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5.111 Principles of Chemical Science
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Lewis Structures of some Biologically-Interesting Molecules

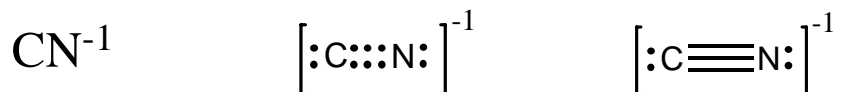
See lecture 10 (starting on page 3 of the notes), lecture 11, and lecture 12 for a description of covalent bonding and Lewis structures.

Lewis structures can be found in almost any chemistry laboratory notebook at MIT. They are easy to draw and quickly communicate information about the functional groups and reactivity of small molecules.

Below are two examples of molecules frequently used to teach Lewis structure rules with some additional information about the chemical and biological significance of the molecules.

Example 1) from page 2 of Lecture 11 notes: Cyanide ion (CN^{-1})

Salts of CN^{-1} , such as sodium cyanide (NaCN) and potassium cyanide (KCN), are used as reagents in organic synthesis. These reagents are very reactive and allow chemists to add a carbon atom to molecules, a reaction that is very useful in the synthesis of complex molecules.



However, students may be more familiar with **cyanide as a poison**. Even in a laboratory setting, cyanide salts are considered dangerous to work with and are labeled as a PHS (a particularly hazardous substance), requiring special safety precautions. Hydrogen cyanide (HCN) smells like almonds, and while there are trace amounts of cyanide in certain types of almonds, the concentrations are far too small to cause any harm.



In contrast, dangerous levels of cyanide (or a cyanide precursor) can be found in cassava, a shrub native to South America. Although it is poor in protein and nutrients, the cassava root is a major source of carbohydrates for much of the world. Roots, which are eaten cooked or raw throughout Africa, are characterized as sweet or bitter. Bitter cassava roots contain high levels of cyanide, even when cooked. Plant scientists have developed techniques to reduce the cyanide concentrations, namely by mixing the cassava powder with water, spreading it very thin and leaving it in the sun for several hours. This enables the enzymes in the flour to break down the cyanide, releasing the poison as HCN into the air. This cassava preparation is promoted throughout rural African villages that rely on cassava as a major part of their diet.

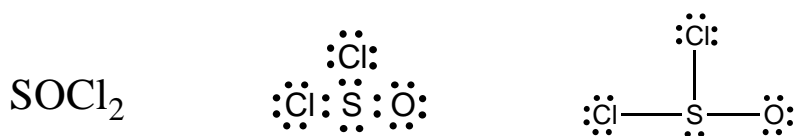


Cassava photo courtesy of Peter Volsky (Flickr user azure elixir).

Luckily in the US, we don't have to worry about ingesting dangerous levels of cyanide...unless you smoke. HCN is a component of cigarette smoke.

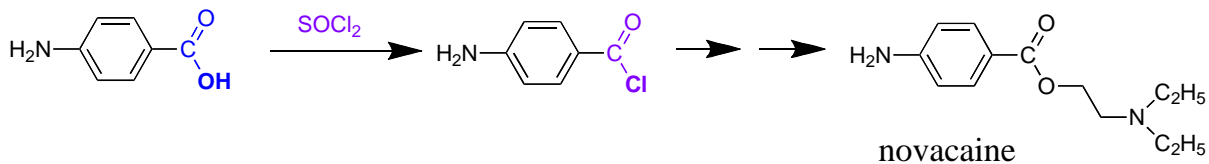
Image of Cancer Research UK "When There's Smoke There's Poison" anti-smoking advertisement removed due to copyright restrictions. See http://info.cancerresearchuk.org/images/pdfs/hl_sip_hydrogencyanide.pdf

Example 2) from pages 2-3 of Lecture 11 notes: Thionyl chloride (SOCl₂)



SOCl₂ is a reagent used in organic and medicinal chemistry to convert carboxylic acid (COOH) groups to acid chloride (COCl) groups in molecules. One example of using SOCl₂ in the synthesis of pharmaceuticals is for novacaine, an anesthetic drug used in dentistry and to reduce pain in intramuscular injections of other drugs, such as antibiotics.

Synthesis of novacaine (with line-drawing shorthand used to depict the molecules)



Synthesis of novacaine (with structures showing all atoms and lone pairs)

