaction enters the atmosphere whenever we burn hydrogen. Still, compared to the carbon dioxide that is produced when we burn gasoline, ethanol, and other carbon-containing fuels, the water produced by burning hydrogen has a less harmful effect on Earth's climate.

If we can power our cars with hydrogen without producing carbon dioxide, then why don't more vehicles use hydrogen fuel? Unfortunately, the technology needed to use hydrogen as a fuel is expensive, and storing hydrogen fuel can be difficult. Also, the most common way of getting pure hydrogen is by separating it from substances that contain carbon—so although burning hydrogen fuel does less harm to Earth's climate than burning carbon-containing fuels, the production of hydrogen fuel is still a problem for scientists trying to reduce climate change.




**When hydrogen burns, it mixes with oxygen, and the atoms of these reactants rearrange to form the product: water in the gas phase.**