

Teachers' notes; chemical's in tobacco smoke

Tobacco Smoke consists of mainstream and side stream smoke:

- Mainstream smoke is smoke breathed in and out by smokers
- Sidestream smoke is smoke which comes from the tip of a burning cigarette or cigar and makes up 85% (much of which is invisible) of the smoke in a smoky place. Sidestream smoke is about four times more toxic than mainstream smoke, although people inhale it in a more diluted form. This is because sidestream smoke contains much higher levels of many of the poisons and cancer-causing chemicals in cigarettes

7000 chemicals are produced by a burning cigarette: **250** of these chemicals are toxic and just under **70** of them are known to cause cancer.

Up until recently we have used the previous figure, from Cancer Research UK, of 4,000 chemicals in cigarettes. However, updated evidence from the US Food and Drug Administration (FDA) puts the figure much higher (ASH Scotland, Taking Action on Smoking and Health, Tobacco-free schools resource pack)

The tobacco companies add these chemicals for the following reasons:

- **Menthol and eugenol** (the aroma of cloves) are added because they act as a pain reducer on the mucous membranes of the throat, making cigarette smoke less irritating.
- **Some** of the chemicals improve the flavour of cigarettes and deliver nicotine more efficiently.
- **Some** chemicals are used to improve combustion and give the cigarette an even burning quality

Please refer to P5 Attachment, lesson plan 1, teachers' notes: the triangle of chemicals which provides additional information about the three main chemicals; **Tar, Carbon monoxide and Nicotine**

Other ingredients and chemicals found in tobacco are:

- **Flavourings** like cocoa and liquorice dilate the airways, allowing smoke to pass deeper into the lungs, making more tar and nicotine available to the body
- **Sugar, vanilla and honey** are used to make the cigarette taste nicer and to mask toxic ingredients to encourage people to keep smoking and to encourage brand loyalty
- **Acetic Acid** is a weak acid and is the chemical that gives vinegar its sour taste and recognizable smell
- **Acetone** works as a solvent for other additives. It dissolves them so they can mix together. It is a colourless, flammable liquid used as paint stripper and is the active ingredient in nail varnish remover
- **Ammonia** makes more nicotine available from a cigarette (29% extra), thereby increasing the addictive properties of cigarettes and tobacco smoke. It changes nicotine into a gas that is more readily absorbed into the lungs, airways and bloodstream. Like carbon monoxide ammonia also kills cilia

- **Arsenic** is a poison. Arsenic compounds are applied to growing tobacco plants to protect them from insects and pests. Arsenic is notoriously poisonous; it's used in the production of pesticides like rat poison. Arsenic is one of the most dangerous chemicals in cigarettes. It can cause cancer as well as damaging the heart and its blood vessels. Small amounts of arsenic can accumulate in smokers' bodies and build up to higher concentrations over months and years. As well as any direct effects, it can worsen the effect of other chemicals by interfering with our ability to repair our DNA. Fish and seafood can be major sources of arsenic, but in a form that is less toxic and more readily removed from the body. In contrast, tobacco smoke contains arsenic in a more dangerous form
- **Benzene** is a solvent used to manufacture other chemicals including petrol. It is a natural constituent of crude oil, and is one of the most basic petrochemicals. Tobacco smoke contains large amounts of benzene and accounts for a big proportion of our exposure to this poison. The average smoker inhales about ten times more benzene than the average non-smoker. It is well-established that benzene can cause cancer, particularly leukaemia
- **Butane** is a highly flammable, colourless, easily liquefied gases. Used as fuel for cigarette lighters and as a propellant in aerosol sprays such as deodorants
- **Cadmium**, tobacco plants naturally concentrate cadmium from soil. Cadmium is a metal used mostly to make batteries. The majority of cadmium in our bodies comes from exposure to tobacco smoke. Smokers can have twice as much cadmium in their blood as non-smokers. Studies have found that the amounts of cadmium present in tobacco smoke are capable of affecting our health. It is a known cause of cancer, and can also damage the kidneys and the linings of the arteries. Our bodies have proteins that mop up harmful chemicals like cadmium, but the amounts in smoke can overload these proteins. Cadmium can also prevent our cells from repairing damaged DNA. Because of this, it can make the effects of other chemicals even worse
- **Caesium**: A metal
- **Carbon monoxide** is a colourless gas with no smell. It is formed when we burn carbon-based fuels, such as gas in cookers or petrol in car engines
- **Ethanol**: Ethanol fuel is ethyl alcohol, the same type of alcohol found in alcohol beverages, but is also used in fuel and can be found in anti-freeze
- **Formaldehyde** Is a smelly chemical which kills most species of bacteria, it is used for preserving dead bodies and laboratory specimens. It is one of the substances in tobacco smoke most likely to cause diseases in our lungs and airways. Formaldehyde is also a known cause of cancer. It is believed that even the small amounts in second-hand smoke could increase our lifetime risk of cancer. Tobacco smoke is one of our major sources of formaldehyde exposure. Places where people smoke can have three times the normal levels of this poison
- **Hydrazine**: Colourless flammable liquid which is a highly toxic chemical used mainly in rocket fuel
- **Hydrogen Cyanide**: Poisonous Gas (Used in chemical warfare and as a method of execution in USA)

Hydrogen Sulphide: Chemical compound. It is a colourless gas with the characteristic foul odour of rotten eggs (used in stink bombs). It is very poisonous, corrosive and flammable

- **Lead:** A heavy metal that is denser than most common materials. Used for car batteries, found in paint and to store corrosive liquids. Lead is **NOT** found in pencils
- **Methane:** Methane is a greenhouse gas and is produced by cows and landfill sites. It is also a component of sewer gas
- **Methanol:** Light volatile colourless flammable liquid and is used as an antifreeze, solvent and as a fuel
- **Nicotine** occurs naturally in the leaves of plants as well as being in insecticide (bug spray). A stimulant drug with addictive properties. It causes a smokers heart rate and blood pressure to increase
- **Nitric Acid:** Power Station Smoke
- **Polonium – 210:** Rare radioactive element in its most common form. Polonium strongly emits a very dangerous type of radiation called alpha-radiation
- **Radon:** Radioactive Gas
- **Stearic Acid:** Found in candle wax
- **Tar** is a mixture of lots of chemicals, many of which can cause cancer. It is a brown, sticky substance inhaled from a cigarette as a bi-product of combustion and when it settles, tar forms a sticky, brown residue
- **Toluene:** Industrial glue

Toxic chemicals can cause death if swallowed, breathed in or absorbed by the skin. Anyone using or working with a toxic chemical would need to take great care. They will wear gloves and eye protection, and they may wear a mask over their mouth and nose or handle the chemical in a fume cupboard

Often the above household chemicals are out of reach or locked away because of their dangerous toxicity. While a person may be exposed to some of these chemicals in diluted form through domestic items or food, inhaling toxic chemicals direct to lungs and bloodstream from cigarettes tends to be repetitive throughout every day, which causes detrimental health effects in the body both immediate and long term