

Killer in the smoke

The rate at which carbon monoxide is produced and fills the air in a fire usually makes other deadly toxins irrelevant.

'You've taken a breath and you can't open your eyes because as soon as you do they water. You take another breath and the irritants hit the back of your throat. You retch and take a deep breath – it's a natural involuntary reaction – of these very toxic fumes. That disorientates you, puts you down on the floor, and while you're incapacitated there the toxicity takes over. You succumb to the effects of carbon monoxide particularly.'

— Bob Graham, MBE, as quoted by Nicholas Faith in his book *Blaze*

Normal respiration

As the lungs inflate with air, they actually function more like a sponge than a balloon. Air flowing down the trachea branches off into the bronchi. These tree-like branches become continually smaller and more numerous until they terminate into clusters of tiny air-sacs called alveoli. These sacs make up the actual, spongy tissue of the lungs.

Gas exchange

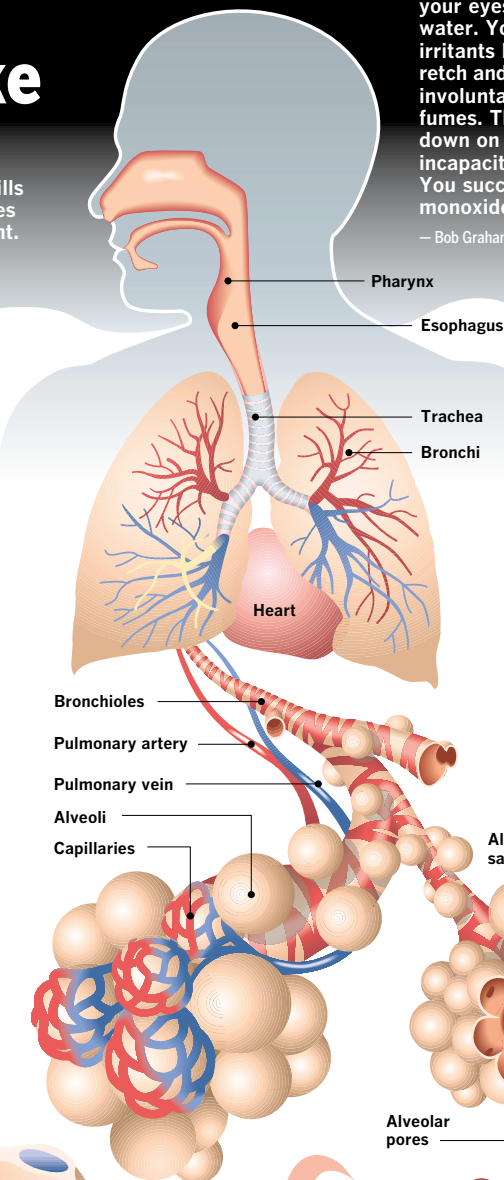
Each alveoli sack is wrapped in tiny blood vessels of two types. One carries blood away, the other brings it back.

Incoming

Oxygen is the fuel all cells need to function. It is inhaled by the lungs and transferred into the blood stream through the thin membrane walls of the alveoli. Red blood cells pick up the O₂ molecules and deliver them to all the cells of the body.

Outgoing

Carbon dioxide is the waste gas from the cells. It is carried back to the lungs, transferred back into the alveoli and exhaled from the lungs.



How smoke kills

Soot, superheated but unburned particles floating in the air, burn the esophagus and trachea, drying up mucus and making breathing painful. Very hot, dry air draws moisture rapidly from the mouth and throat causing the tongue and pharynx to swell. Soot build up and swollen tissues, if severe enough, can block airways, causing death by asphyxiation in seconds.

Carbon monoxide

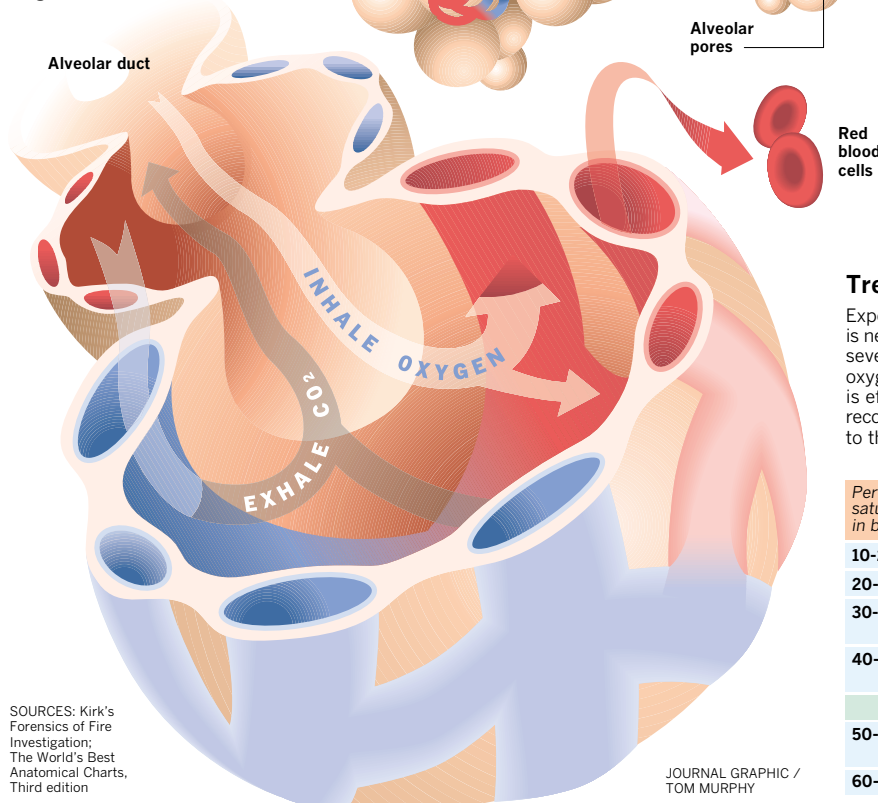
Carbon monoxide causes suffocation of another kind. It's called internal asphyxiation. This occurs when the victim continues to breathe but the cells of the body suffocate from a lack of oxygen. Here's how it works:

Bad blood

The victim takes a deep breath and brings a mixture of oxygen and carbon monoxide into the lungs.

Ready to pick up their cargo of oxygen from the alveoli, many of the red blood cells combine with carbon monoxide instead. As more cells get tied up with CO, there are less available to carry oxygen to the brain and muscles.

This process is known as hypoxia and can lead to unconsciousness in 10 to 15 seconds.



Treatment

Exposure to fresh air may be all that is needed in less severe cases. For very severe cases, feeding the victim pure oxygen in a pressurized environment is effective but may require days for recovery and may still result in damage to the brain and other organs.

Percent of saturation in blood	Physical effects
10-20	Slight headache
20-30	Severe, throbbing headache
30-40	Weakness, dizziness, confusion, vomiting, collapse
40-50	Unconsciousness, death in some cases
Recovery unlikely	
50-60	Convulsions, possible coma, probable death
60-70	Death

SOURCES: Kirk's Forensics of Fire Investigation; The World's Best Anatomical Charts, Third edition

JOURNAL GRAPHIC / TOM MURPHY