Ethylene Glycol

Chemical Structure
A polyhydric alcohol; wonderfully syrupy and deliciously sweet to the tongue.

Chemical Relatives
Ethylene glycol is a precursor for many polymers, eg. polyethylene glycol
It is only the most common toxin among a whole family of glycols:
- Dioxane- the dimer of ethylene glycol - which causes coma and hepatic / renal failure
- Dipropylene glycol, which causes CNS depression
- Diethylene glycol, which causes hideous renal failure even in small doses
- Polyethylene glycol, which is relatively non-toxic, and rapidly renally excreted
- Propylene glycol, which is also relatively non-toxic

Administration and Absorption
- Typically, people drink this stuff. It gives one a buzz similar to that of alcohol intoxication.
- It is not well absorbed through the skin; nor does it evaporate particularly well.
- This one, like all other glycols, is RAPIDLY ABSORBED, even through the gastric mucosa.
- Half life is short, but longer with any therapy that blocks the metabolism of ethylene glycol to glycoaldehyde... so with ethanol therapy, the ethylene glycol can hang around for up to 24 hours
- With therapy, elimination is entirely renal. Otherwise, much of it is metabolized into hideous daughter-compounds, which are excreted by the unhappy kidneys (which find themselves mangled by the process)

Metabolism and Clearance

From "Goodman & Gilman’s The Pharmacological Basis of Therapeutics" 11th ed by Brunton et al and "Poisoning and Drug Overdose" by Olson, as well as "Basic & Clinical Pharmacology" 11th ed. By Katzung et al
Mechanism of Action
- It is believed that the desired CNS effect is achieved in a mechanism similar to that of ethanol.

Indications for Use
- Depression?

Interactions
- Its major interaction is with ethanol and fomepizole, which is put to good use in management of the toxicity.
- Potentially, it may interact with things like disulfiram and metronidazole, which block acetaldehyde dehydrogenase.

Chronic Toxicity

Acute Toxicity and Overdose
- A mouthful is enough.
- First they are drunk for ~ 4 hours
  - At this stage, there is no acidosis, but the anion gap is widened (unmetabolised ethylene glycol floods the bloodstream)
- Then, they feel slightly ill.
  - Wide anion-gap metabolic acidosis ensues
  - Hyperventilation follows,
  - convulsions and coma ensue
  - Cardiac conduction disturbances and arrhythmias are to be expected, pulmonary oedema may result from myocardial depression (caused by the acidosis)
  - Hypocalcemia may occur as oxalate chelates the serum calcium
- After about 36-48 hrs, the renal failure becomes the dominant feature.
  - The calcium oxalate crystals finally end up clogging the renal capillaries.

Management of acute toxicity
- BICARBONATE!! Then...ETHANOL or FOMEPIZOLE
  Either will block the conversion of ethylene glycol into its hideous metabolites.
  Good old alcohol, in massive quantities, will overwhelm alcohol dehydrogenase, saturating it. The result is a failure to convert ethylene glycol into glycoaldehyde.

HEMODIALYSIS
- Indicated when the osmolar gap is over 10, or when there is a high anion gap acidosis with hemodynamic instability
- Ethylene glycol has a small volume of distribution and thus is very well suited to removal by dialysis.

Activated charcoal is useless.
If ingestion was recent, lavage may be useful.

There may be a “rebound” after dialysis. Ethylene glycol may redistribute back into the bloodstream.
Thus, ethanol or fomepizole should continue until osmolar gap is normal again.