

Teachers' notes; the triangle of chemicals (tar, carbon monoxide, nicotine)

Tobacco is best known for three toxic dangers: tar, carbon monoxide and nicotine.

Tar from a cigarette is a term used to describe the toxic chemical particles, of which there are thousands caused by burning tobacco. This substance forms a sticky brown or yellow residue which stains everything it comes into contact with. One example is the lungs, which are the organs in the body we use for breathing. Even smoking one cigarette will show evidence of tar coating the throat and lungs. It is **not** the same as tar used on road surfaces.

All cigarettes produce tar but the brands may differ in amounts, which are written on the cigarette packets. Smokers can be fooled into thinking that by using "low tar cigarettes" they are less damaging to health which is incorrect. The average smoker of 15-20 cigarettes per day takes about a ½ litre of brown sticky tar into the lungs every year. From there, toxins from tar can be carried in the bloodstream to other parts of the body, which in turn can affect every organ in the body causing damage or disease.

Tar is present in any tobacco product that is burned. The level of tar increases as the cigarette burns down. Most cigarettes have a filter on the end that goes in the mouth. This filter was designed and introduced in order to trap some of the fine particles, including tar, before they entered the body. However, the design does not work as well as hoped for. The last puff on a cigarette can contain as much as double the amount of tar as the first puffs.

Carbon monoxide is a poisonous gas that you can't see, smell or taste. The gas is associated with faulty gas appliances, car exhaust fumes and smoking. Exposure to carbon monoxide, particularly in an enclosed environment can be life threatening immediately or over a long period of time. All homes with gas central heating and appliances are advised to have a carbon monoxide monitor with alarm for this very reason. Tobacco contains carbon and when it burns gives off carbon monoxide.

Every time a cigarette is inhaled traces of carbon monoxide are breathed in, which is then absorbed through the lungs into the bloodstream. Red blood cells in our bloodstream transport vital oxygen around the body, but a person who smokes has oxygen in their red blood cells replaced by carbon monoxide. The more a person smokes the higher the percentage and presence of carbon monoxide in their red blood cells. The red blood cells carrying carbon monoxide combined with nicotine become stickier, which causes the walls of the arteries that carry blood away from the heart around the body more likely to develop fatty plaques inside them, which means blood can't flow through so easily. The result is, the heart is starved of oxygen and can't work as well as it should. Additionally, less oxygen being carried in the red blood cells results in smokers getting out of breath more easily than non-smokers. Because of carbon monoxide smokers are more at risk of heart attack, stroke and amputation with the body's ability to heal and repair itself reduced due to sluggish and poorly oxygenated blood circulating the body and vital organs. The good news is that when a person stops smoking the carbon monoxide levels drop very quickly. In 24 to 48 hours the carbon monoxide levels go back to the level of a non-smoker.

Nicotine is a colourless, naturally occurring substance from the tobacco plant, which is found in the nightshade family of plants. Interestingly, what is often referred to as the tobacco plant is, in fact, the *Nicotiana tabacum* species of plants. These plants are indigenous to Australia, south west Africa, the Americas and the South Pacific. *Nicotiana* plants produce nicotine to protect themselves from herbivores, which is why diluted nicotine is used as an ingredient in insecticides. Nicotine is a poison and it is so dangerous in its purest form that many countries across the world have banned its use as an insecticide for crops. Foods imported from countries in which nicotine pesticides are allowed, such as China, must not exceed maximum nicotine levels.

Nicotine is an addictive substance found in tobacco and some liquids for electronic cigarettes/vapes. When inhaled from tobacco, nicotine and other chemicals from tobacco smoke are delivered into the lungs and rapidly absorbed by the blood, reaching the brain within approximately 10 to 20 seconds. This changes how the body uses food (speeds up metabolism), causes the heart to beat faster, pulse to quicken, increases blood pressure and veins to tighten causing blood flow throughout the body to become more difficult, reducing the amount of essential blood flow to the vital organs like the brain and heart. At this point, smokers experience a nicotine “hit”, “rush” or “buzz”. In addition, nicotine suppresses the appetite making a smoker feel less hungry but it will **not** prevent them from putting on weight. Nicotine inhaled from an electronic cigarette/vape depending on the strength of the nicotine liquid has a slower delivery and effect on the body. The weaker the dose of nicotine the weaker the effect.

Nicotine works by stimulating the nervous system to release specific chemical messengers (hormones and neurotransmitters) that affect different parts of the brain and body. One hormone that nicotine affects is epinephrine, also known as adrenalin. When nicotine is inhaled, the buzz felt is the release of epinephrine which stimulates the body and causes the blood pressure and heart rate to increase, resulting in breathing faster and harder. Nicotine also activates a specific part of the brain that makes you feel happy by stimulating the release of the hormone dopamine. The release of dopamine when nicotine is inhaled is thought to be the source of the pleasurable sensations experienced from smoking, which can result in a feeling of a buzz, relaxation, calming effect and relief of tension. As users become more tolerant to nicotine they require higher doses more frequently to enjoy the same effects. The brain soon develops a comfortable level of nicotine, and withdrawal symptoms are produced when the supply is interrupted and the nicotine level goes down. Within approximately two hours after entering the body, half of the nicotine has gone. The addictive nature of nicotine is due to frequent repeated dosing, rapid delivery to the brain and the brief feel good effect from the hormone dopamine each time.

Nicotine poisoning happens when you have too much of it in the body. The amount that causes overdose depends on things like body weight and where the nicotine comes from. It's not likely an adult will overdose dangerously on nicotine from smoking cigarettes or using an electronic e-cigarette/vape as they will regulate any symptoms like nausea by reducing or stopping use until symptoms subside. Overdosing from nicotine replacement therapy which is medication that provides a low level of nicotine, without the tar, carbon monoxide and other poisonous chemicals present in tobacco smoke, is rare, but it's possible if the person does not follow the instructions carefully. Nicotine replacement therapy can help reduce unpleasant withdrawal effects, such as bad moods and cravings, which may occur

when stopping smoking. Usually, someone who gets quick, medical care will recover fully from nicotine poisoning. However, a severe case of poisoning could have long-lasting effects. Because children are smaller, it takes less nicotine to poison them (or pets, for the same reason). There's enough in a cigarette butt to harm a toddler or child if they decide to eat one off the floor or if they get access to any nicotine replacement medication like gum, lozenges, patches, inhalator cartridges or mouth spray for example. E-cigarette liquid poses a bigger risk to children. Inhaling or swallowing this liquid nicotine can be toxic and very dangerous. In addition, it can also be harmful if the liquid nicotine is spilled on the skin or gets into eyes. Children will not know by looking at the liquid in an e-cigarette tank or top up bottle if it has nicotine in it or not. Often the nicotine liquid comes in colourful packages or smells like sweets, so it's not surprising that children will be attracted to it. All tobacco and nicotine products should be kept safe out of reach from children and pets.