BASIC INDUSTRIAL TOXICOLOGY

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Today`s goal ... (1)

- Focus on industrial intoxications
  - Lead poisoning (Pb)
  - Carbon monooxide (CO)
  - Insecticides (organophosphates)
  - Hydrogen cyanide (HCN)
  - Hydrogen sulphide (H_2S)

Today`s goal ... (2)

- Focus on industrial intoxications

  - Toxicokinetic properties
  - Toxicodynamic effects
  - Industrial occurance and health effects

Lead (Pb)

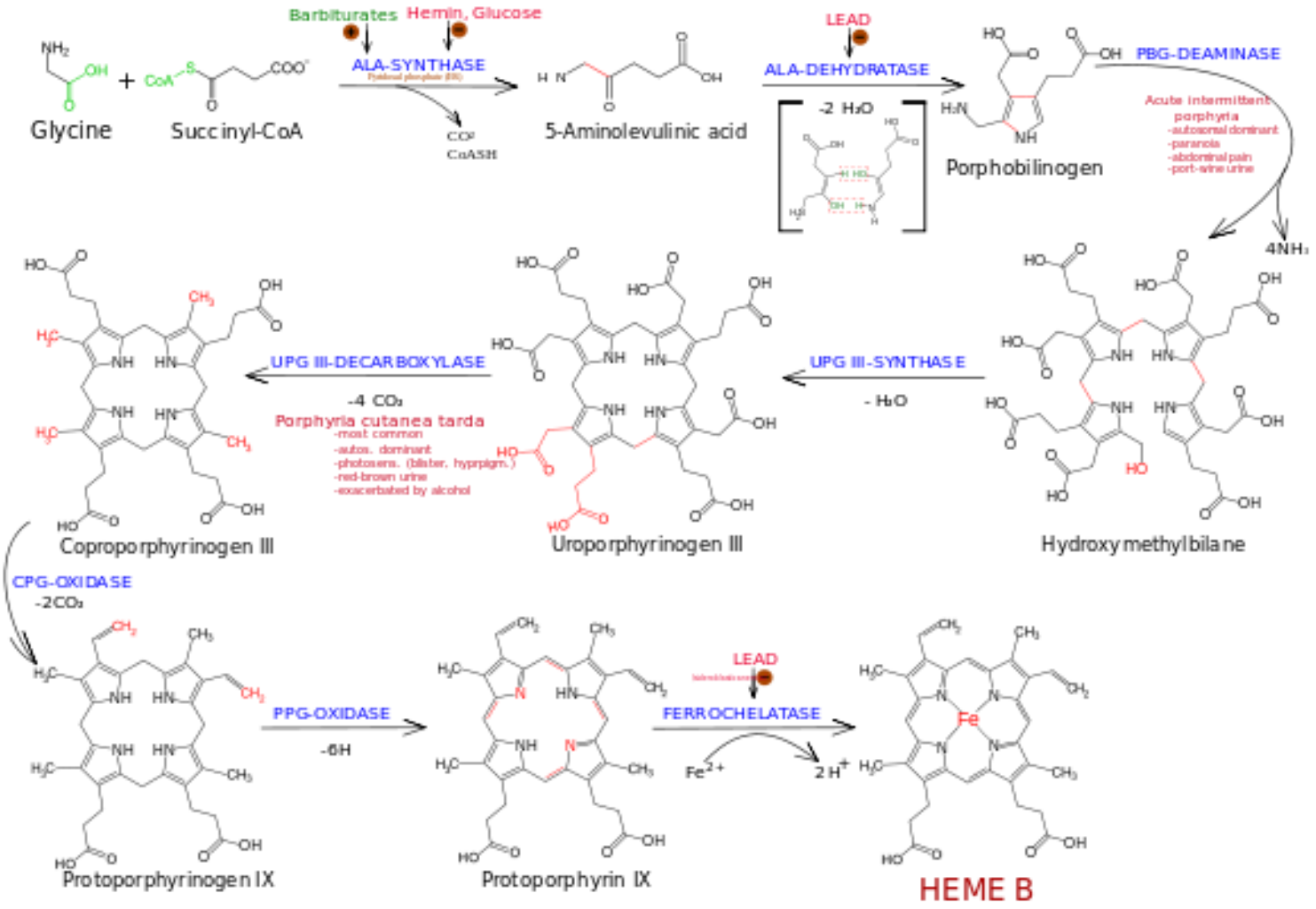
Lead - properties

- Heavy soft grey metal
- High density and resistance against rust
- Forms
  - „pure“ metal
  - Organic compund (petrol hydrocarbons) **TML, TEL**
  - Inorganic compound (PbS)
- Pipes, petrol, ammunition, foil

Lead - toxicokinetic parameters

- **Absorbtion**
  - Lungs (major absorption)
  - minority via GIT
  - **Presence of other metals in diet increases GIT absoption !**
- **Distribution**
  - RBC biomembrane
  - Bone deposits
  - Extreme long half-time

Lead - toxicodynamic parameters (1)



Schema author: Boswell, 2012

Lead - health effects

- Acute symptoms
  - Fatigue, Abdominal cramps
  - Constipation, Myalgia
  - Encefalopathy, Renal failure (**children**)
- Chronic intoxication
  - Peripheral neuropathy,
  - Anemia
- Organic forms – psychosis, mania

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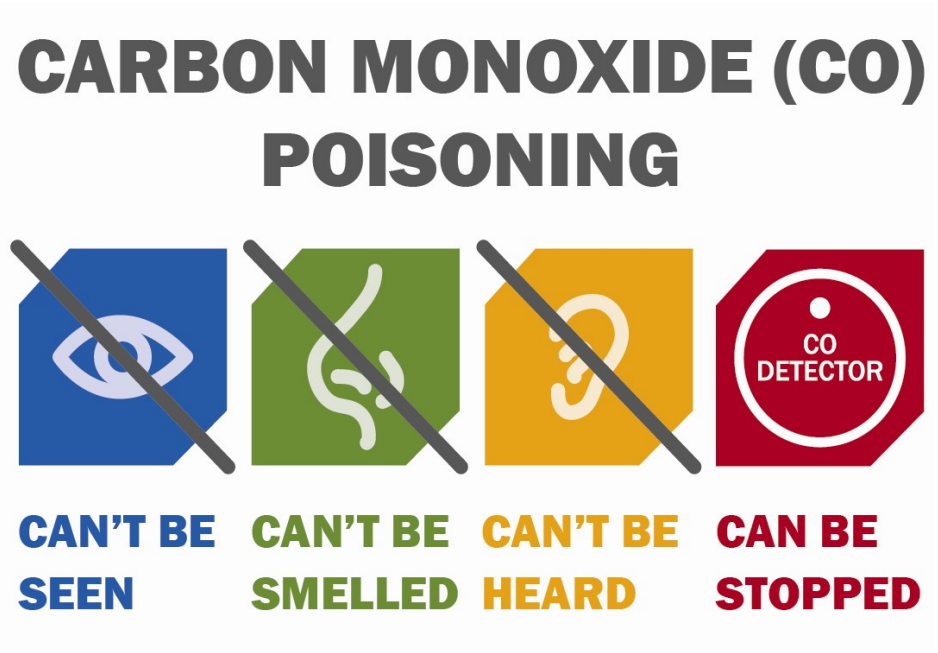
Carbon monooxice (CO) - properties

- Incomplete combustion of carbonaceous compounds
- Colourless, odourless gas



CO - toxicodynamics

- CO causes **tissue hypoxia**
  - Active competition with oxygen at HB binding sites
  - Decrease of $\mathbf{P_{O2}}$
  - Carboxyhaemoglobin **(COHb)** synthesis
  - HB vs. CO - high affinity (100 – 240 x stronger)

- **RESULT: Hb transport capacity for O_2 diminishes**

CO – health effects

- Toxicity in corelation with **c[COHb]**
- **CO level in acute intoxication**
  - Below 1 % - asymptomatic
  - Up to 30 % - non specific effects: dizzyness, headache, neusea, vomitus, tachycardia
  - Above 30 % - hypotension, spasms,

    cherry-red skin discoloration,
  - Above 60 % - generalized weakness, confusion, cardiac and respiratory depression,
  - Above 90 % - death within few minutes

Carbon monooxide intoxication symptoms

CO intoxication treatment

- **Hyperbaric oxygen**
  - Increase P_{O2} in plasma
  - Result: **decrease of c[COHb] due to chemical competitive shift**

- **Brain edema**
  - Corticosteroids, diuretic therapy

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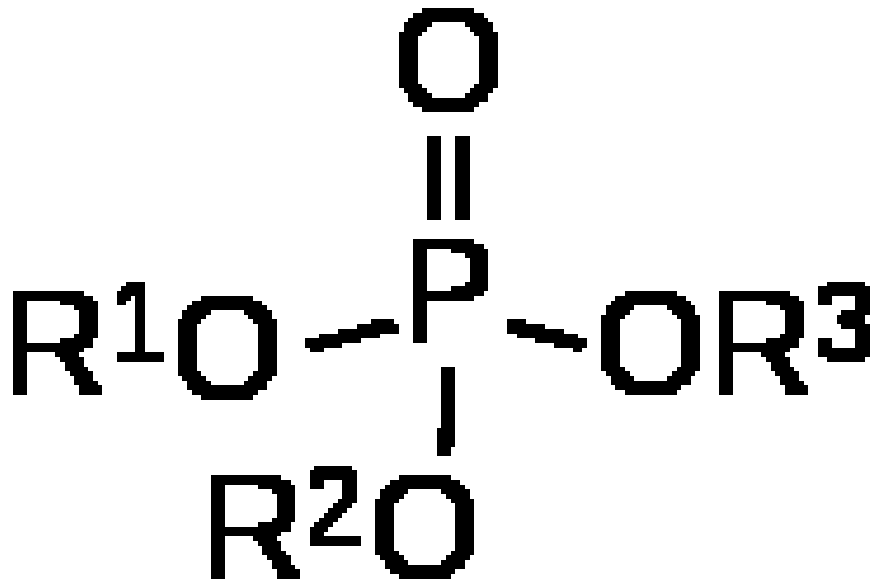
Organophosphates

- Inhibition of AchE, PchE
- Insecticides in agriculture (obsolete)
- Chemical weapon – war gas

- Route of poisoning
  - Dermal absorption
  - Inhalation

Organophosphates



Organophosphates

- Accumulation of acetylcholine
  - Synapsis
  - RBC
  - Increased **c[acetylcholine]** affects both central and peripheral nervous system

- Treatment: atropine, **AchE-reactivators**
- Problem: **enzyme aging,**

  respiratory depressant medication

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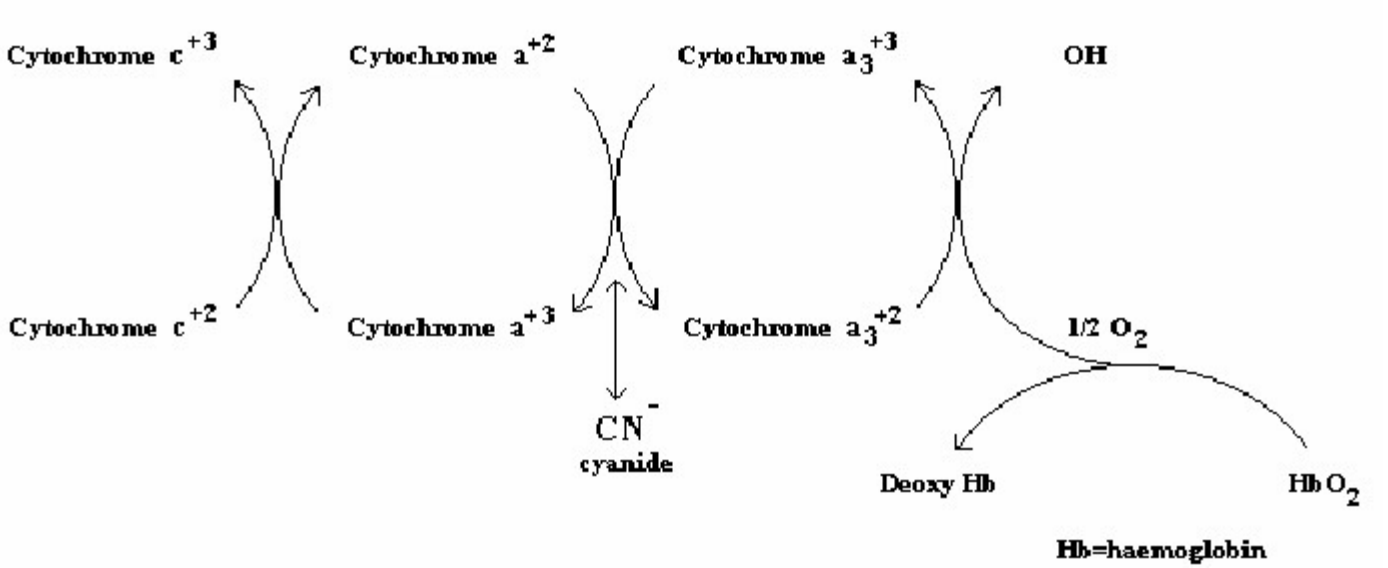
Hydrogen cyanide (HCN)

- Colourless gas with bitter smell

- Use in industry
  - Extraction of gold, silver
  - Synthetic fibres and plastic matherials
  - Metallurgy

Hydrogen cyanide (HCN)

- Toxicity
  - Inhibition of cytochromeoxidase in mytochondrial oxydative metabolism



Hydrogen cyanide (HCN)

- Route of intoxication
  - Skin absorbtion
  - inhalation

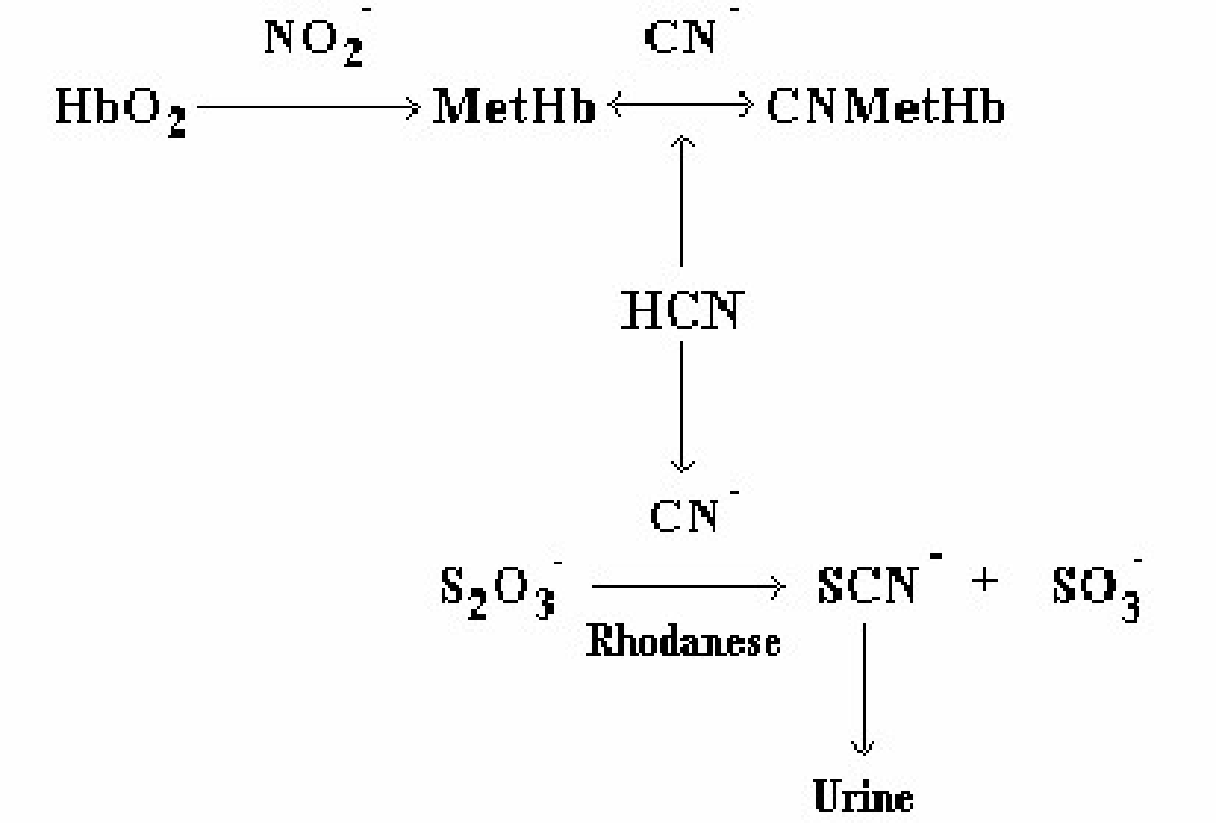
- Acute toxicity symptoms
  - Headache, tachycardia, hypotension, convulsion
  - Death

Hydrogen cyanide (HCN)

- Remove contaminated clothing
- Wash exposed skin

- Amylnitrite inhalation
- 25 % sodium thiosulphate sol. i.v.

Hydrogen cyanide (HCN)



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Hydrogen sulphide (H_2S)

- Colourless gas with characteristic smell
- Toxicity similar to HCN
- **Inhibition of oxidative mitochondrial metabolism (cytochromeoxidase, HbO_2)**
- **Sulphmethaemoglobin formation**

- Petrol products (fuel gas), ruber factories

Hydrogen sulphide (H_2S)

- Acute poisoning
  - Lacrimation, photophobia, mucose irritation (low concentration)
  - Pneumonitis, respiratory centre paralysis (high concentration)

- Chronic exposure
  - Keratitis, skin vesicles

Hydrogen sulphide (H_2S) - therapy

- Immediate removal of hydrogen sulphide source

- Oxygen
- Sodium amylnitrite
  - conversion of sulphmethaemoglobin
  - Symptomatic therapy

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