
McEuen Group
KEEP YOUR HOOD SASH LOW!
SAVE ENERGY
MAINTAIN SAFETY
LOWER YOUR SASH!
HIGH HEAT LOADS
NORMAL
HEAVIER THAN AIR
THIS SIDE OUT
Chemical Safety

General Lab Safety



General Lab Safety

- What do we own?
- What are the risks?
- How can we be safer?



General Lab Safety



A lot of us aren't trained as chemists.

General Lab Safety



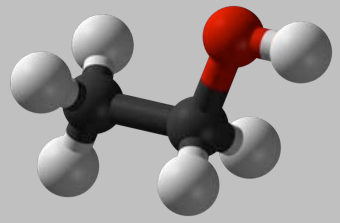
Chemicals We Own:

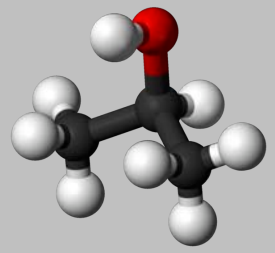


Solvents and Bases

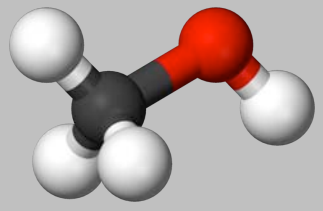
Solvents and Bases







IPA
Ethanol
Methanol



IPA / Ethanol / Methanol

Will they kill me?

- Don't drink them.
- Skin sensitivity can build up over time.
- All are very flammable.



IPA / Ethanol / Methanol

Will they kill me?



IPA / Ethanol / Methanol

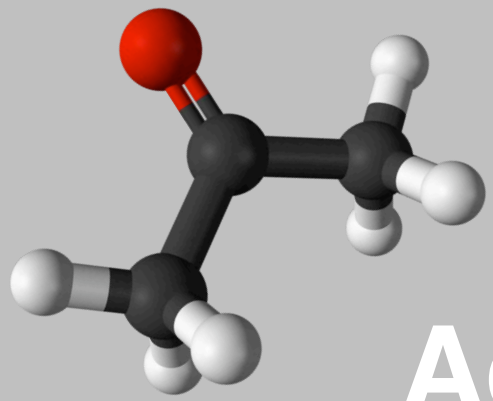
Methanol:



IPA / Ethanol / Methanol

Lab ethanol is full of contaminants.





Acetone

Acetone

What is it?

- It's acetone.



Acetone

Will it kill me?

- Very low toxicity, but melts some plastics!

- Very flammable.

- Dangerous when it combines with hydrogen peroxide and acetic acid!

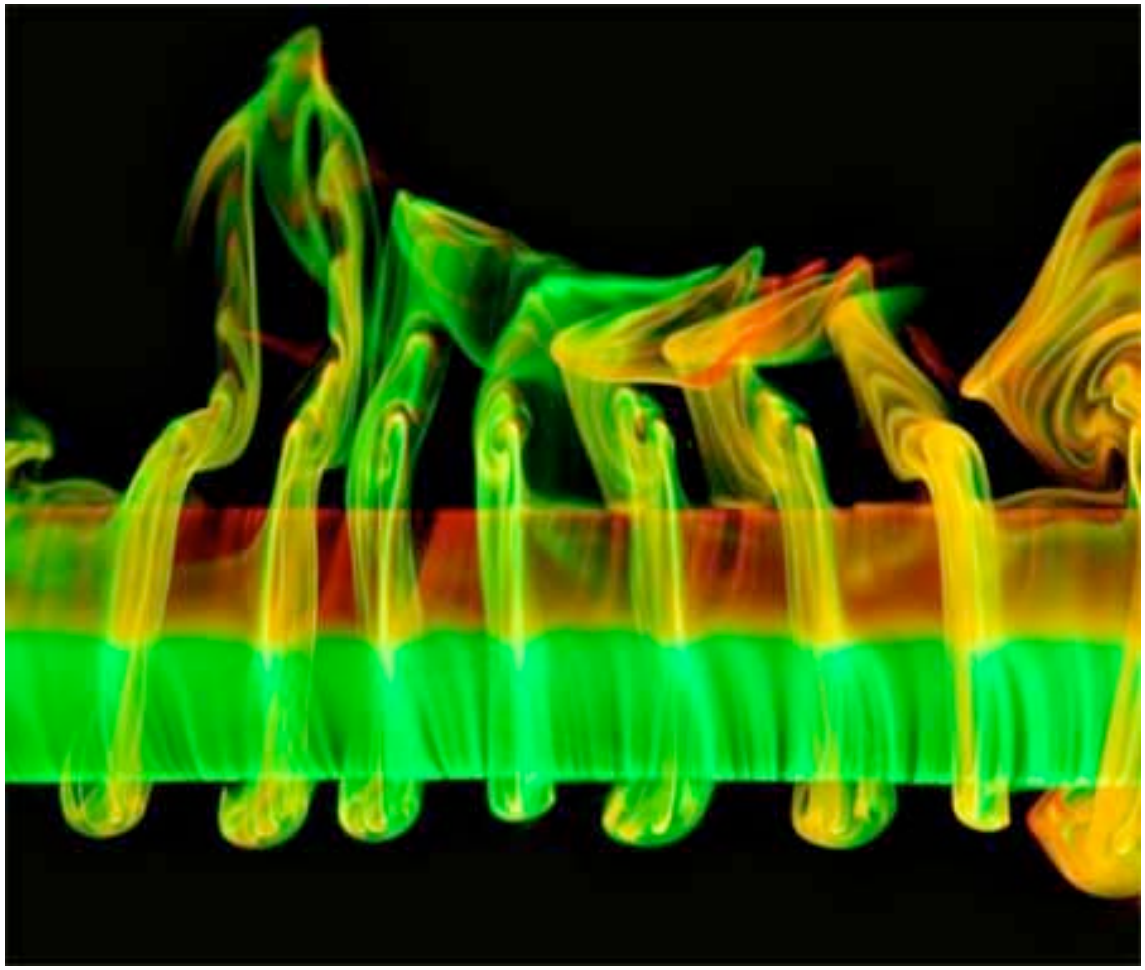
Acetone peroxide is more than ten times as sensitive to shock as nitroglycerin.







Acetone



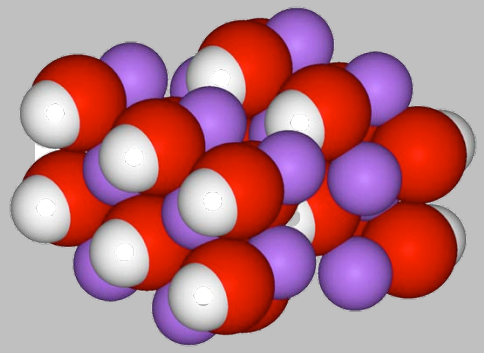
Fluorescent under ultraviolet light.

Acetone

Diabetics with ketoacidosis have levels of acetone in their breath up thousands of times higher than normal.



Sodium Hydroxide (NaOH)



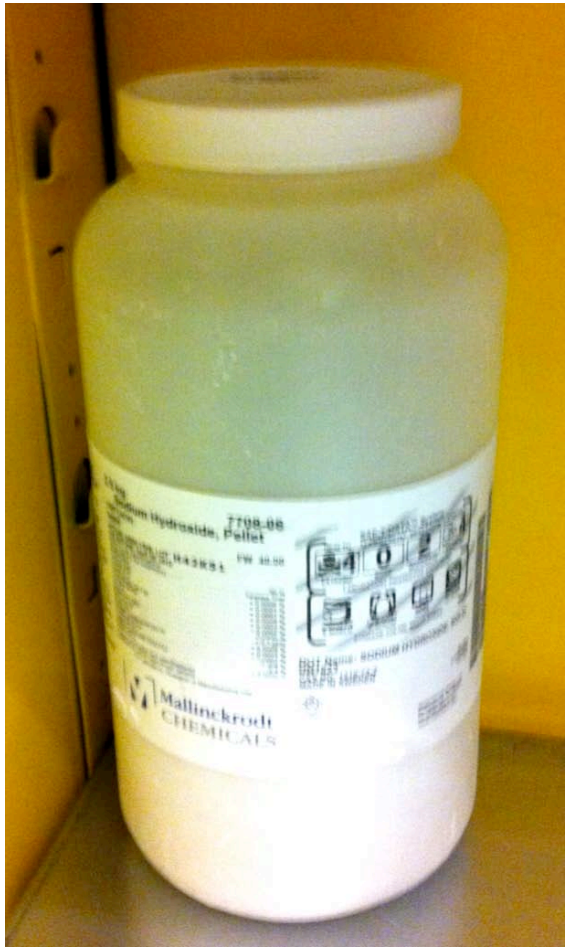
Sodium Hydroxide (NaOH)

What is it?

- Very strong base.

- We mix a 20% solution in water to clean glassware.

<u>Generates heat on contact with water.</u>



Sodium Hydroxide (NaOH)

Will it kill me?

- It can burn your skin, cause lung damage, and blind you.

- Produces hydrogen gas when it contacts magnesium, zinc, tin, chromium, brass, and aluminum.



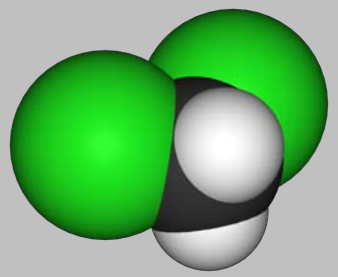


Sodium Hydroxide (NaOH)



The Resomator

Dichloromethane (DCM)



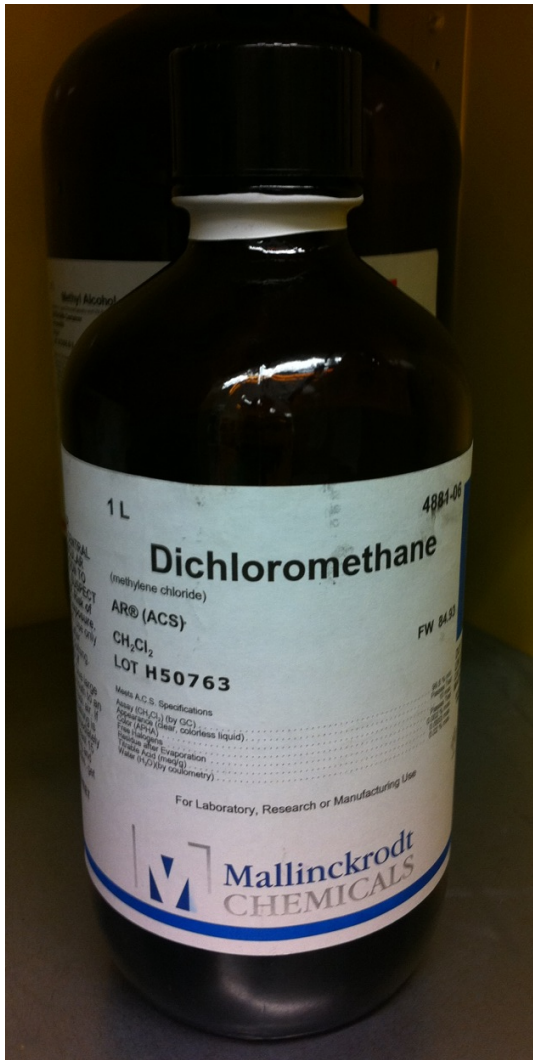
Dichloromethane (DCM)

What is it?

- Very volatile halogenated solvent.







Dichloromethane (DCM)

Will it kill me?



• Inhalation hazard (high volatility). Metabolized into carbon monoxide.

• Severe eye damage.

• Nitrile gloves provide poor protection. Readily absorbed through skin.







Assorted Other Chemicals

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- **Dimethylformamide (DMF):** Melts plastic; carcinogenic.

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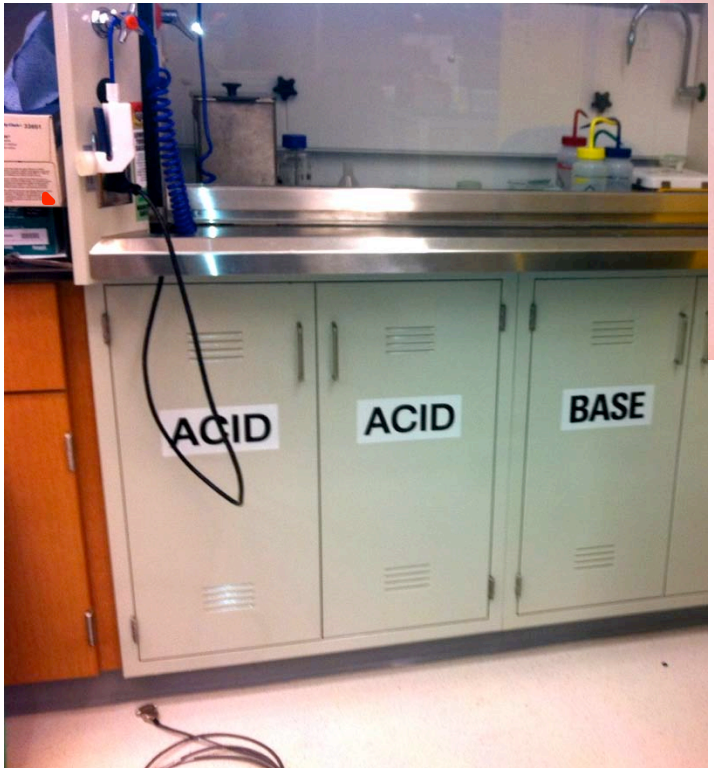
- **Dimethyl sulfoxide (DSO):** Not very dangerous alone, but it penetrates the skin very readily and carries things with it. <u>Nitrile gloves dissolve.</u>



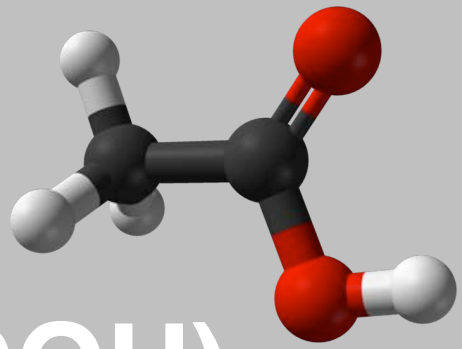
Scary Acids

Scary Acids





Acetic Acid (CH_3COOH)



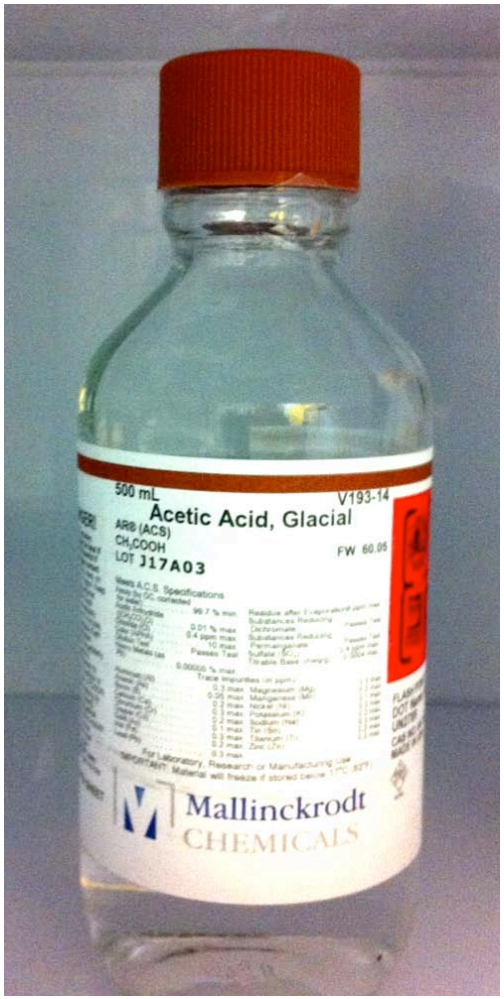
Acetic Acid (CH_3COOH)

What is it?

- Glacial just means it's 100%.

- It's what gives vinegar its sour taste (8%).

The presence of water in vinegar has a profound effect on its behavior.



Acetic Acid (CH_3COOH)

Can it kill me?



- Skin burns and permanent eye damage. Blisters may not appear until hours after exposure.

- Latex gloves offer no protection, but nitrile gloves do.

- Due to incompatibilities, keep acetic acid away from ethylene glycol, nitric acid, peroxides, and Acetone!



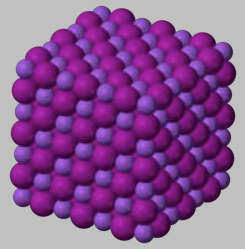


Acetic Acid (CH_3COOH)



Weak acetic acid is used for treating the sting of the box jellyfish by disabling the stinging cells.

Gold Etch TFA

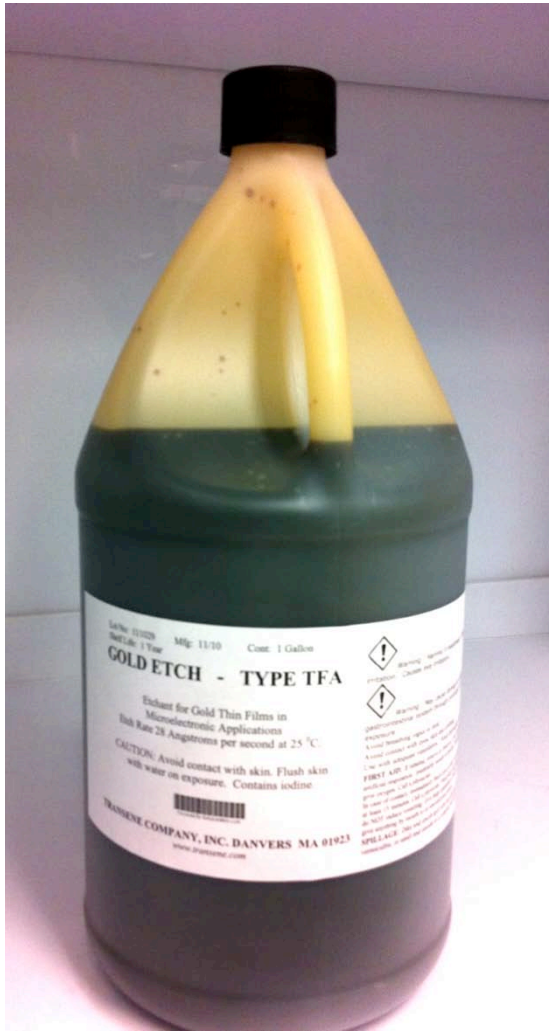


Gold Etch TFA

What is it?

- Solution of potassium iodide and water.

- Will etch gold selectively.*



Gold Etch TFA

Can it kill me?



• Contact with oxidizing reagents may cause extremely violent combustion!

• Skin burns and eye damage. Very bad to inhale - delayed pulmonary edema can result.









Gold Etch TFA



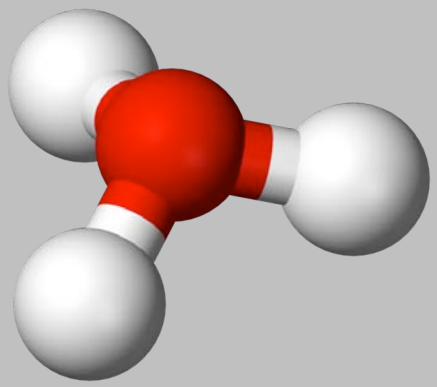
Potassium iodide is used in nuclear accidents to block the thyroid's uptake of radioiodine.

Gold Etch TFA

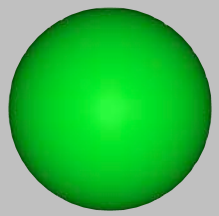
Potassium Iodide is used to iodize table salt.



Worldwide, iodine deficiency may be the single greatest preventable cause of mental retardation. Iodized salt only costs 5¢ per person per year.



Hydrochloric Acid (HCl)

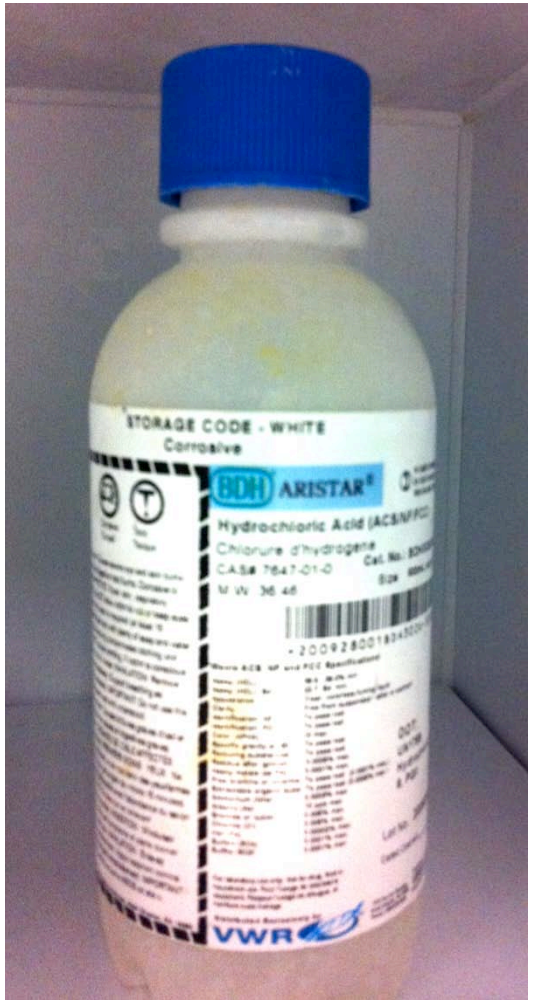


Hydrochloric Acid (HCl)

What is it?

- Very strong acid.
- Incompatible with metals.
- One component of stomach acid.





Hydrochloric Acid (HCl)

Can it kill me?



- Forms acidic mists. Both the mist and the solution have a corrosive effect on human tissue.

- Damages lungs, eyes, and skin. Can be fatal.

- Killed WWI soldiers who were exposed to chlorine gas - it reacts with water in the lungs and turns into HCl.









Hydrochloric Acid (HCl)

Cocaine is absorbed from cocaine hydrochloride, and the hydrochloride forms dilute hydrochloric acid in the nose.



That can degrade the nasal septum, "leading eventually to its complete disappearance."

Hydrochloric Acid (HCl)

Schmidt Sting Pain Index:



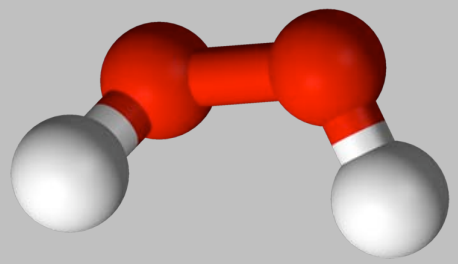
Hydrochloric Acid (HCl)

Schmidt Sting Pain Index:



3.0 Paper wasp: *Caustic and burning. Distinctly bitter aftertaste. Like spilling a beaker of hydrochloric acid on a paper cut.*

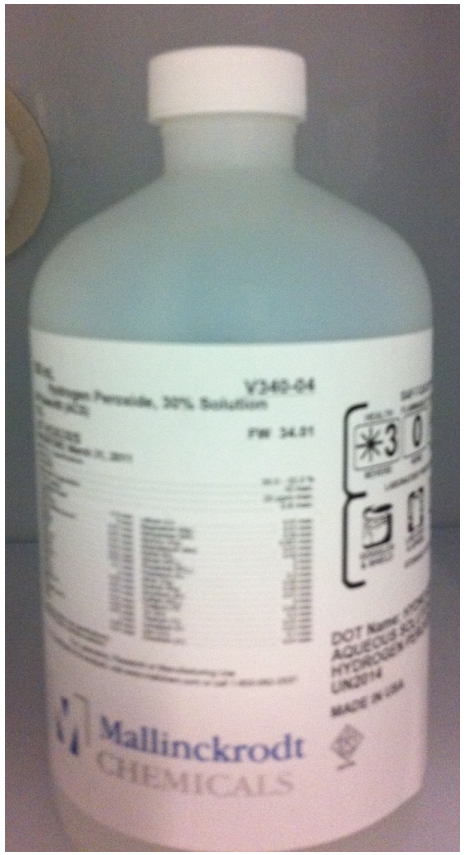
Hydrogen Peroxide (H_2O_2)



Hydrogen Peroxide (H_2O_2)

What is it?

- Very strong oxidizer.
- Mix (CAREFULLY) with sulfuric acid to get Piranha.
- Incompatible with copper and iron.
- Reacts violently with water and organics.



Hydrogen Peroxide (H_2O_2)

Can it kill me?

- 3% solution is used medically for cleaning wounds; our lab solution is 30%.

- Inhalation can cause severe pulmonary irritation; long term exposure to low concentrations can result in permanent lung damage.







Hydrogen Peroxide (H_2O_2)

Safety:

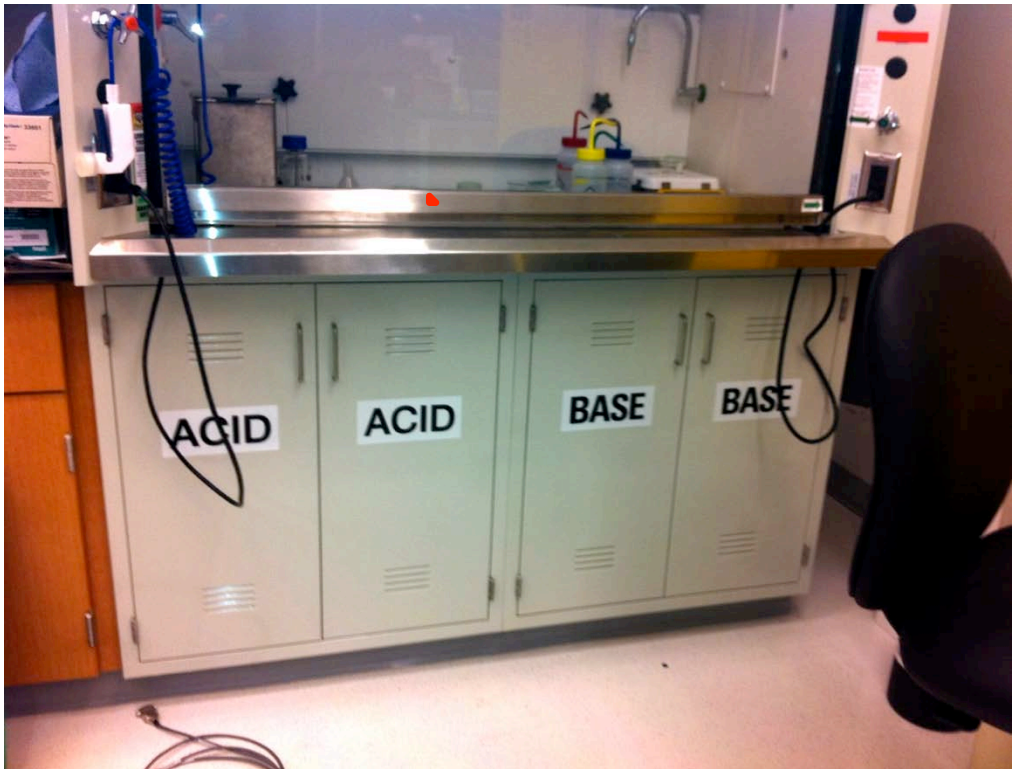
• Hydrogen peroxide vapors can form sensitive contact explosives with hydrocarbons such as alcohols and acetic acid.



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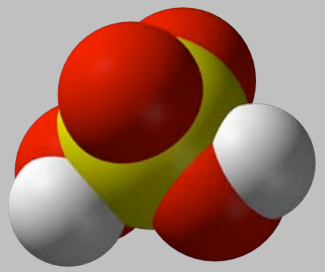


Hydrogen Peroxide (H_2O_2)

If spilled on clothing (or other flammable materials), preferentially evaporates water until the concentration can spontaneously ignite.

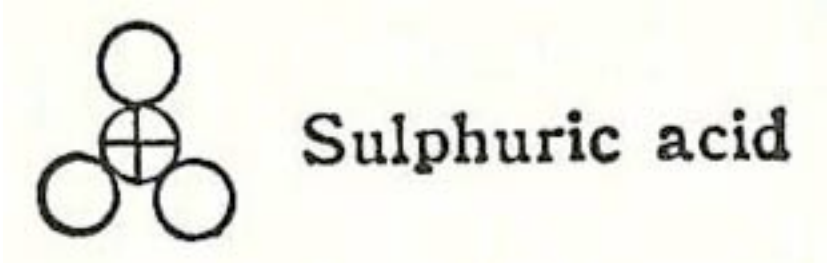


Sulfuric Acid (H_2SO_4)

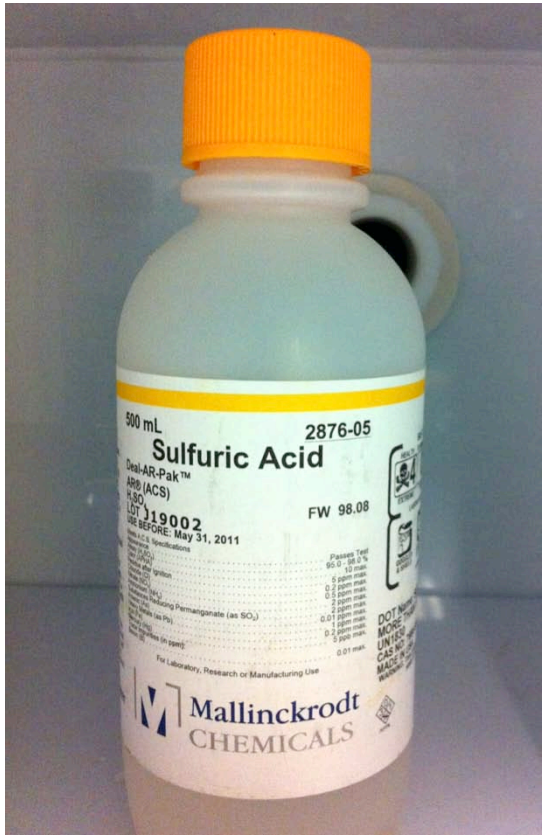


Sulfuric Acid (H_2SO_4)

What is it?



- Very strong acid.
- Mix with peroxide to get Piranha.
- Violent reaction with water!

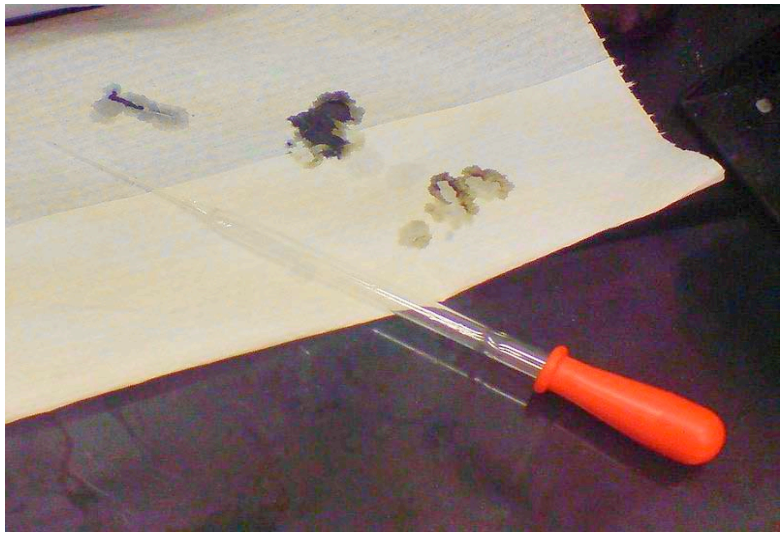


Vit•ri•ol /vɪtriəl/
noun, verb, -oled, -ol•ing

1. Something highly caustic or severe in effect, as criticism.

Sulfuric Acid (H_2SO_4)

Can it kill me?



- Burns are extra bad - dehydration and secondary burns from the heat liberated by the reaction with water!

- Low, chronic exposure causes *erosion of the teeth*.

- Vapor: eyes, respiratory tract, and mucous membranes. Risk of pulmonary edema in cases of severe damage.









Sulfuric Acid (H_2SO_4)

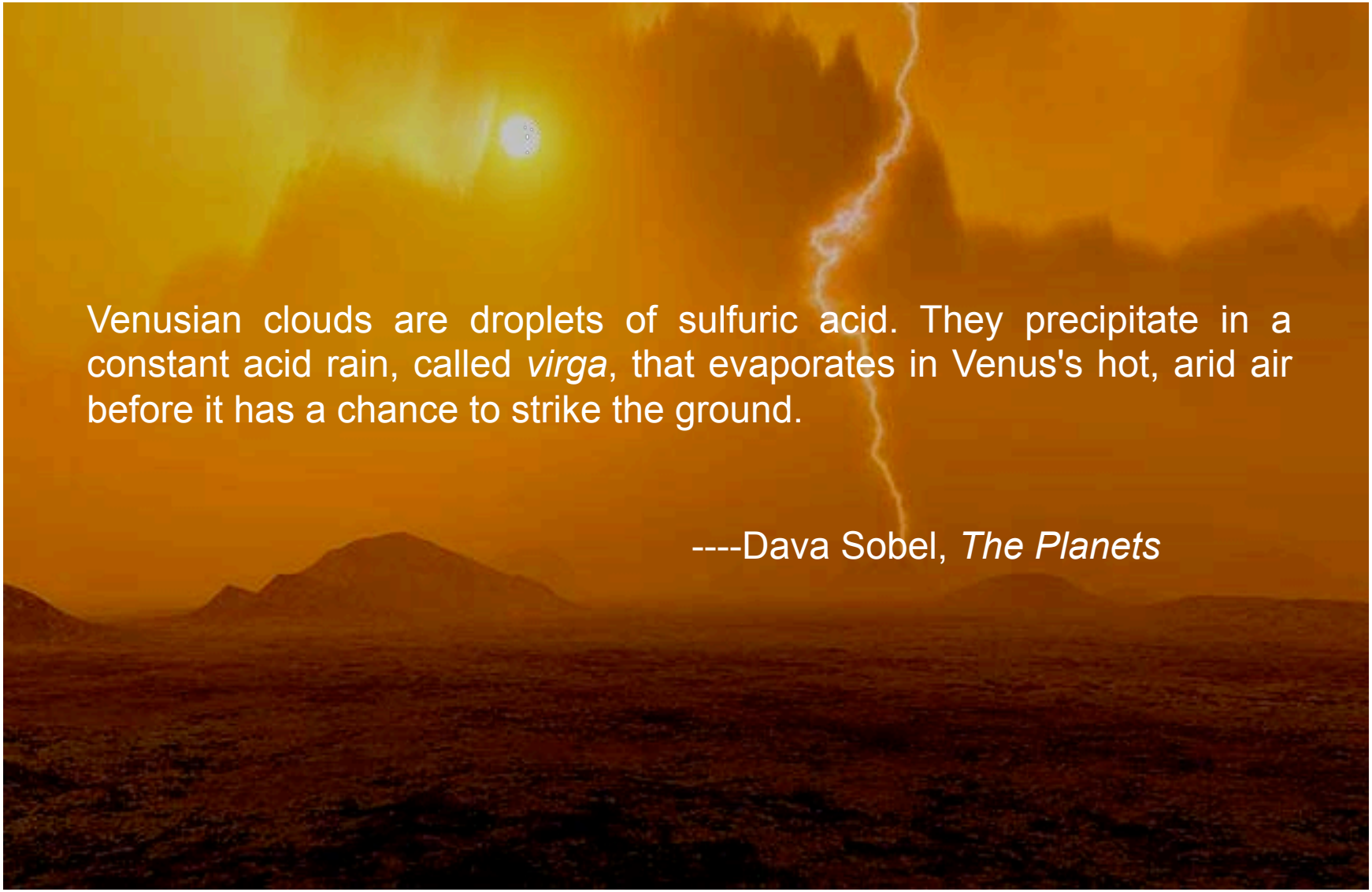
Safety:



Quebec, 1997.

"I saw someone get two large drops of sulfuric acid on their arm, and the acid ran down their arm about 4 inches. They now sport scars that look like a wolf attacked them."

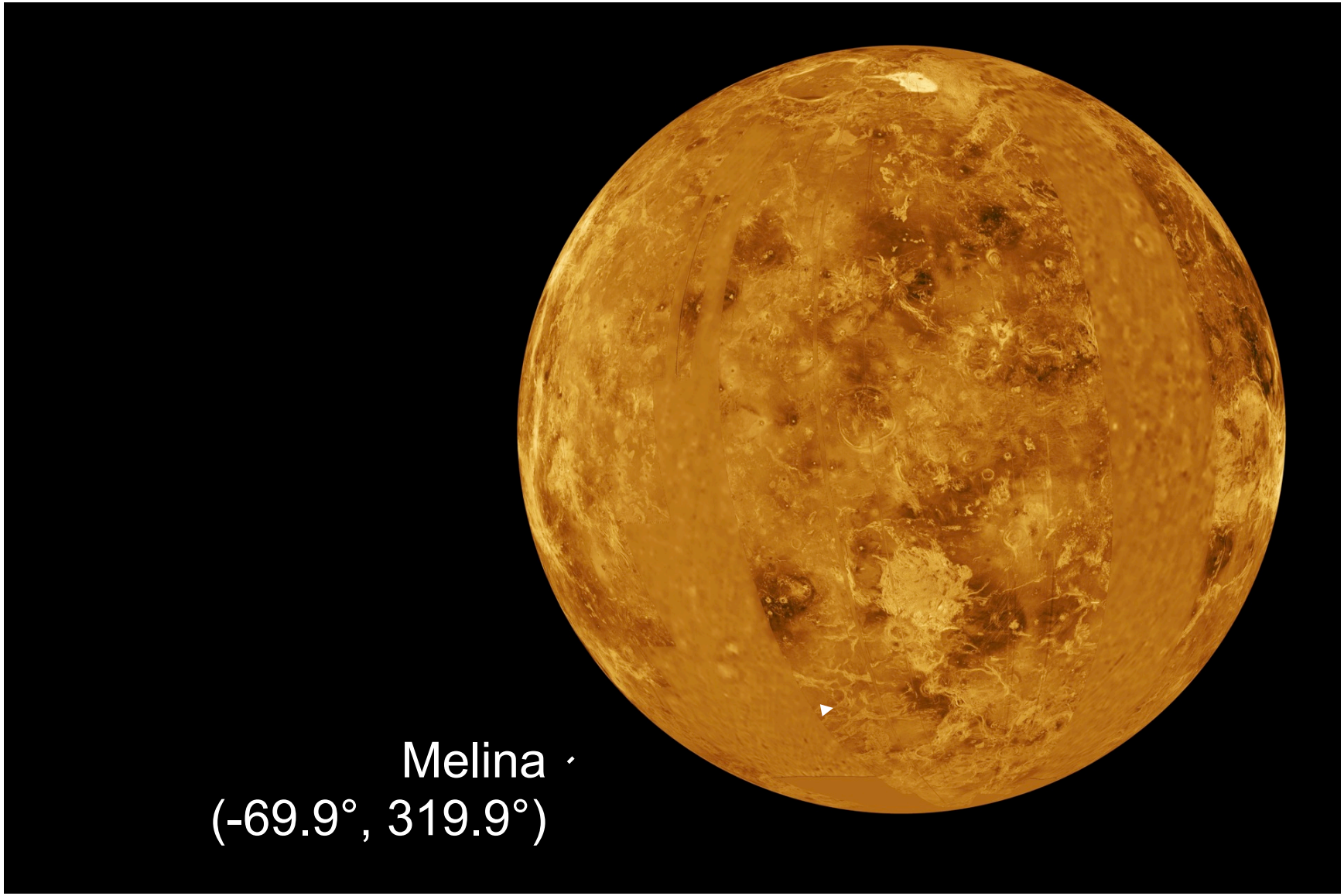
Sulfuric Acid (H_2SO_4)



Venusian clouds are droplets of sulfuric acid. They precipitate in a constant acid rain, called *virga*, that evaporates in Venus's hot, arid air before it has a chance to strike the ground.

----Dava Sobel, *The Planets*

Sulfuric Acid (H_2SO_4)



Sulfuric Acid (H_2SO_4)

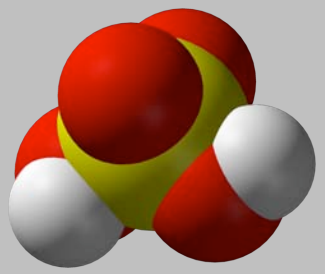




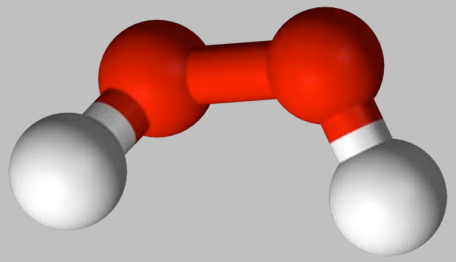




Danaë **by Rembrandt - The Hermitage, St. Petersburg, Russia**



Piranha



Piranha

What is it?

- Extremely dangerous mix of sulfuric acid and hydrogen peroxide.

- When mixing, always add hydrogen peroxide to sulfuric acid. Temperature of mixture easily exceeds 120°C.



This man should be wearing gloves.

Piranha

Can it kill me?

- Absolutely.

- Explodes on contact with organic solvents (acetone!) and metal residues. **Make sure that no spray bottles, dishes, or chemical bottles are nearby.**

- Piranha is used to remove organic *residues* from substrates, not the compounds themselves.









Piranha



Don't store piranha!

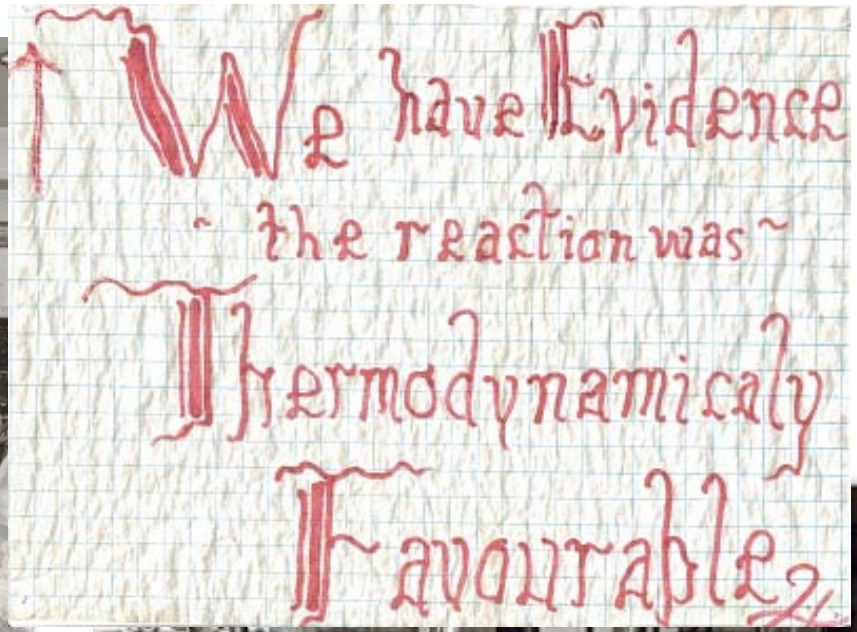
Piranha



Cornell, 1986:

Piranha




We have Evidence
the reaction was
Thermodynamicaly
Favourable



Compressed Gases

Compressed Gases



Compressed Gases

Can it kill me?



Compressed Gases



Hydrogen Gas

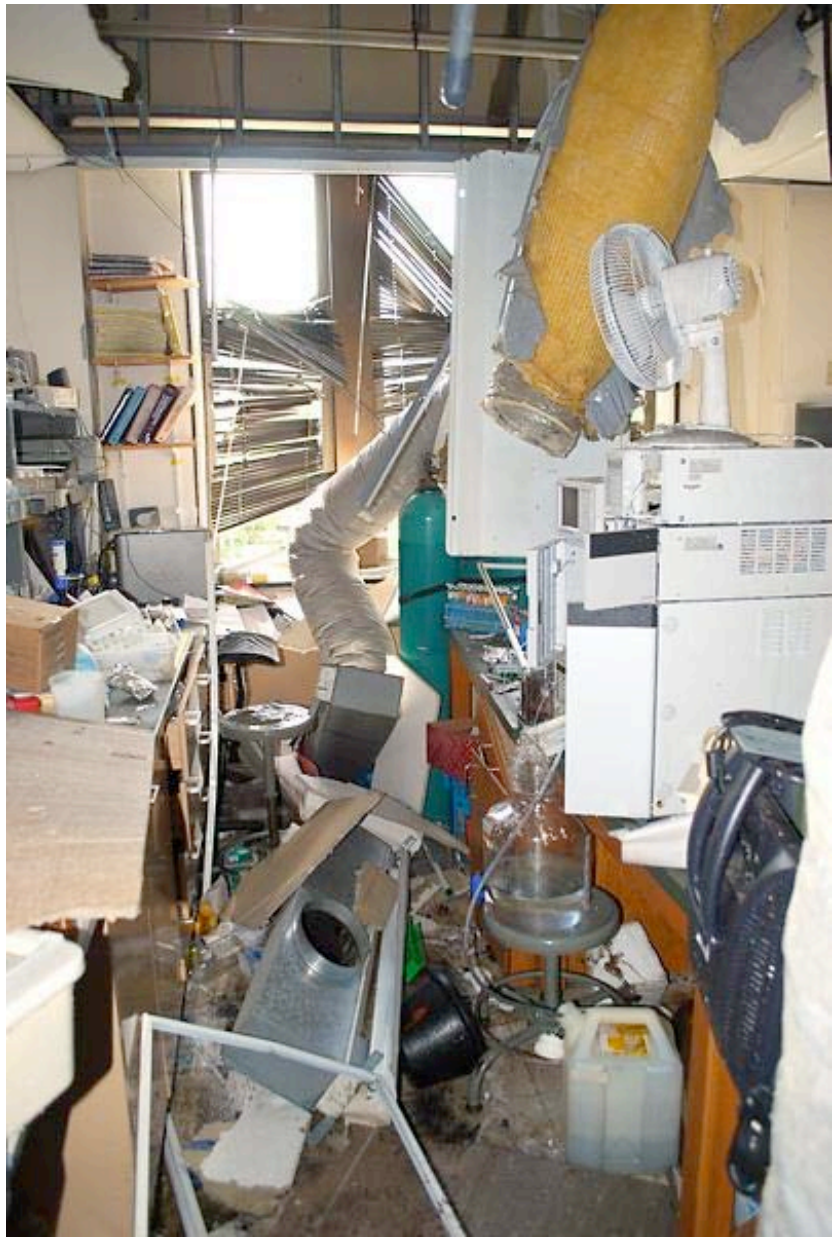
Hydrogen Gas



Hydrogen Gas

Hydrogen-air mixtures ignite at most concentrations.





Liquid Nitrogen

Liquid Nitrogen

Can it kill me?

- Cold burns.
- Asphyxiation danger.
- NEVER seal a container!





Liquid Nitrogen



Texas A&M, 2006:

Both the pressure relief and rupture disks had *been removed and sealed off with metal plugs.*

Liquid Nitrogen



Suffocation danger

A lot of it in an enclosed space can displace breathable air.

Nitrogen suffocation does not induce drowning sensations - you just pass out.

NEVER go in an elevator with it.

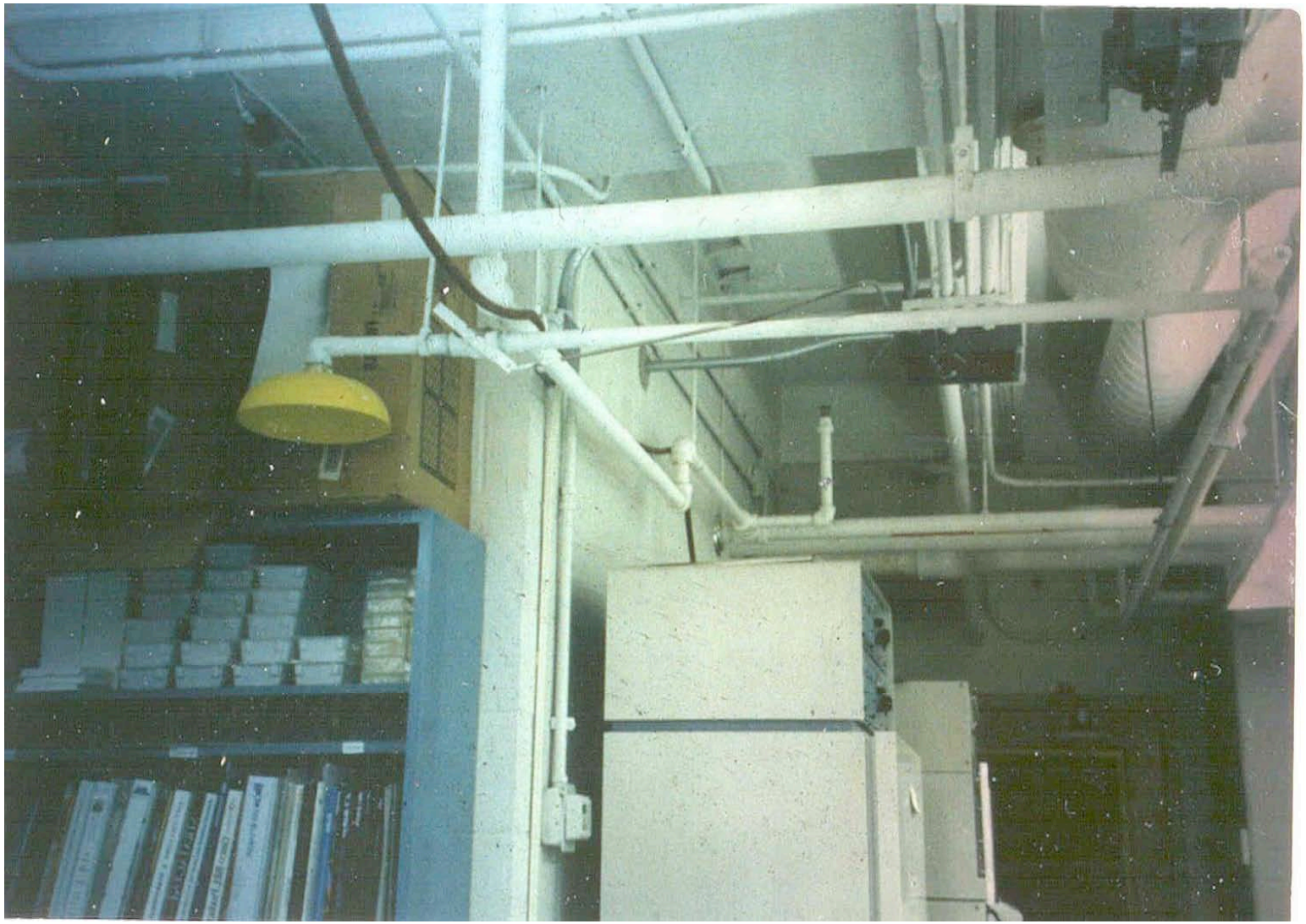
NEVER put it in the front of your car.

So, in summary:

Know The Risks



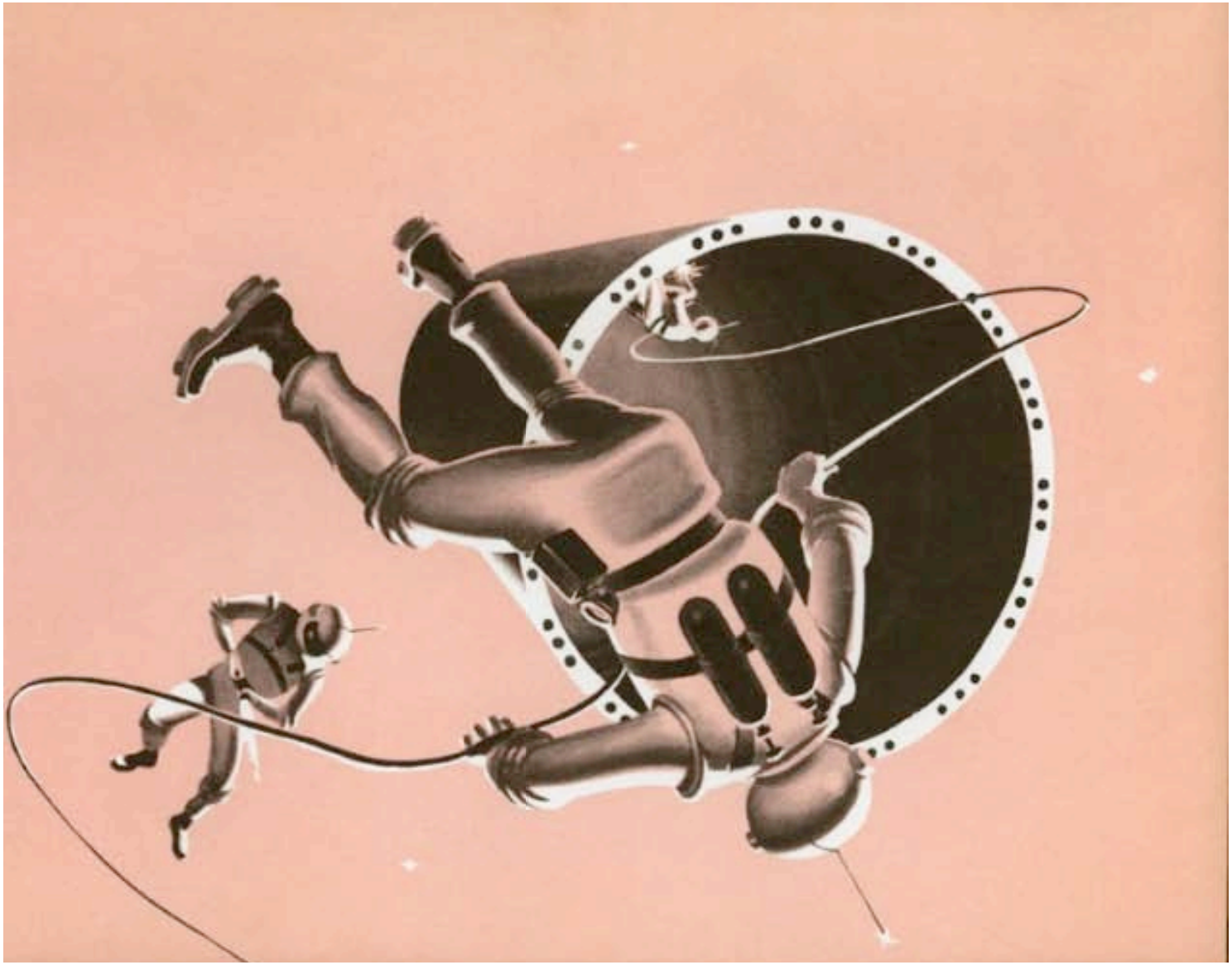
Plan For An Emergency



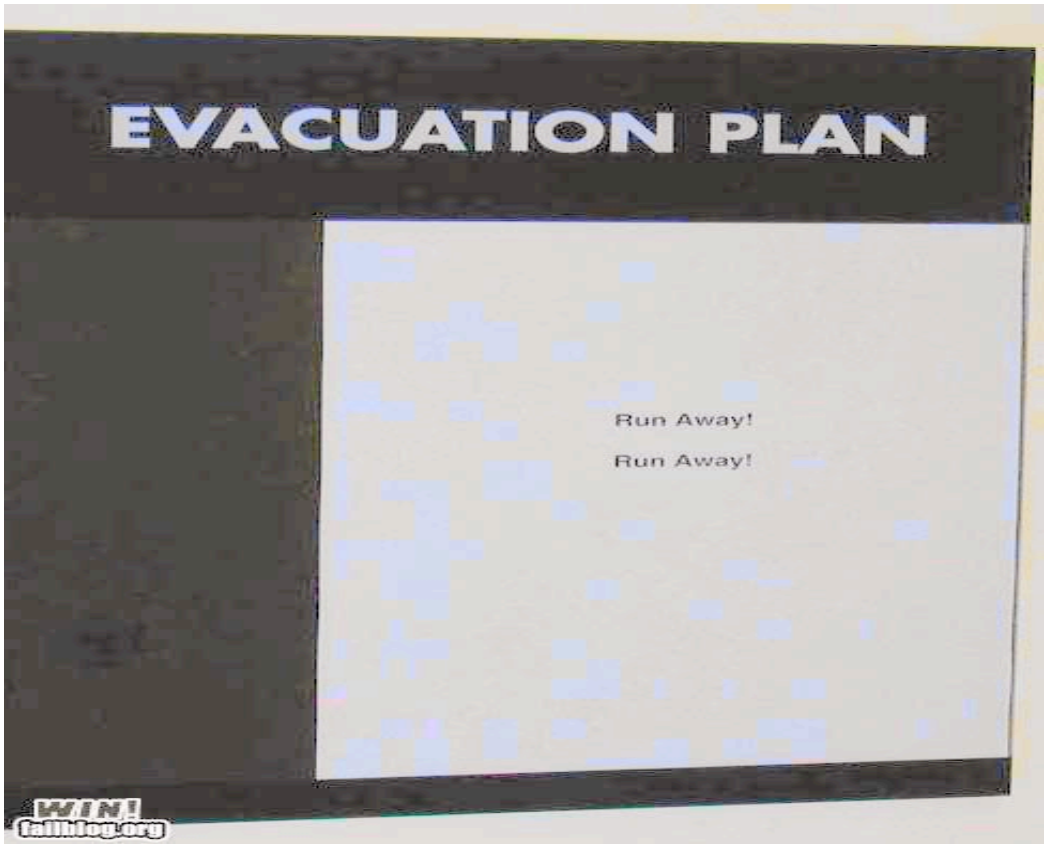
WEAR EYE PROTECTION



Buddy System?



When All Else Fails:



If you can't be a good example,
try to be a horrible warning.

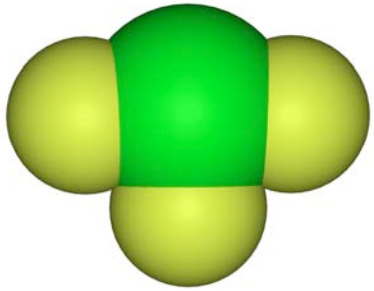
--- Stephen Fry

HF

"The use of local anaesthetics is contraindicated since treatment with the gel should continue until the HF is completely neutralized, and this is indicated by the cessation of pain. In areas where the skin is tightly adhered to underlying tissues, and where splitting or removal of affected nails may be required, a general anaestheic may be given.

A thick necrotic coagulum may form and this may act as a barrier to prevent the penetration of the gel into underlying tissues. In this case the necrotic tissue should be excised and the gel should be massaged into the bone and underlying tissues using aseptic procedures."

Chlorine Trifluoride



• "Much more difficult to handle than fluorine gas."

• Stronger oxidizer than oxygen itself - it can burn ash and asbestos.

• Releases clouds of HF gas and HCl as it burns.

• Exposure to large amounts of it as a gas or liquid will spontaneously ignite human tissue.

• Hypergolic with every known fuel - so much so that *no ignition delay has ever been measured.*

Chlorine Trifluoride

"General Chemistry Co. had a one-ton steel cylinder of CTF that split and spilled it onto the floor. It chewed its way through twelve inches of concrete and dug a three-foot hole in the gravel underneath, filled the air with fumes that corroded everything in sight, and, in general, made one hell of a mess. Miraculously, no one was killed, but there was one casualty -- the man who had been steadying the cylinder when it split. He was found some five hundred feet away, where he had reached Mach 2 and was still picking up speed when was stopped by a heart attack."

General Lab Safety



Liquid Nitrogen



Step 1

The body is gently frozen down to -18°C.



Step 2

It's then exposed to liquid nitrogen and becomes brittle.



Step 3

The body is then vibrated, which reduces it to dust.

PROMESSA

Organic burial