From orange peel to chewing gum

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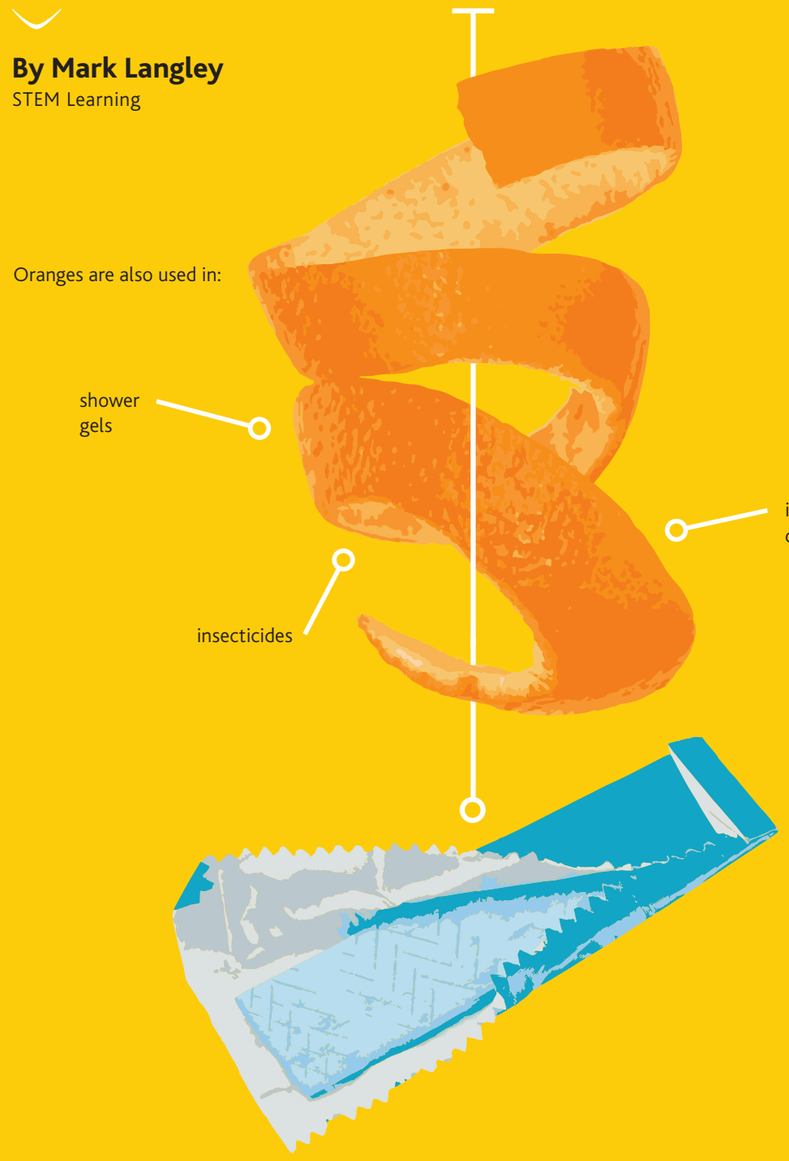
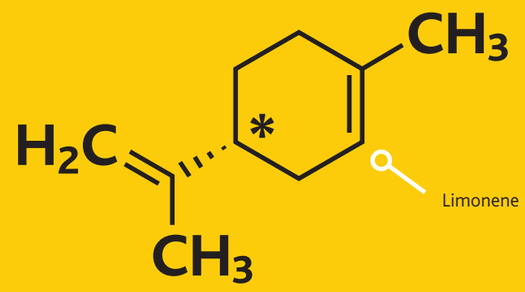
STEM Learning

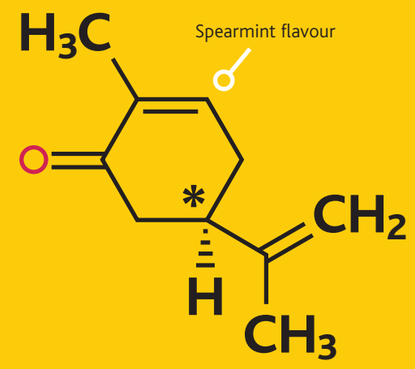


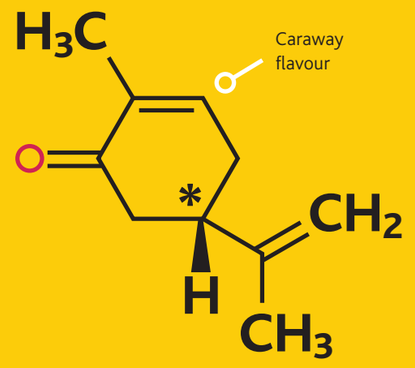
Oranges are a rich source of limonene – this terpene is found in high concentrations in the peel and has a raft of commercial uses, from being used in shower gels, through to industrial cleaners and insecticides. Easily extracted from the orange skins left by the orange juice industry by steam distillation, or using a centrifuge, it is a cheap, biodegradable, natural product. But it has another, surprising, use – in chewing gum.

If you look closely at the molecule, there is a chiral centre, so that limonene comes in two versions (d-limonene and l-limonene). Chiral molecules are identical in atomic structure to each other, but are mirror images. Biologically, only one version is made, while synthetic routes often make a mixture which can be hard to separate. So, in oranges, the d-limonene (the (R)-enantiomer) is made, giving a pure product which can be used as a starting point for many synthesis routes.



One of these is the oxidation to produce carvone, which also can be found in two chiral forms. The (S)-enantiomer has the taste and smell associated with caraway seeds, while the (R) form is spearmint. The fact we can tell identical, but mirror-image molecules apart just by smell also points to how our body reacts to chiral compounds.





While the (R)-enantiomer of carvone can be extracted from spearmint, it is a delicate process and needs a lot of mint! So, given how much orange peel is left over from juicing oranges, it makes sense to convert the extracted limonene into (R)-carvone, to use as a mint flavour in all manner of products, from air fresheners to food. So, quite possibly the minty taste in your chewing gum or toothpaste might have started its life in an orange!

Limonene and carvone are both trivial names, as the systematic names are more complex: limonene is *1-Methyl-4-(1-methylethenyl)-cyclohexene* and *2-Methyl-5-(prop-1-en-2-yl) cyclohex-2-en-1-one* is carvone!