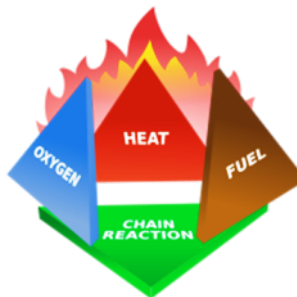


Chemistry of a Fire

The Fire Tetrahedron

Fires start when a flammable and/or a combustible material, in combination with a sufficient quantity of an oxidizer such as oxygen gas or another oxygen-rich compound (though non-oxygen oxidizers exist that can replace oxygen), is exposed to a source of heat or ambient temperature above the flash point for the fuel/oxidizer mix, and is able to sustain a rate of rapid oxidation that produces a chain reaction.



This is commonly called the fire tetrahedron. Fire cannot exist without all of these elements in place and in the right proportions. For example, a flammable liquid will start burning only if the fuel and oxygen are in the right proportions. Some fuel-oxygen mixes may require a catalyst, a substance that is not directly involved in any chemical reaction during combustion, but which enables the reactants to combust more readily.

Once ignited, a chain reaction must take place whereby fires can sustain their own heat by the further release of heat energy in the process of combustion and may propagate, provided there is a continuous supply of an oxidizer and fuel.

Fire can be extinguished by removing any one of the elements of the fire tetrahedron. Consider a natural gas flame, such as from a stovetop burner. The fire can be extinguished by any of the following:

- turning off the gas supply, which removes the fuel source;
- covering the flame completely, which smothers the flame as the combustion both uses the available oxidizer (the oxygen in the air) and displaces it from the area around the flame with CO₂;
- application of water, which removes heat from the fire faster than the fire can produce it (similarly, blowing hard on a flame will displace the heat of the currently burning gas from its fuel source, to the same end), or
- application of a retardant chemical such as Halon to the flame, which retards the chemical reaction itself until the rate of combustion is too slow to maintain the chain reaction.

In contrast, fire is intensified by increasing the overall rate of combustion. Methods to do this include balancing the input of fuel and oxidizer to stoichiometric proportions, increasing fuel and oxidizer input in this balanced mix, increasing the ambient temperature so the fire's own heat is better able to sustain combustion, or providing a catalyst; a non-reactant medium in which the fuel and oxidizer can more readily react.

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