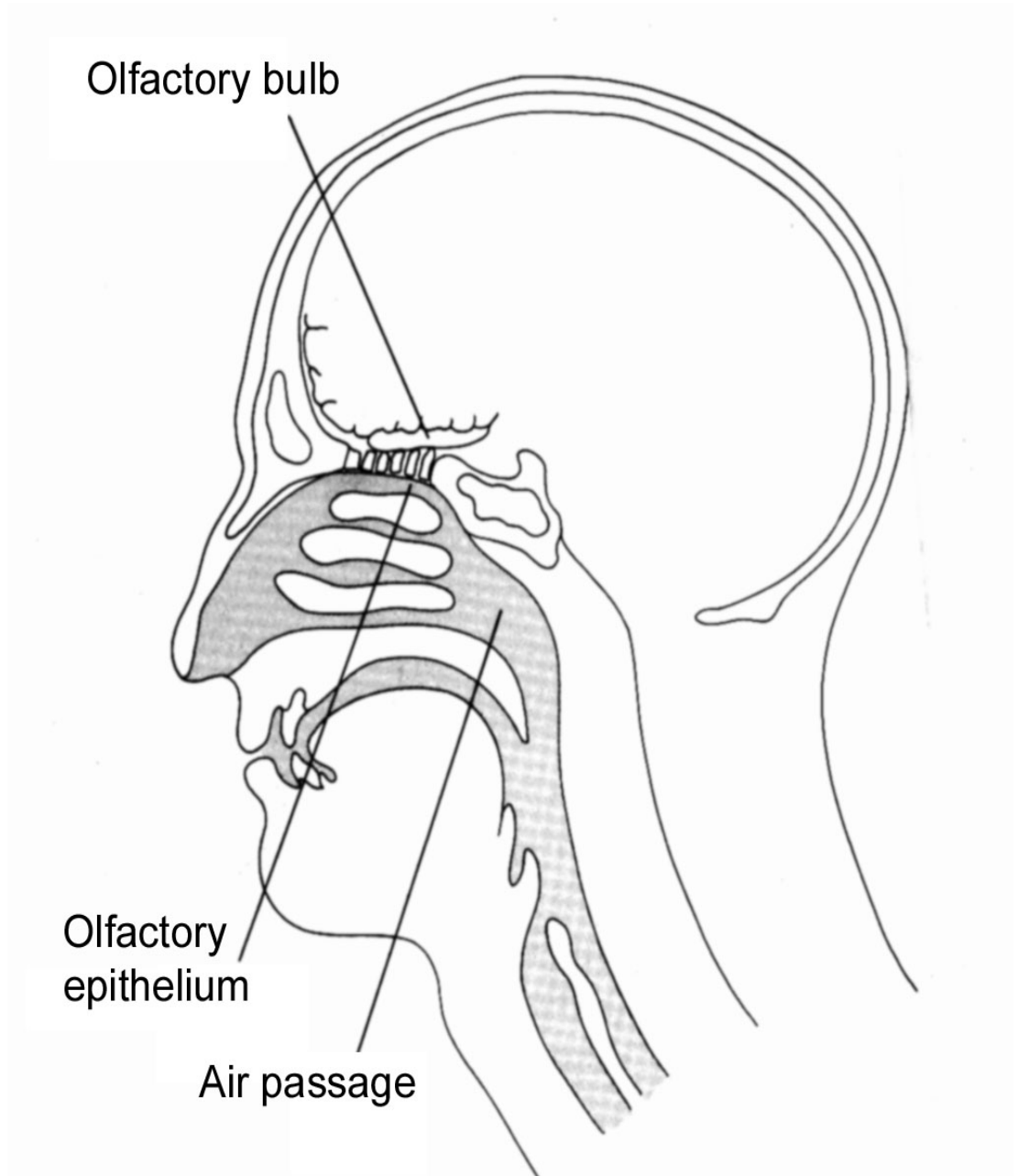


Chemical detection the nose

Human nose olfactory (smell) receptors send input through the cribriform plate of the the skull to olfactory bulb

olfactory cortex is referred to as paleocortex as it is not organized like the cerebral cortex.

The fish brain can be described as containing almost exclusively paleocortex (smelling brain).



requirements for odor

detection limits

must be volatile -solids do not have an odor.

some volatile elements must be able to reach your nose in order to smell it.

Some solids such as ferric chloride appear to have an odor because they react with the air (or moisture in it) to produce a volatile odor (in this case HCl)

In the case of heroin police dogs are trained to smell the trace acetic acid (vinegar) associated with the heroin from its manufacture/purification.

The in case of cocaine (an ester) police dogs are trained to detect methyl benzoate, a pleasantl smelling substance released from the decay of cocaine in humid air.

Stink -arbitrary categories

spoiled food/putrefaction -volatile fatty acids

natural odor/defense -skunks-thiols

other noteworthy odors- unique historical

-phenol

putrefaction

bacteria

Louis Pasteur described the spoiling of wine (and food) due to bacteria which required exposure to at least some oxygen. eg. Spoiled wine alcohol (Ethanol) is converted to acetic acid (Ethanoic acid) by acetobacter bacteria

facultative anerobes and oxygen -acetic acid bacteria/wine
VFA (volatile fatty acid) products- respiration needs oxygen
typically acetic, propionic, lactic, formic acids sometimes butyric acid

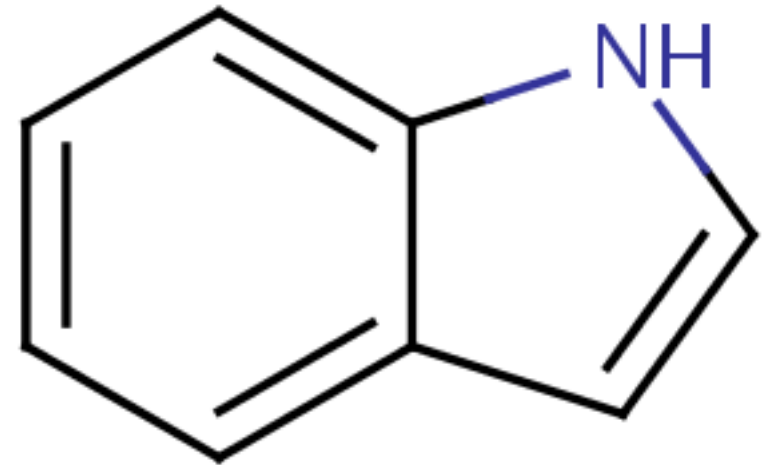
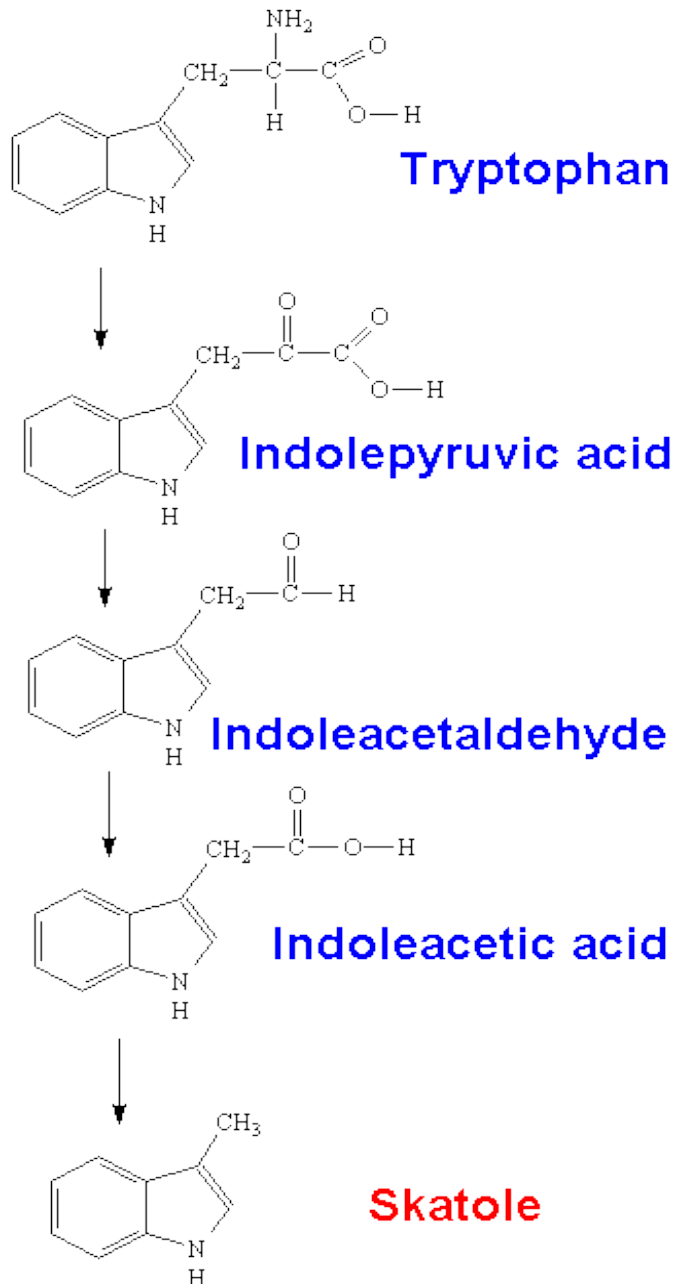
indole from tryptophan metabolism -enterobacteria/coliforms such as E.Coli

strict anaerobic- Clostridium bacteria produce butyric acid -very putrid odor.
After facultative anaerobic bacteria use all available oxygen, clostridia take over environment.

Clostridium tetanae -tetanus needs deep puncture wound to grow (zero oxygen)

ammonia releasers-to obtain the 2-carbon acetate from amino acids the ammonium group is removed and released

tryptophan metabolism in bacteria



indole

Most characteristic fecal odor comes from indole and skatole produced from tryptophan metabolism. Same tryptophan described in turkey and other meat.

imvics- tests to distinguish various gut bacteria

indole -Does it produce indole from tryptophan?

methyl red -Does it produce acidic (stinky) by-products?

voges-proskauer test -does it produce acetoin by-product (a non-acidic substance)

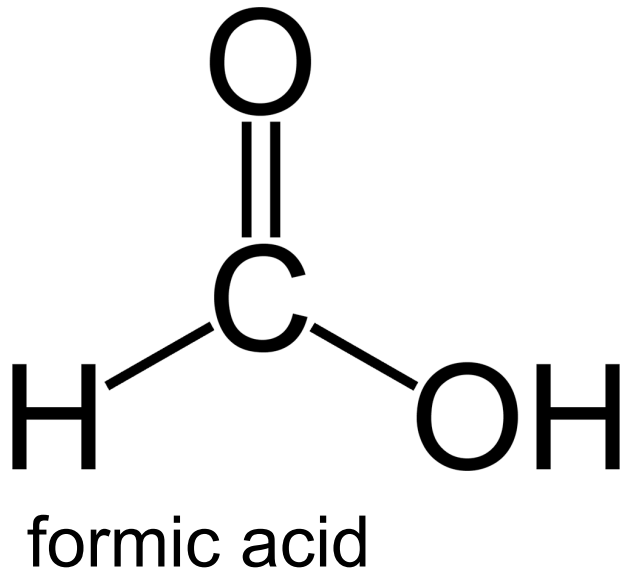
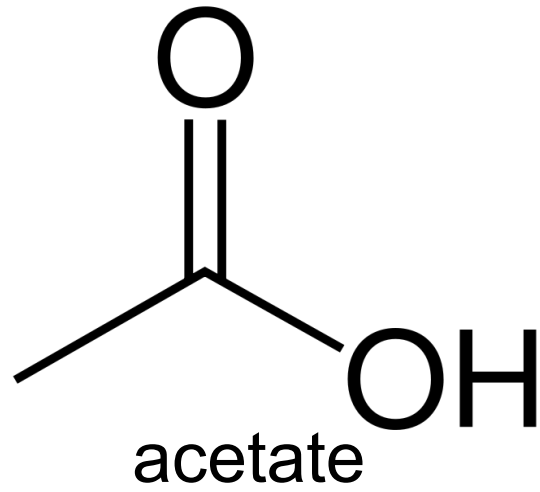
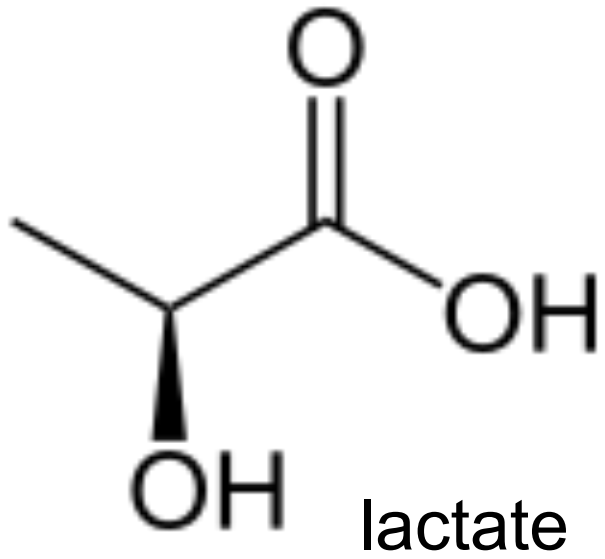
citrate -can it use citrate (citric acid) as a sole source of carbon/food?

spoiled food- the fridge

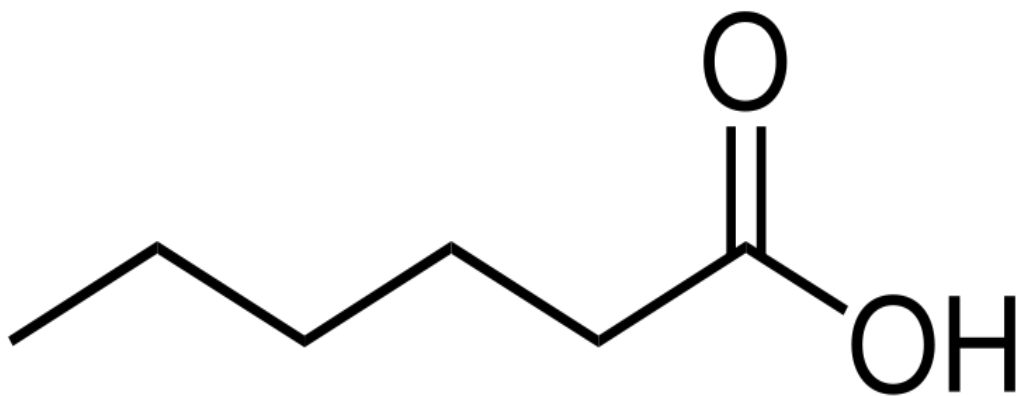
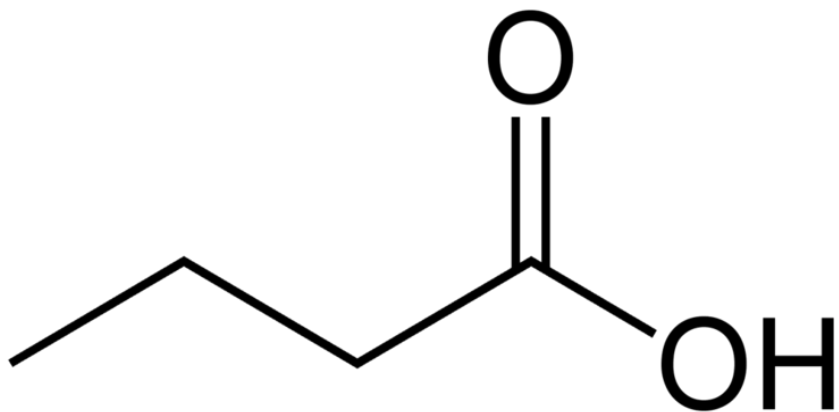
pseudomonads-sweet fruit like? acetophenone?

actinomycetes- earthy - geosmin

molds-musty



butyric & hexanoic acid



Short chain fatty acids

formic, acetic, propionic butyric acid(butanoic acid)

Thus far most of the stinky molecules released by spoiling bacteria are short (short carbon chains) acids.

Further digestion by bacteria will release the longer fatty acids which are a part of fat in meat. Giving rancid sorts of odors.

This fatty acid release is connected with adipocere formation covered later.

acid/base

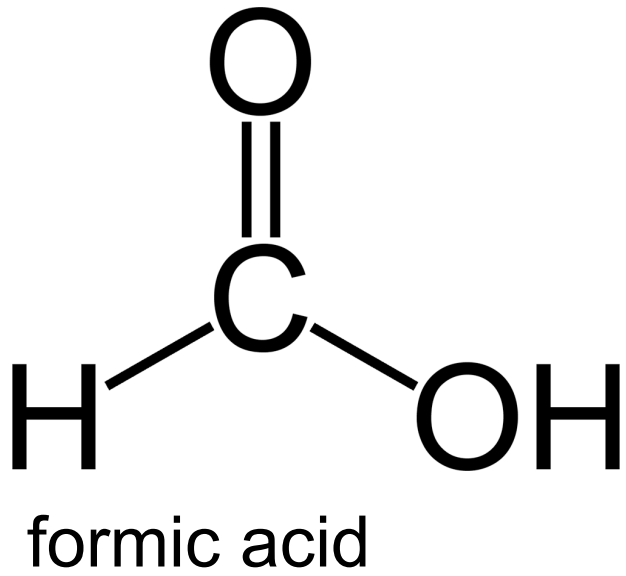
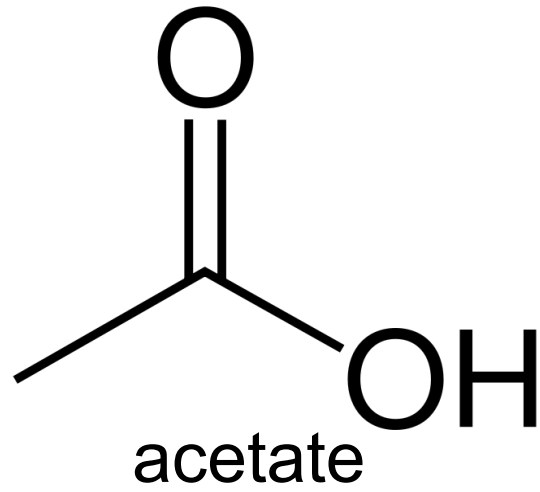
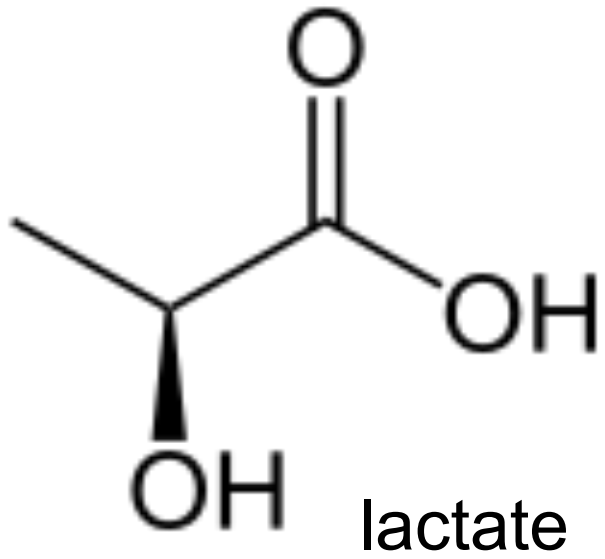
amines vs lemon -the alkaline amines of stinky fish may be neutralized with (acidic) lemon

baking soda vs fridge.- shorty acids may be neutralized with the weakly alkaline baking soda

outhouse vs lime & wood ashes -short acid products and released fatty acids may be effectively neutralized with the strongly alkaline Calcium hydroxide (hydrated lime) or wood ashes (potassium carbonate).

The strongly alkalkine pH shift also prevents the growth of decay bacteria, improving the odor but slowing the decomposition





Lime or is it lime?

powdered limestone lime-calcium carbonate CaCO_3

quicklime calcium oxide CaO CO_2 removed

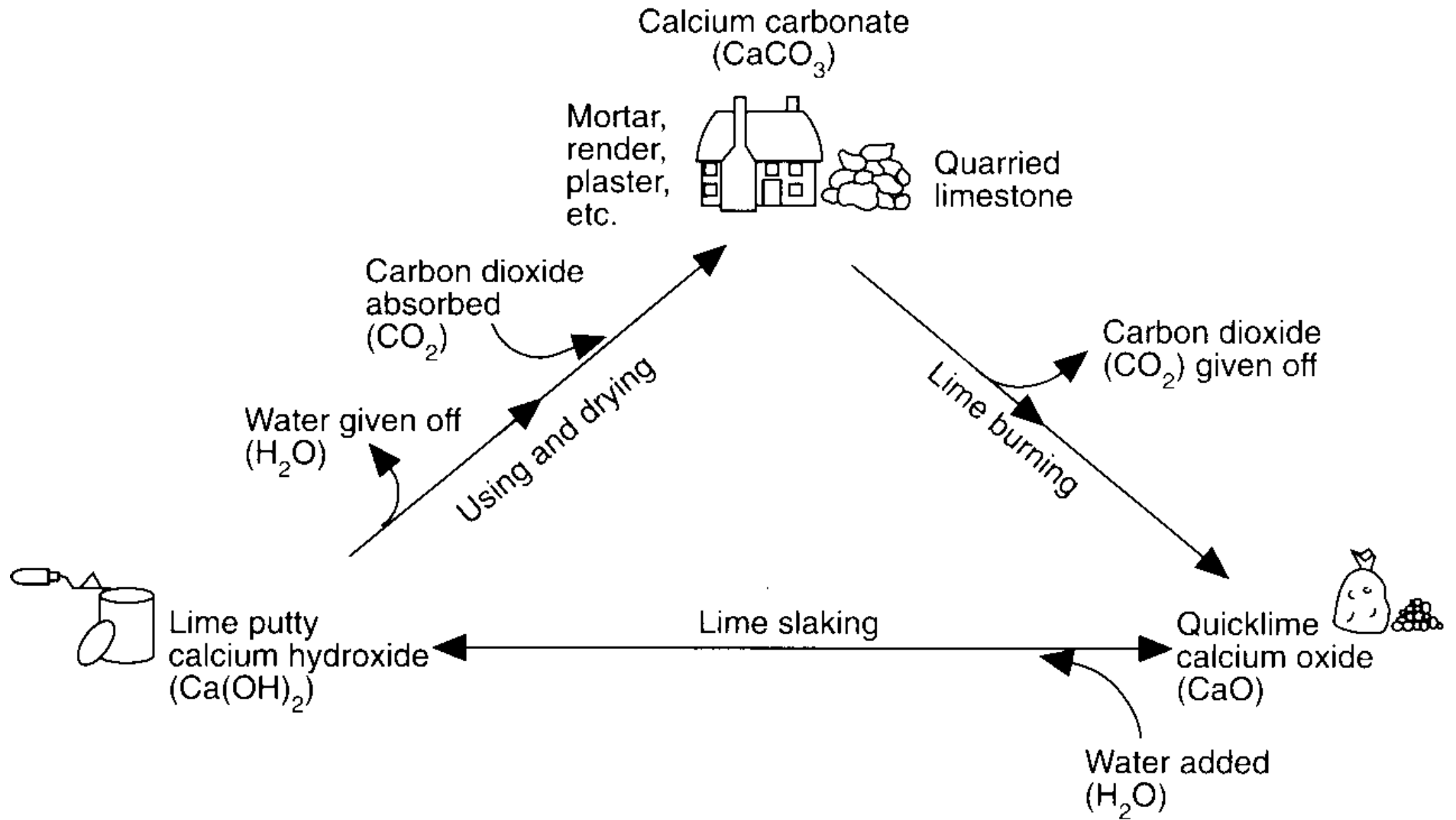
hydrated lime CaOH H_2O added

lime water -calcium hydroxide in water

chloride of lime -Ignaz Semmelweis, bubbled chlorine into lime water

calcium carbonate or calcium hydroxide?
burning seashells and Roman concrete

lime cycle



human body

bile and feces- residual bile not absorbed by small intestine is oxidized/degraded by bacteria giving feces a characteristic brown color.

Bile duct obstruction or gall bladder dysfunction often yield pale colored stool.

bacteroides- common bacteria, more numerous in the gut as you grow older

clostridium- strictly anaerobic but makes super stinky butyric acid

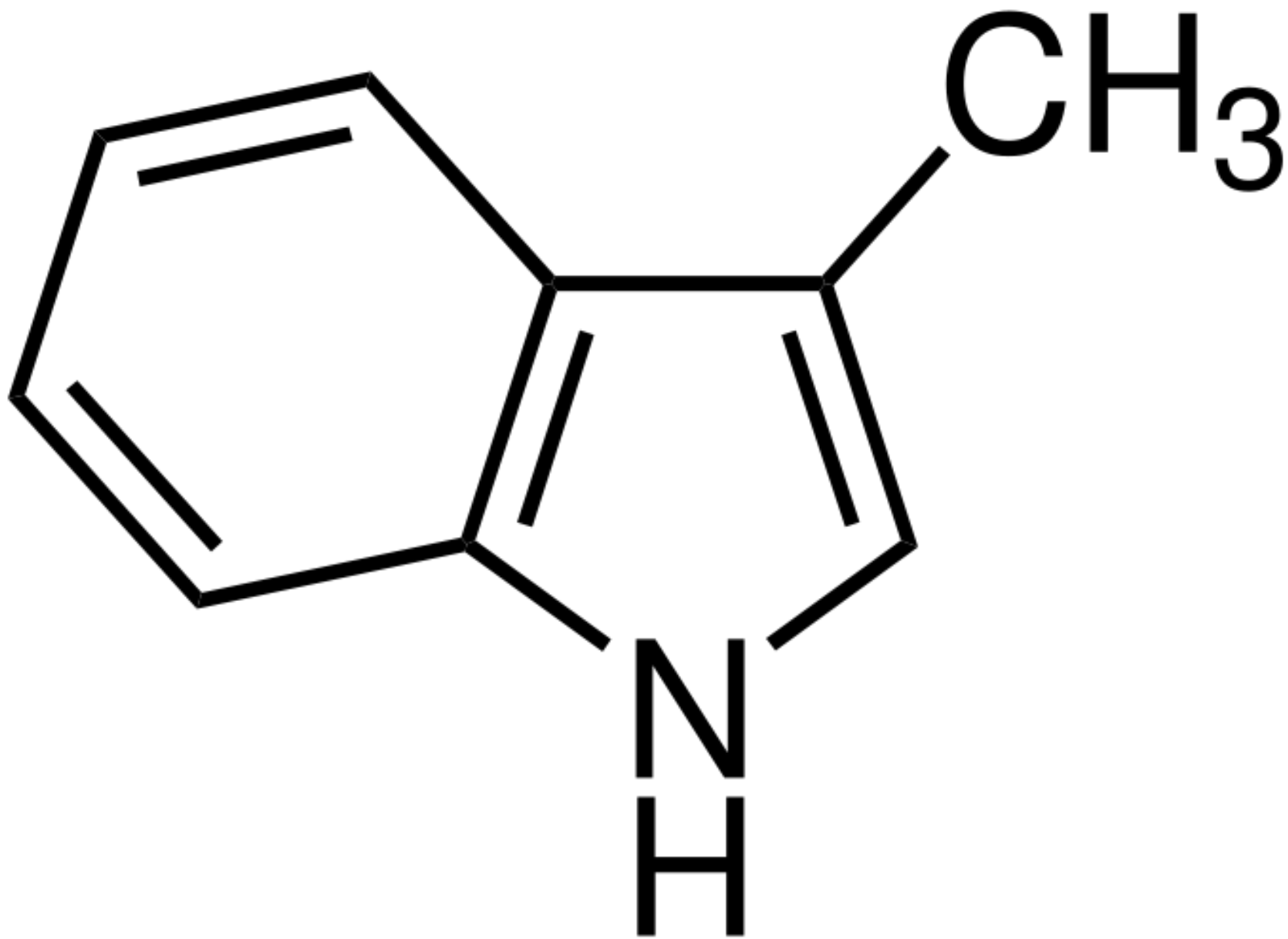
famous species include *C. perfringens* of gas gangrene on corpse bloating

C. tetanum of tetanus/"lockjaw" and *C. botulinum* -botulin toxin and "Botox" wrinkle injections

klebsiella- most common bacteria found at hospital autopsy (recent death)

e.coli- another enterobacter. Used famously in genetics research. Produces indole from tryptophan. Strain O157:H often implicated in serious food poisoning.

skatole



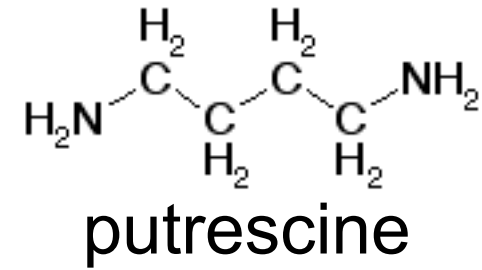
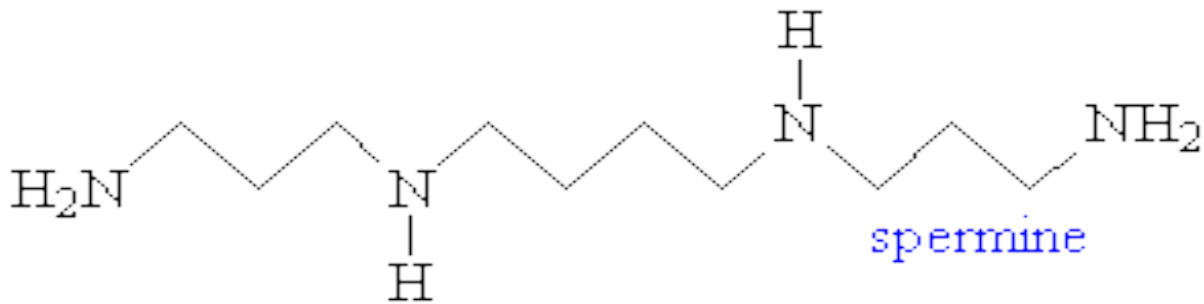
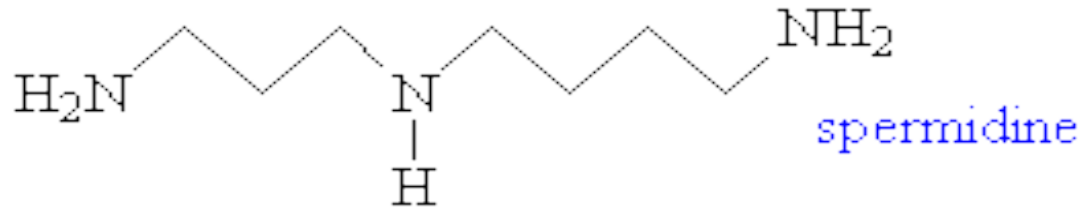
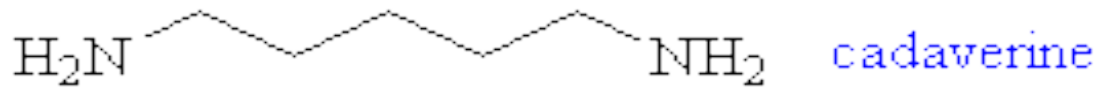
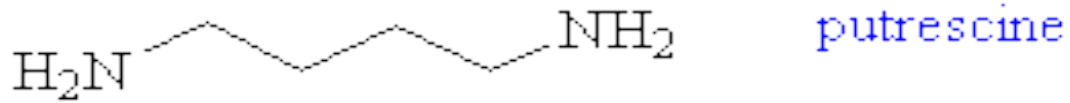
Death and odor

use of lime -alkaline lime neutralizes sticky acids and prevents growth

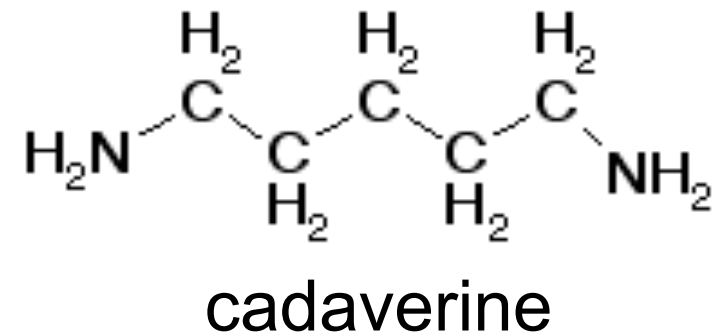
klebseilla first at autopsy

clostridia bloat- after things like E.Coli and Klebseilla use up all oxygen the clostridia take over.

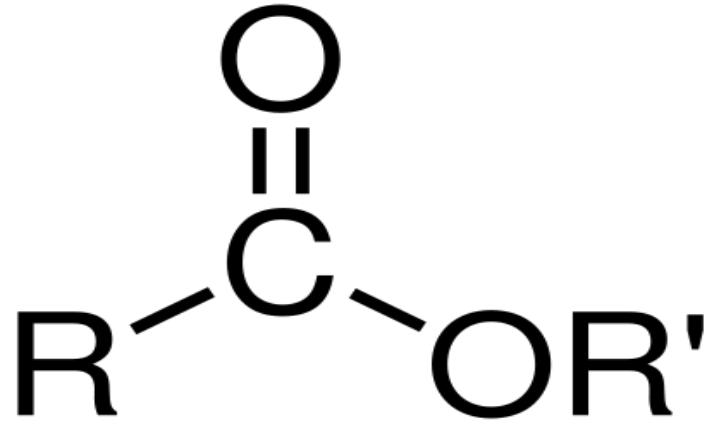
blood marbling



Some longer molecules associated with putrefaction



The ester



Proteins, fats and carbohydrates all joined with ester links

aspirin -ester of salicylic acid and acetic acid. Old aspirin decays and smells of acetic acid (vinegar) especially in humid environments

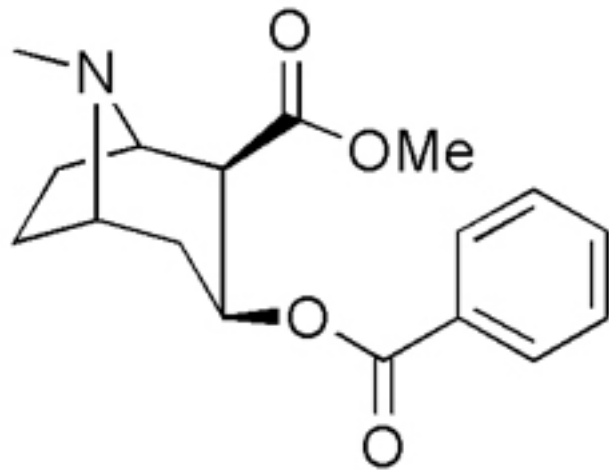
cocaine and methyl benzoate- cocaine decays as aspirin does (both esters) releasing methyl benzoate instead of acetic acid

acid hydrolysis vs base hydrolysis -acids or bases may destroy ester bonds

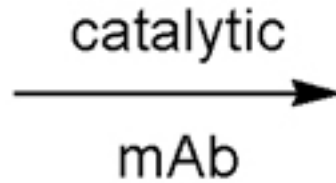
When a base is used the process is often called saponification- soap making

adipocere-grave wax Free fatty acids released by bacterial decay will combine with metallic minerals (Na, K, Ca, Mg) in soil to form a sort of soap or soap scum. The free fatty acids smell horrible along with the shorter VFA's. Adipocere often occurs when corpse is buried in moist alkaline soil. Moisture is the most important factor needed for adipocere formation

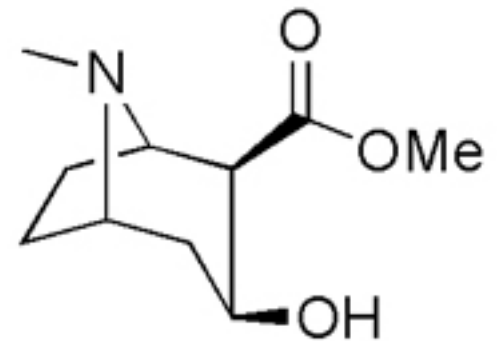
Cocaine decay



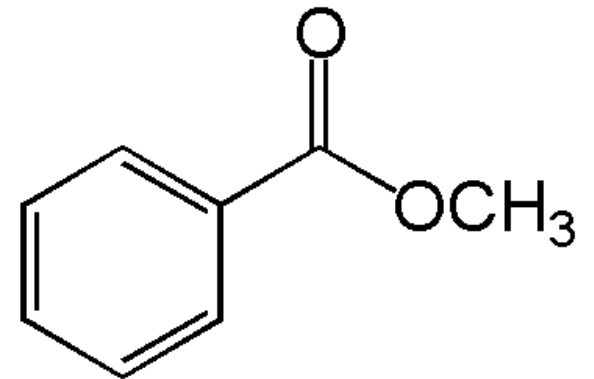
Cocaine



methyl ecgonine

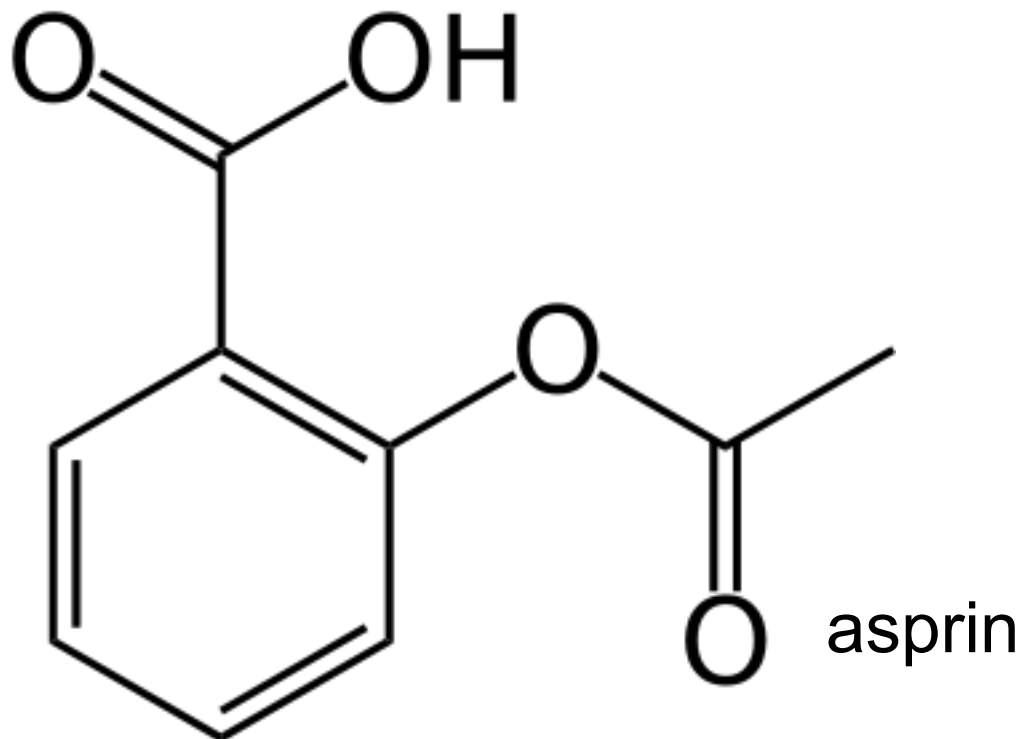
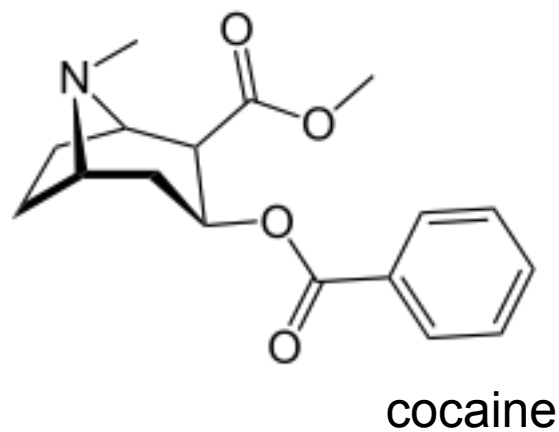
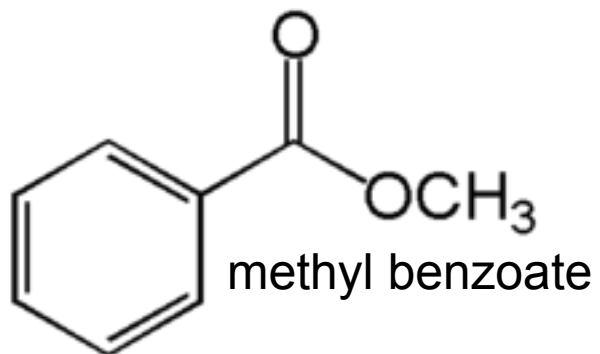


police dog smells the methyl benzoate. Trained with methyl benzoate



methyl benzoate

cocaine/methyl benzoate



Disinfect vs odor removal

quaternary ammonium compounds-kill bacteria

bleach-kill bacteria AND oxidize chemicals-also bleach is an alkaline solution

activated charcoal -absorbs molecules with its fantastic surface area cavities

peroxide -oxidizes compounds kills bacteria (weakly) in the process

oxy-products -sodium percarbonate (release peroxide)and sodium carbonate (alkaline)-peroxide component oxidizes. the alkaline component will neutralize stinky acids

triethylene glycol -Oust, Ozium, Febreze-kills airborne bacteria only

the gas mask- little more than a simple filter with activated charcoal -the same activated charcoal used in aquariums.

the black colored "charcoal filter" pads for litter box vents do not contain enough activated charcoal to be useful.

also baking soda (alkaline) in the ammonia rich (alkaline as well) will do little to neutralize kitty urine odor. You need an acid. Too bad many acids stink.

quaternary ammonium compounds

most common is benzalkonium chloride
dimethyl benzyl ammonium chloride
commonly found in Lysol spray (with
alcohol) or most other disinfectant spray
cleaners



bleach

Sodium Hypochlorite- sodium salt of hypochlorous acid.
bleach is at an alkaline pH which will neutralized many stinky acids regardless of its "bleaching power"

If bleach pH shifts towards acid chlorine gas tends to evolve from solution

activated charcoal

wood heated (charred) in the absence of oxygen
used made in a metal container with a small hole to allow
gases to escape.

Cavities left after charring are ideal to capture large molecules.

peroxide

oxy-products

sodium percarbonate and sodium carbonate

triethylene glycol -Oust, Oziium, Febreze

kills bacteria in the air.

Often additional quaternary ammonium compound added to kill bacteria /disinfect surfaces - dimethyl benzyl ammonium chloride

the gas mask

Very simple canister filled with activated charcoal and a simple particle filter.

One way valve

Sometime sodium thiosulfate added to absorb chlorine gas. -
rare

Nature's funk

thiols and protection-skunk, mercaptans, garlic
saute in oil?

ammonium thioglycolate

sodium thioglycolate

rotten and green egg

Habituation to H₂S ???

Short chain fatty acids

fishies

thiols

hair -cysteine bridges

mercaptan -methanethiol, ethanethiol

beta-mercaptoethanol

thioglycolate

asparagus



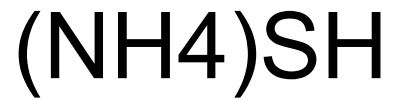
STINKBOMBEN

STINK BOMBS

Zerstören der Ampullen nur durch Hinwerfen oder Zertreten. Es verbreitet sich dann ein übler Geruch, der aber bald verschwindet.



Ammonium sulfide & Hydrogen Sulfide



mercaptan

methanethiol

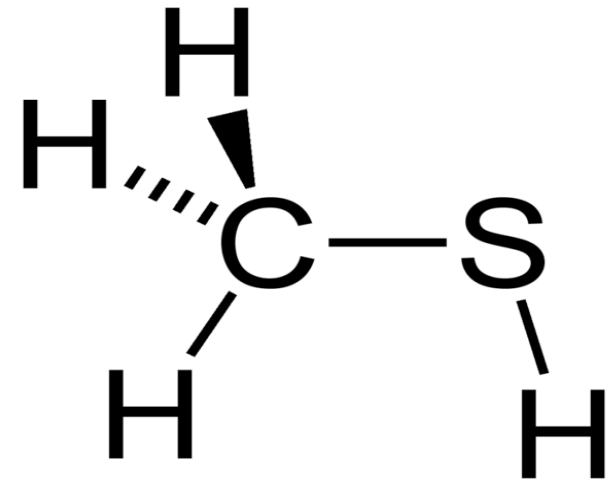
added to natural gas to allow gas leak detection

result from bacterial decay

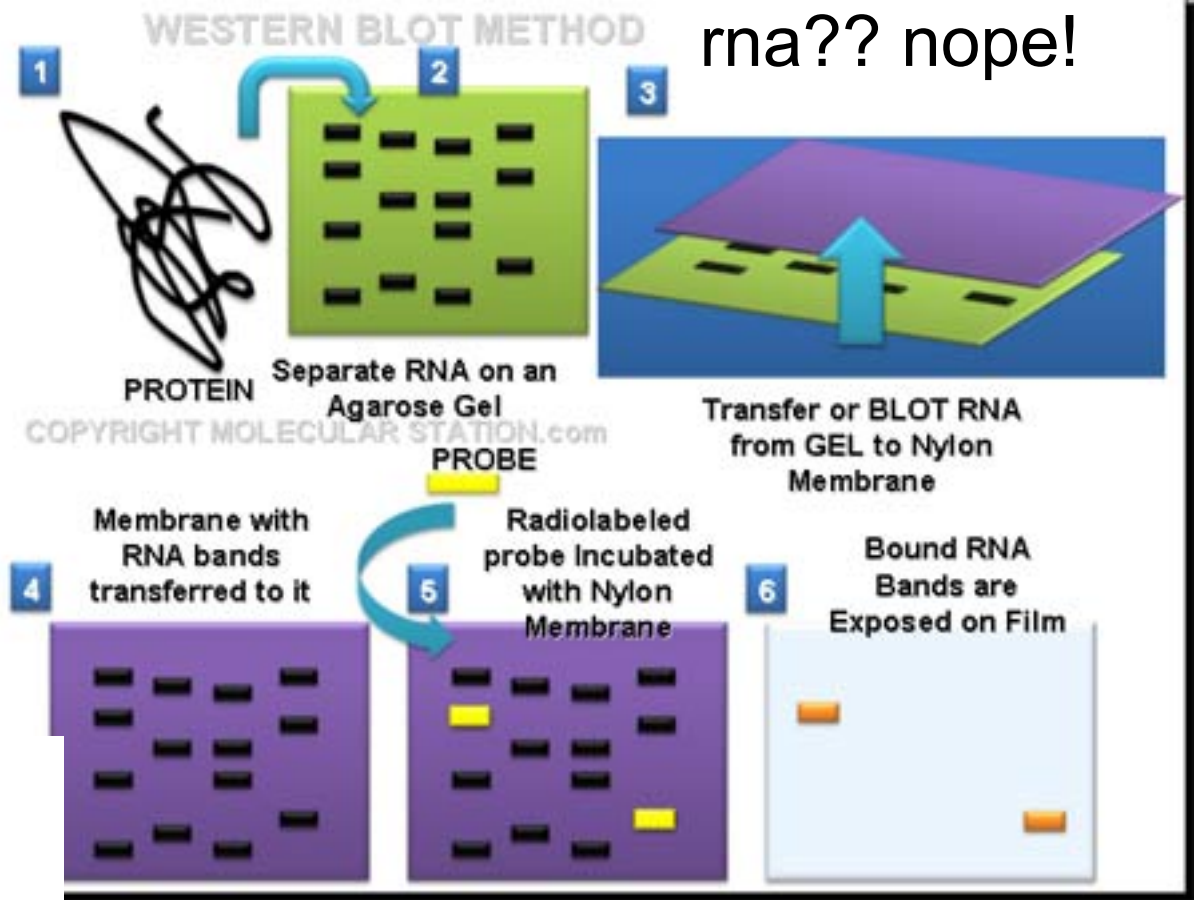
asparagus urine???

natural gas and buzzards

turkey buzzards detect mercaptan from decaying animals- will often be scene circling natural gas leaks/gas lines



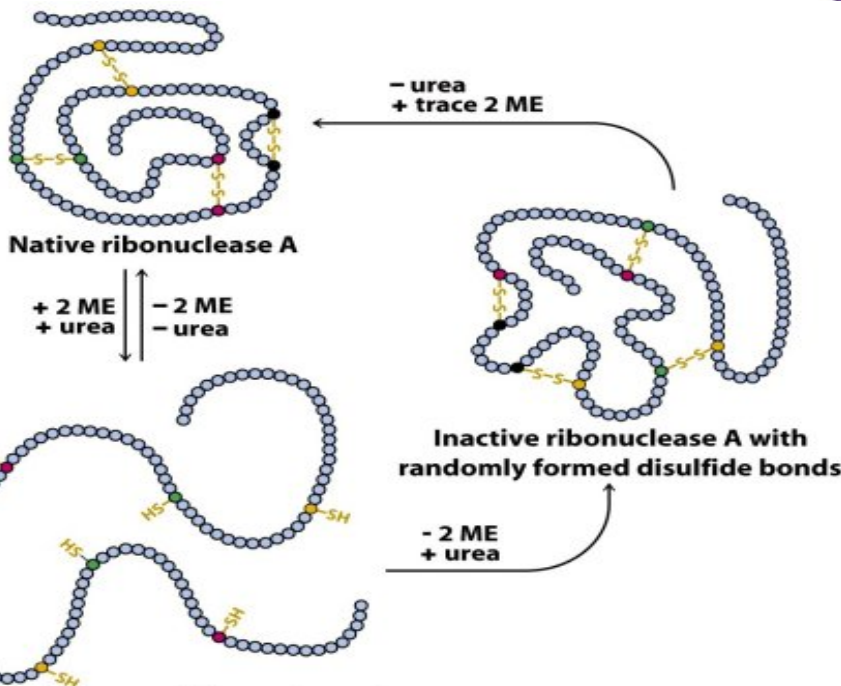
western blot



rna?? nope!

<http://www.molecularstation.com/images/western-blot.jpg>

mecaptan type molecules used to reduce disulfide bridges in proteins allowing for analysis of each protein chain in separate

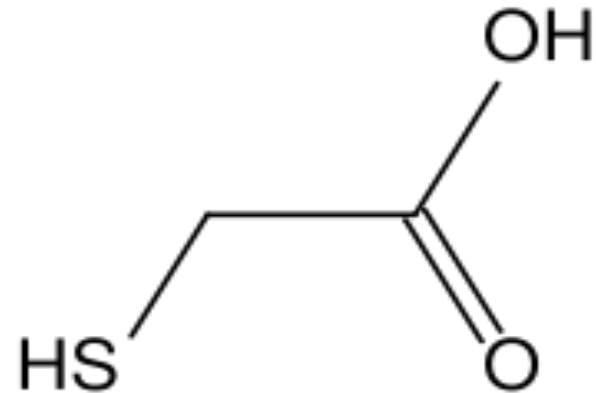
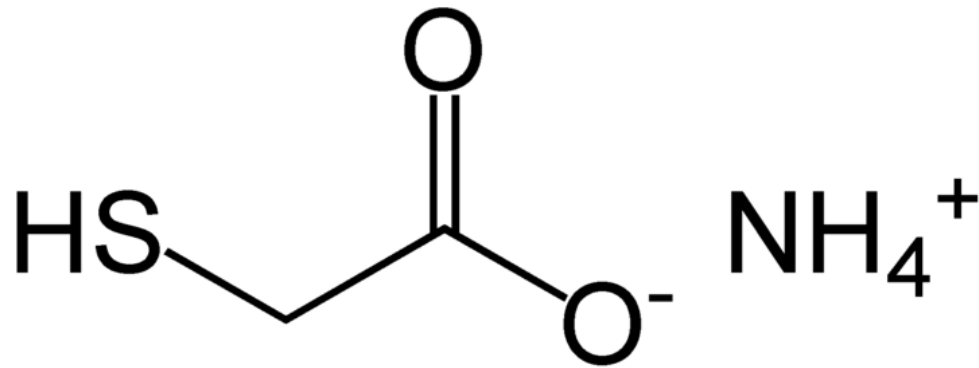


Reversibly denatured ribonuclease A; disulfide bonds have been reduced

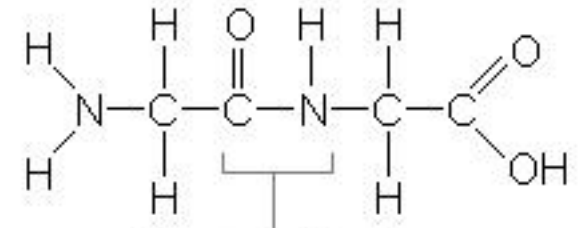
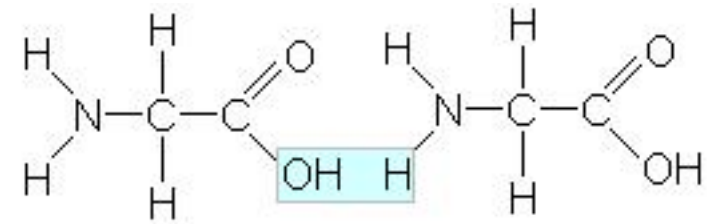
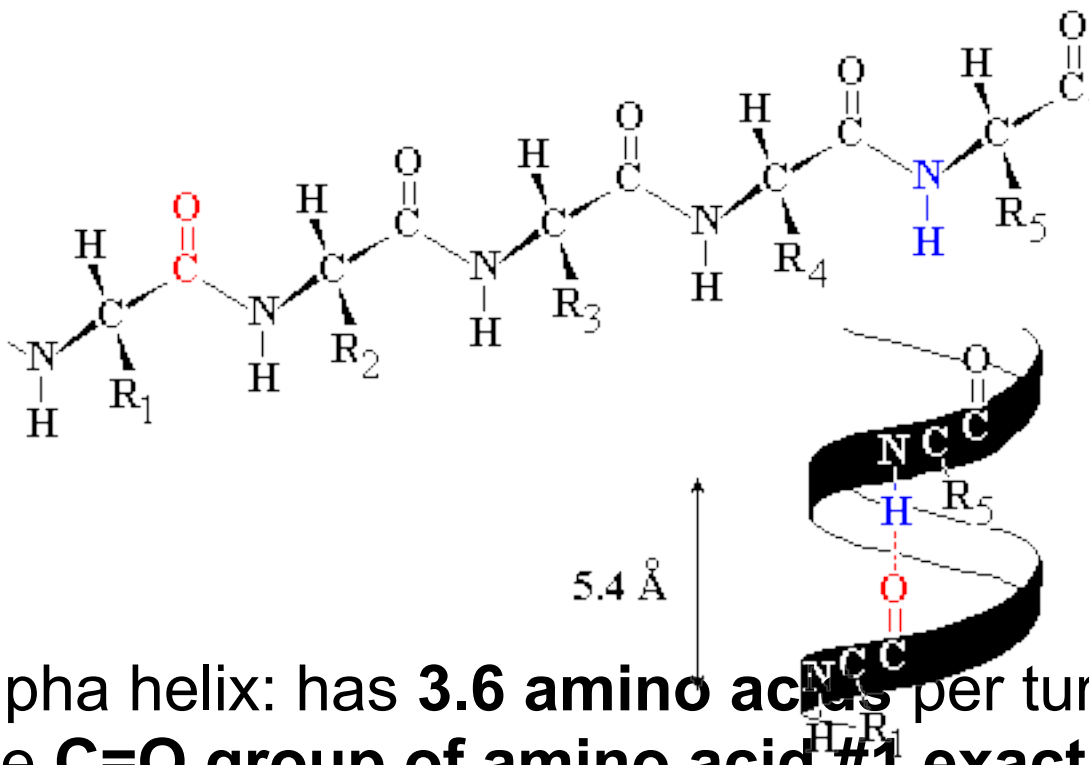
Ammonium thioglycolate - perms

Used to reduce disulfide bridges (cysteine bridges) in hair to introduce permanent waves "Perms"

After curl/wave introduced hydrogen peroxide used to re-establish cysteine bridges. Making the perm "permanent"



hair

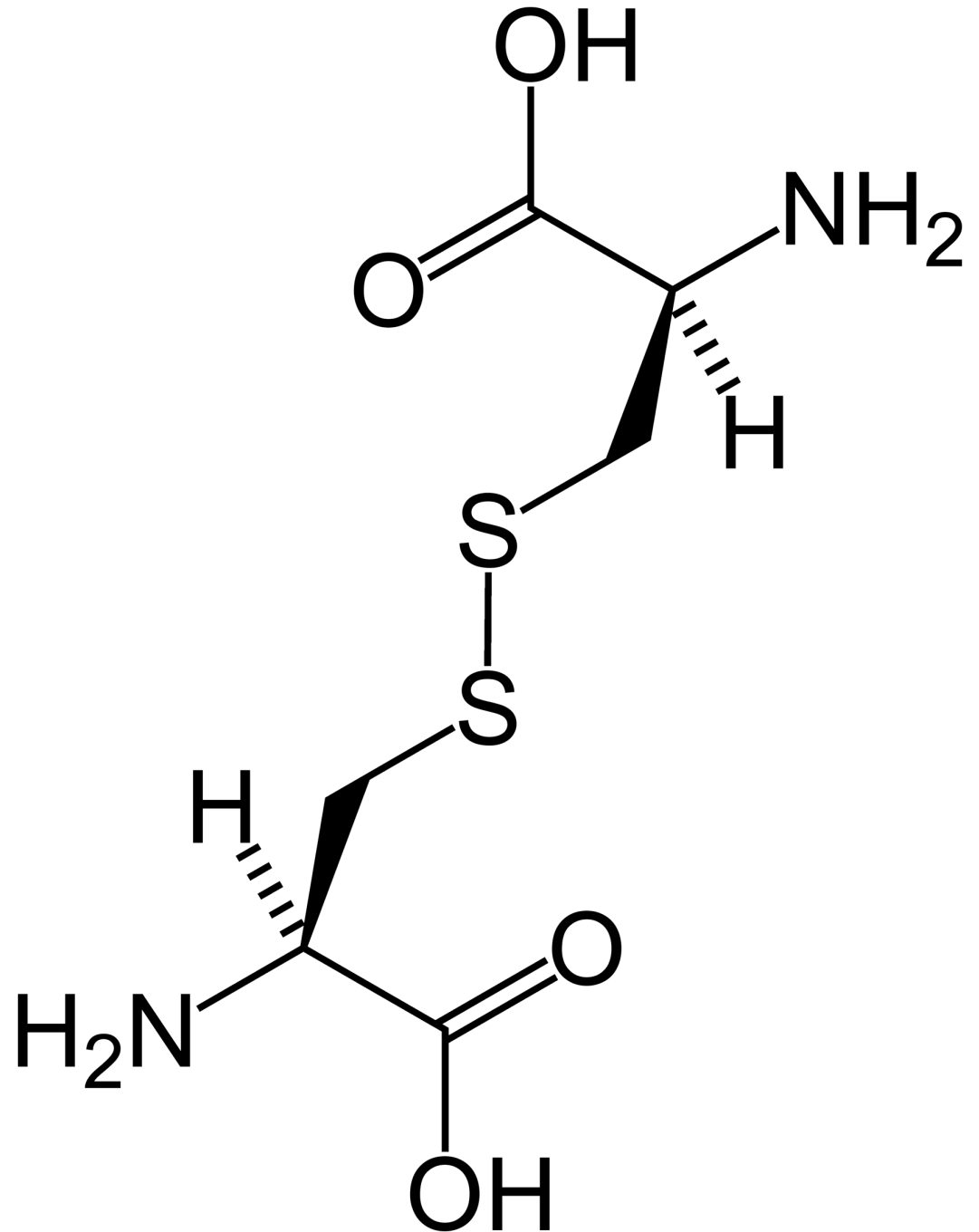
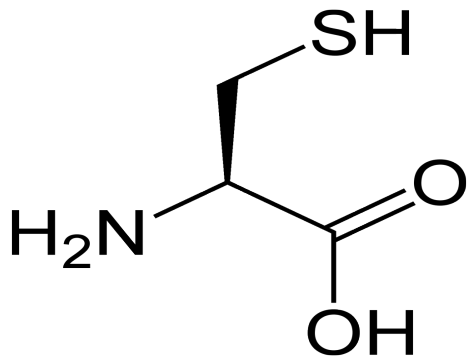
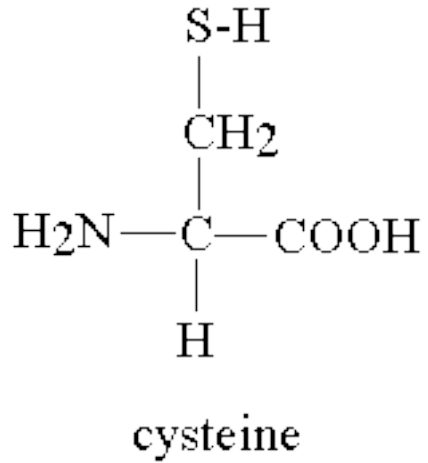


Peptide Bond

A molecule of water is removed from two glycine amino acids to form a peptide bond.

Alpha helix: has **3.6 amino acids** per turn of the helix, which places the **C=O group of amino acid #1 exactly in line with the H-N group of amino acid #5** (and C=O #2 with H-N #6)

cysteine disulfide bridge



hair 3

not a picture of hair!

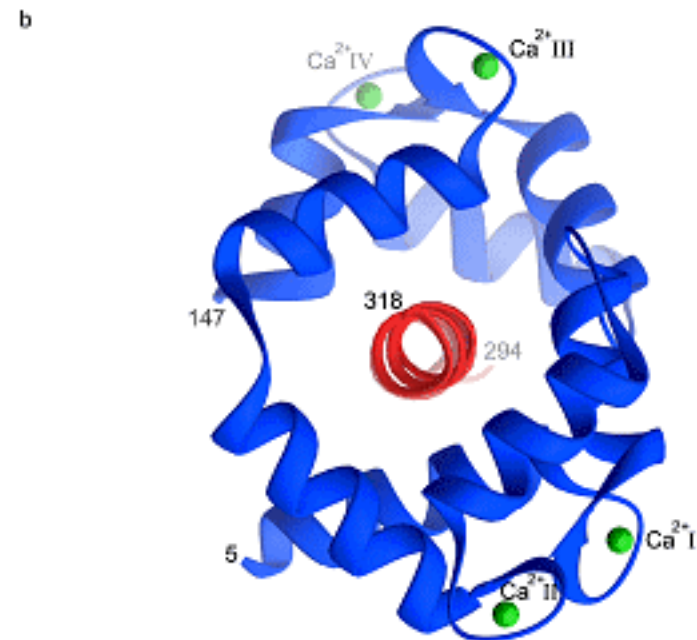
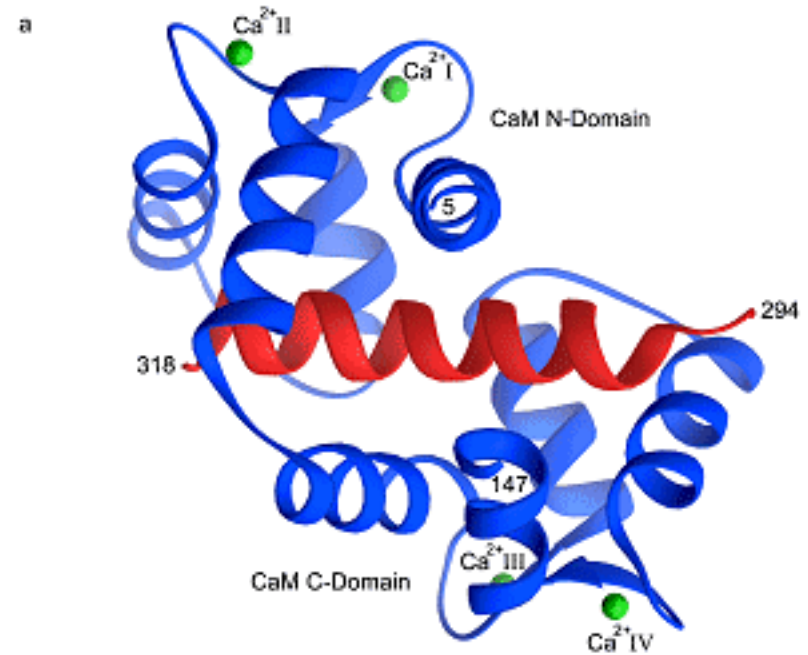
reduce with thioglycolate

bend hair

oxidize with peroxide

rotten egg smell from the THIOL

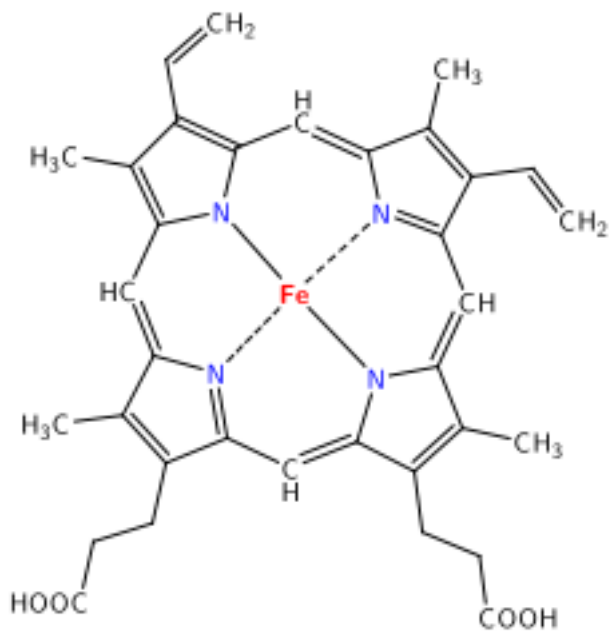
as in THIOglycolate



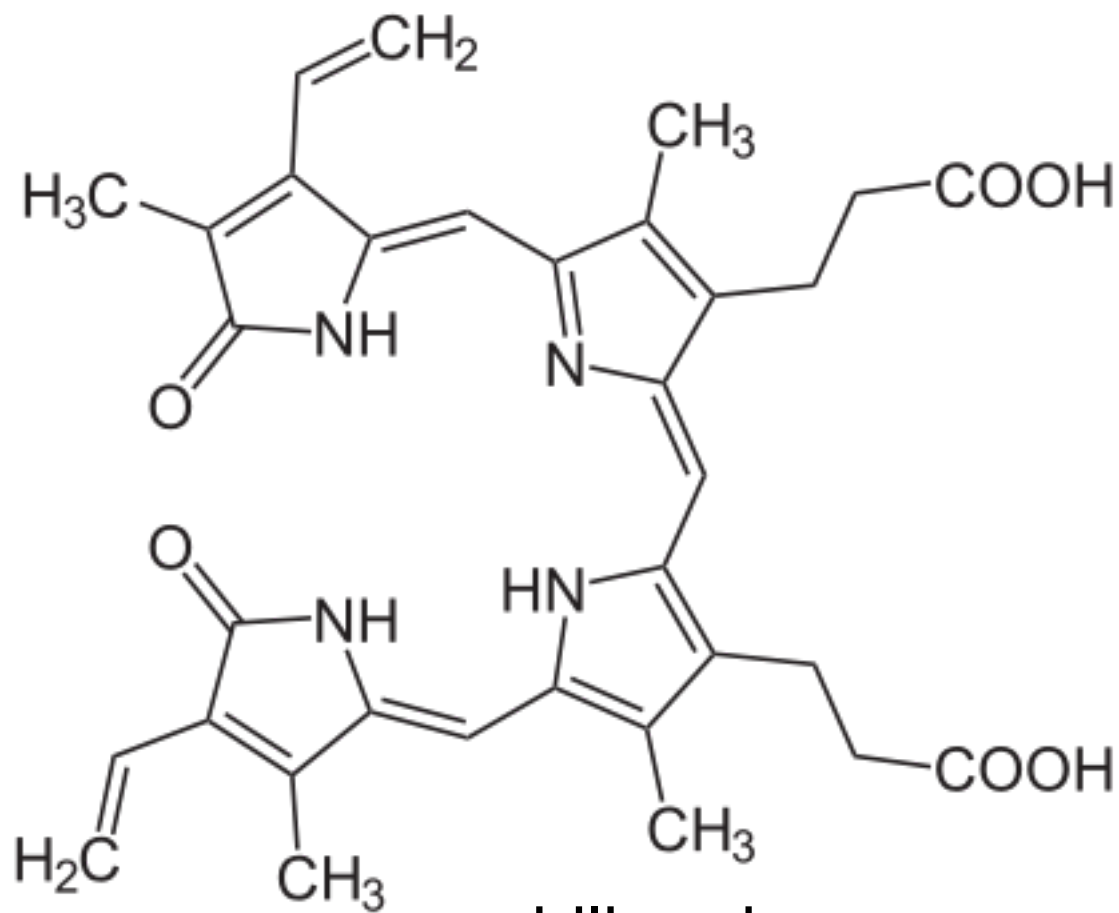
The ester and bile

bile synthesis and metabolism
contribution to feces
organic pics of bile salts

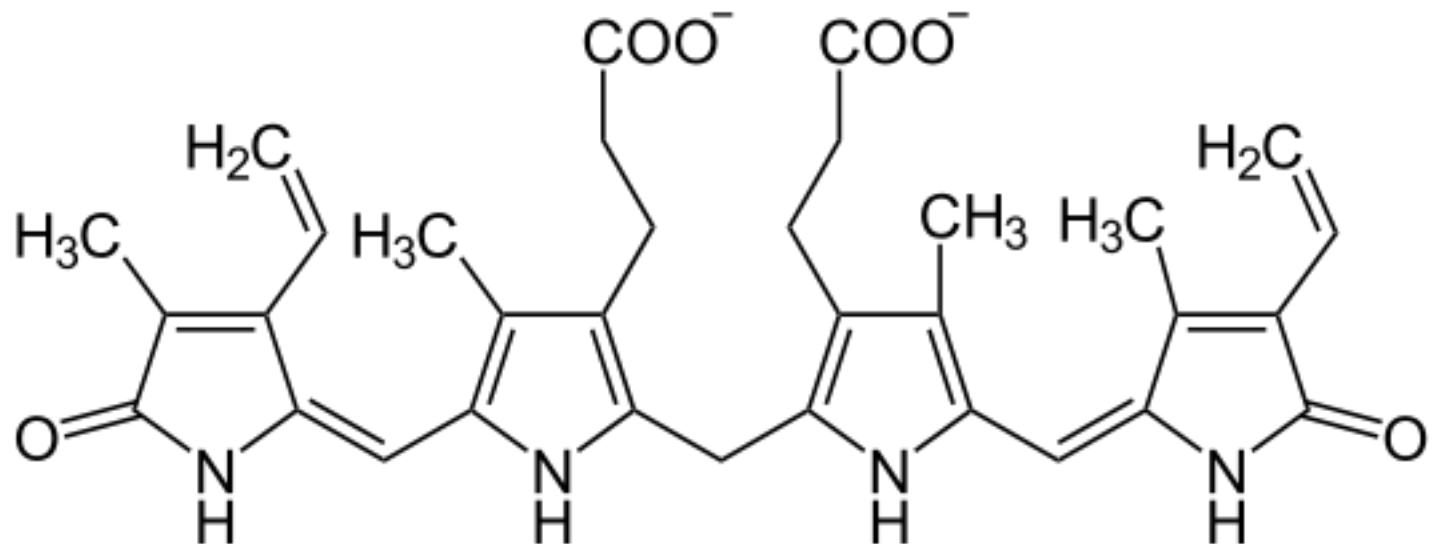
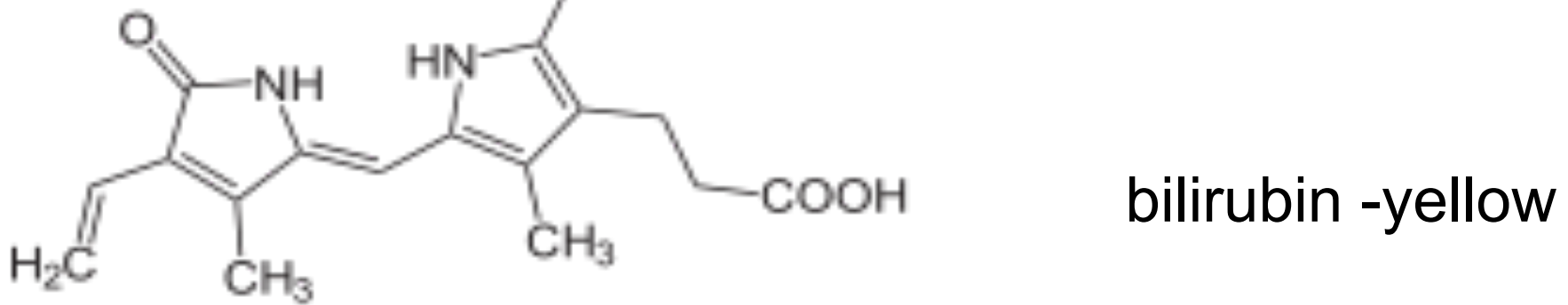
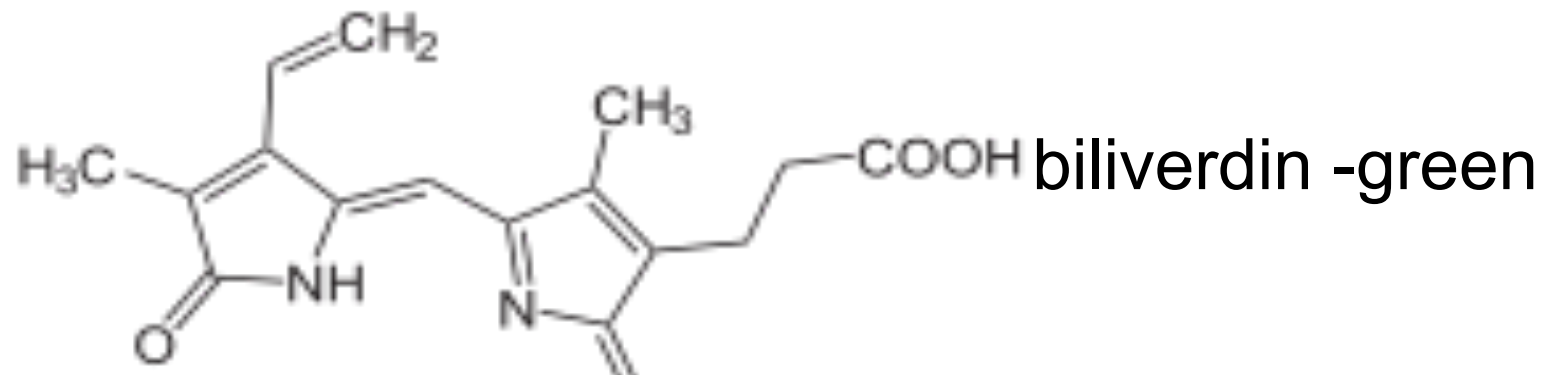
bile



hemoglobin- red

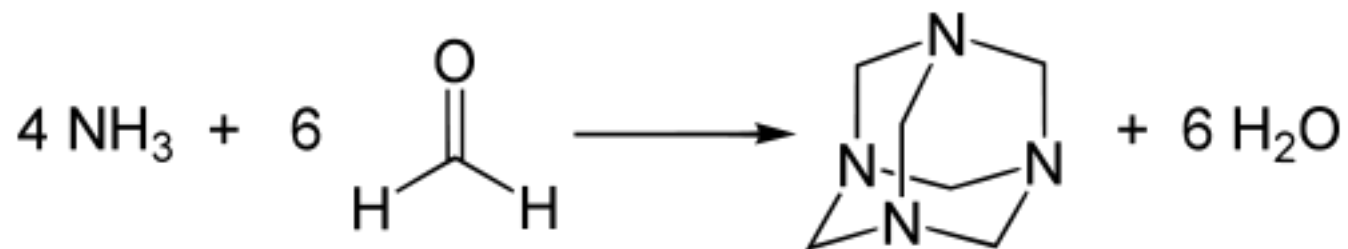


biliverdin -green



amines/fishy

trimethylamine -esbit camping fuel, smells fishy
amines weakly basic-alkaline



esbit stove hexicooker



http://www.1944militaria.com/reproduction_person.htm



The other stuff

durian fruit

ginkgo biloba fruit -female trees

phenols/terpenes -ceder

actinomycetes

citrus

HCL odor

bleach compounds

durian

Popular in South East asian. Sweet custard like inside but awful sulfur (thiol) and fecal (indole) like odor.





Durian components

likely therefore that most of the minor constituents were of little importance individually, although their combined effect might be important.

TABLE 1. VOLATILE FLAVOURING COMPOUNDS OF DURIAN

Hydrogen sulphide		Methyl acetate	(1)
Methanethiol	*	Ethyl acetate	(3)
Ethanethiol	*	Methyl propionate	(3)
Propanethiol		Ethyl propionate	(1)
Dimethylthioether	*	<i>n</i> -Propyl propionate	(1)
Diethylthioether	*	Ethyl <i>iso</i> -butyrate	(1)
Diethyldisulphide	(1)	Ethyl butyrate	
Methanol	(2)	Methyl α -methylbutyrate	(2)
Ethanol	(5)	Ethyl α -methylbutyrate	(5)
<i>n</i> -Propanol	(4)	<i>n</i> -Propyl α -methylbutyrate	(1)
3-Methylbutan-1-ol		Ethyl <i>iso</i> -valerate	(1)
Acetaldehyde	(1)	Ethyl methacrylate	(1)
Propionaldehyde	(2)	Ethyl benzene	(1)

The relative proportions are based on the height of the GLC peaks as a percentage of recorder full-rate deflection: (1) 10; (2) 10-30; (3) 30-60; (4) 60-100; (5) over 100%. Compounds marked * were identified by TLC in one solvent. All other compounds were identified by their MS obtained from condensed headspace vapours. Identifications were confirmed by comparing MS and chromatograms with those of authentic specimens.

In order to confirm the conclusion that propanethiol and ethyl α -methylbutyrate were the predominant constituents of the odour of durian, an aqueous solution containing 2.5 ppm of propanethiol and 20 ppm of ethyl α -methylbutyrate was prepared. The odour of the resulting mixture was very similar in character to that of durian although it was not a precise imitation. The result was considered to be very satisfactory, however, since several substances present in the fruit in concentrations approaching half that of ethyl α -methylbutyrate were omitted from the synthetic mixture.

ginkgo

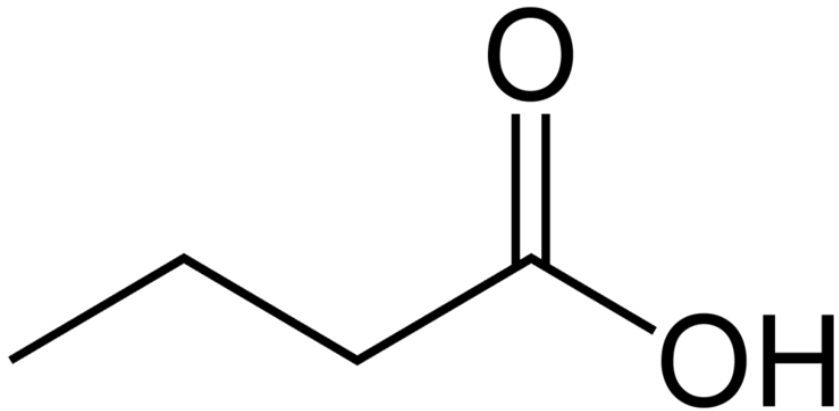


Autumn-yellowed *Ginkgo biloba* leaves
Photograph by TongRo Image Stock/Alamy

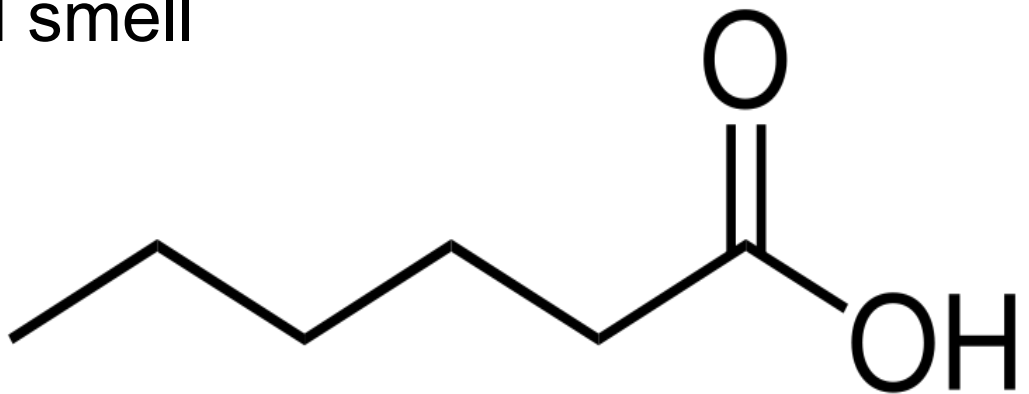
ginkgo2



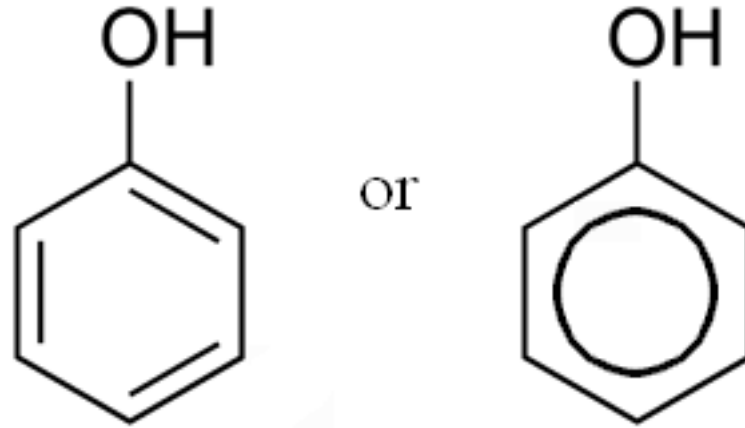
butyric/hexanoic acid



berries from female ginkgo trees
decay and release butyric and
hexanoic acids- truly putrid smell



phenols



Joseph Lister -first use of antiseptic

Antiseptic Principle Of The Practice Of Surgery 1867

Dr. Lister read -work from 1865 Louis Pasteur

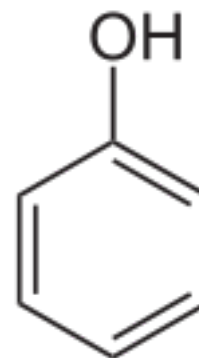
carbolic acid -sewage

acidic, numbing, antiseptic

phenol



Active Ingredient: Phenol 1.4%
Inactive Ingredients: Flavor,
Glycerin, Purified Water, Red 40,
Saccharin Sodium

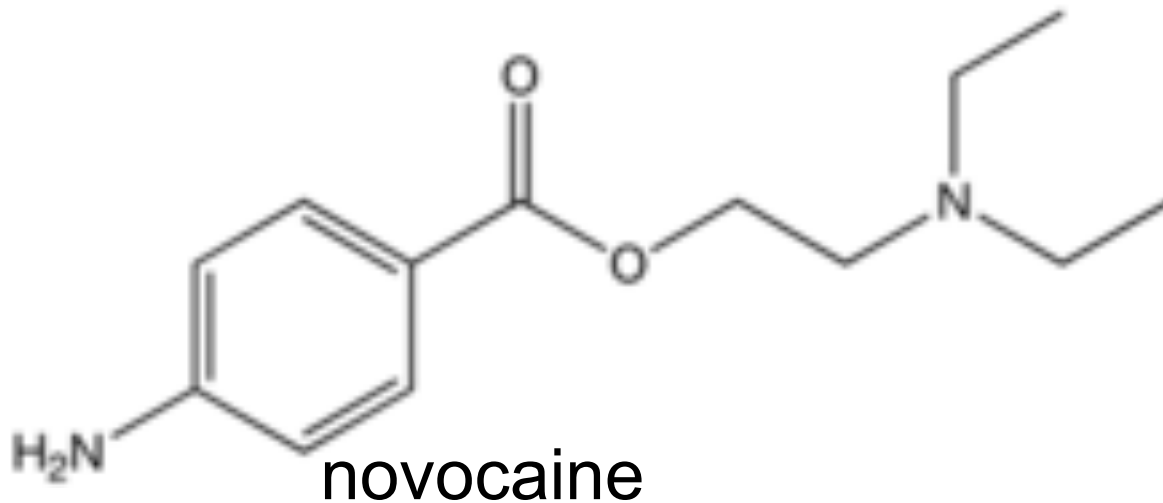
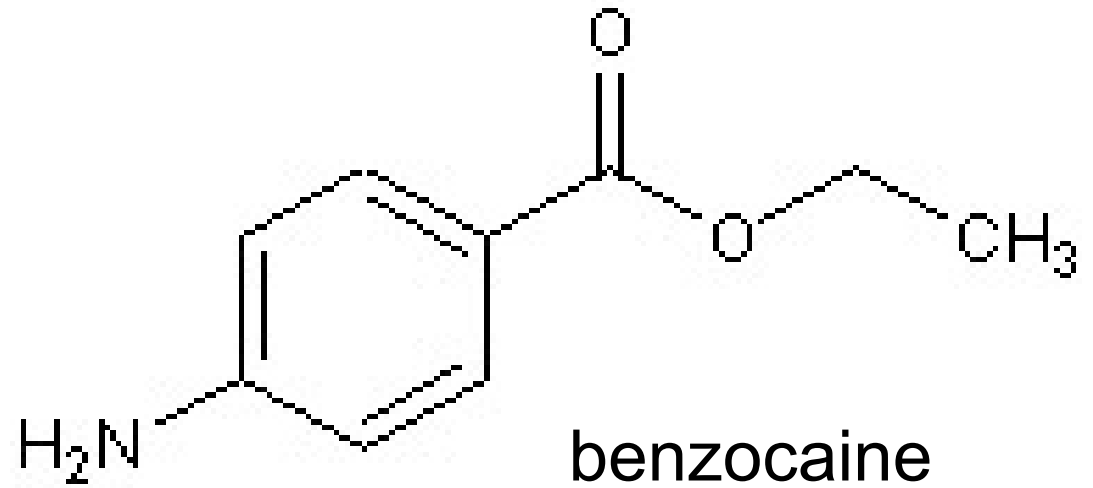




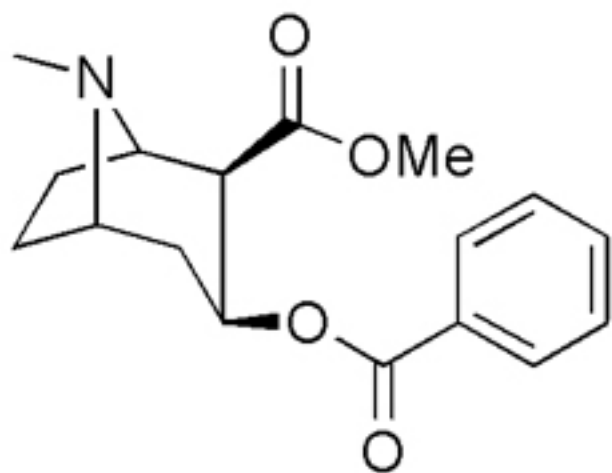
chloro-phenol still very similar
odor and disinfectant activity

Numbing mechanism

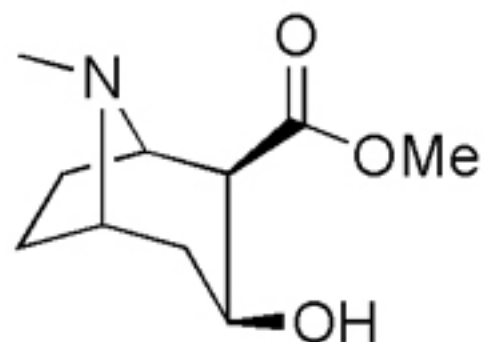
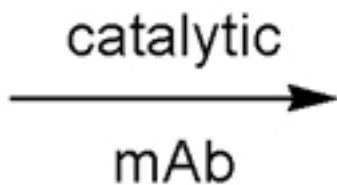
Blocks sodium from entering neurons, just like these popular numbing medications.
A structural similarity to the ring group????



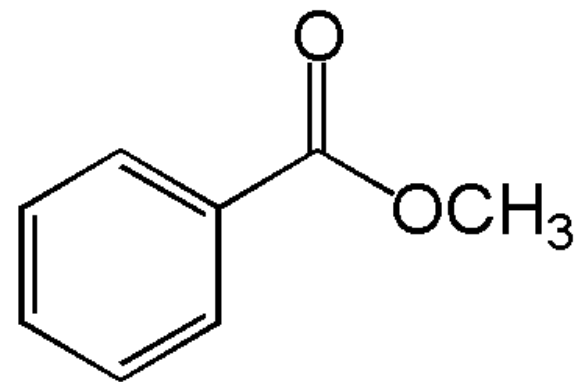
Cocaine numbs too



Cocaine



methyl ecgonine



methyl benzoate

phenol terpene examples

juniper cedar trees - wood doesn't rot! phenols kill the bugs/bacteria/moths

carbolic-phenol

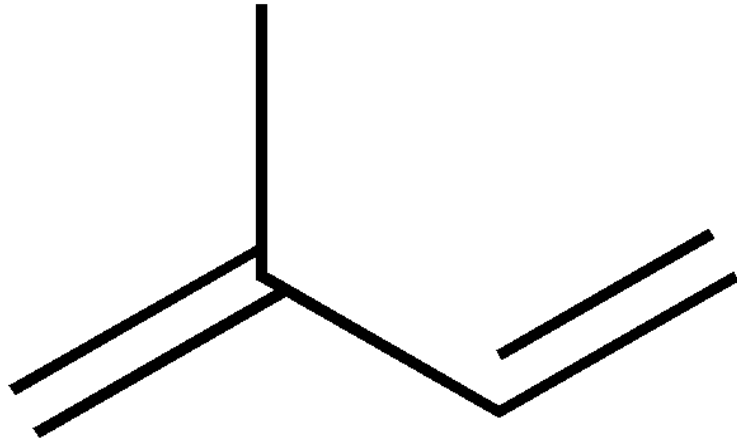
Lysol- chlorophenol

menthol -mildly antiseptic

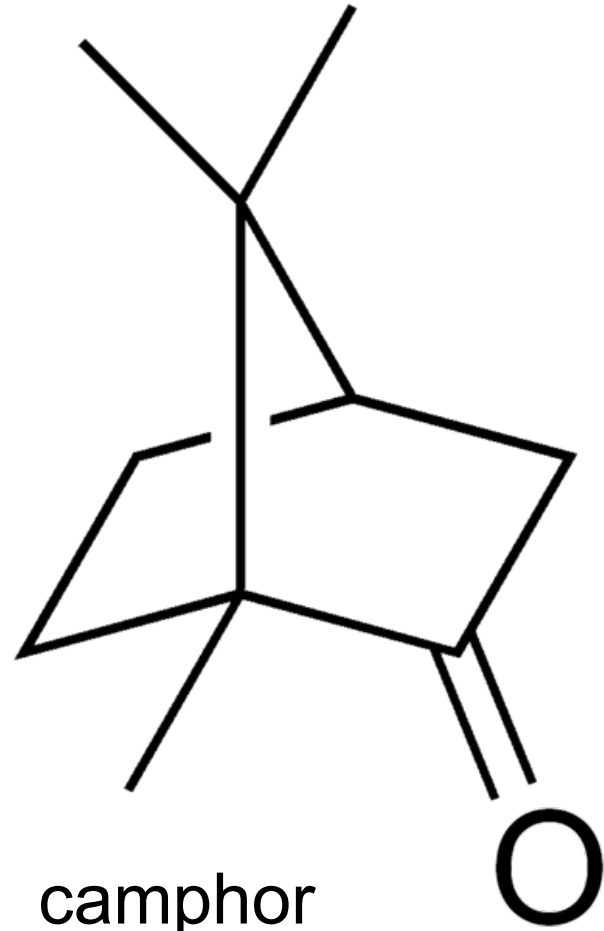
thymol-Listerine -antiseptic

eucalyptus -antiseptic too!

terpenes/terpenoids

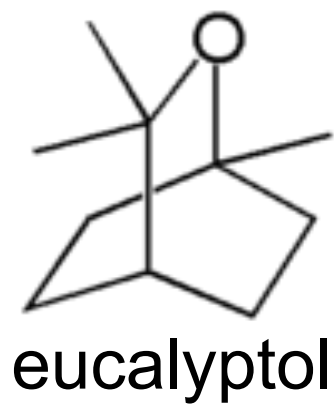
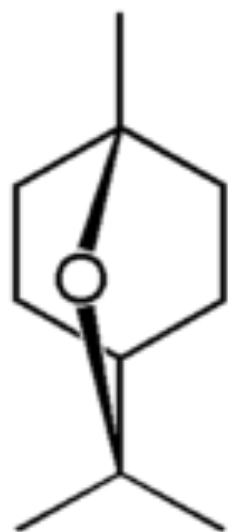
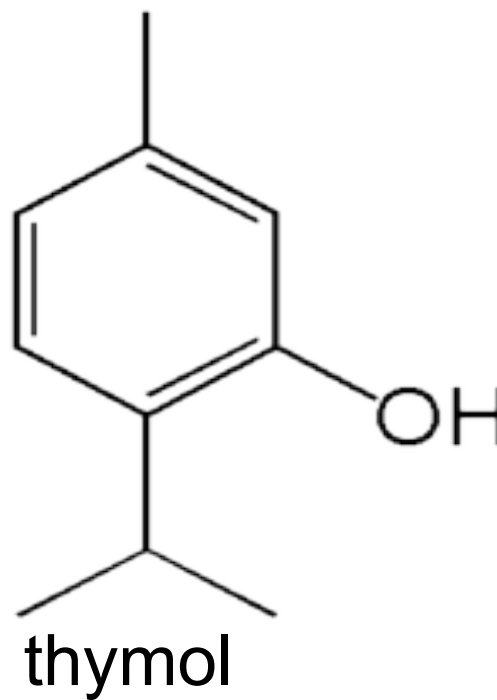
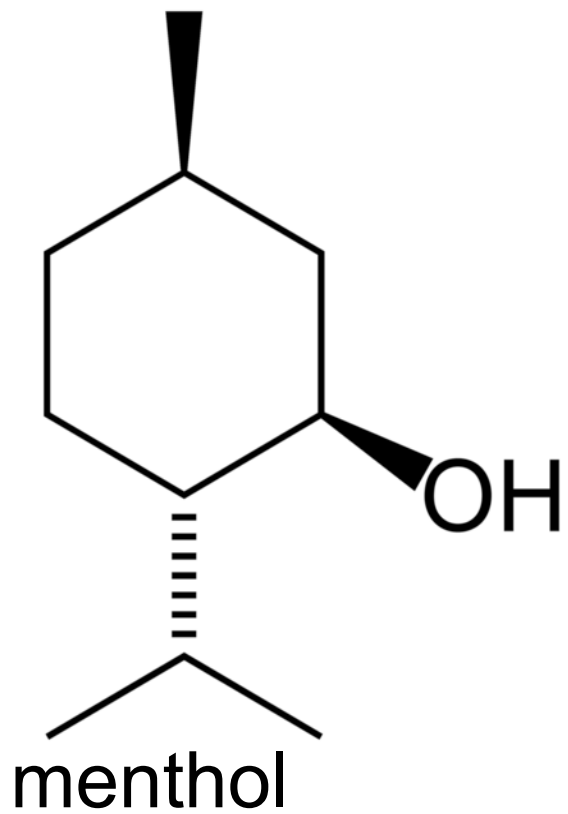


isoprene

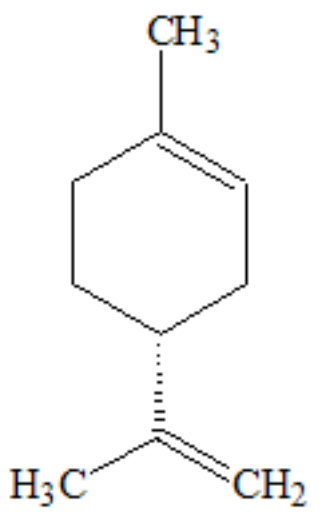


camphor

turpenoids 2

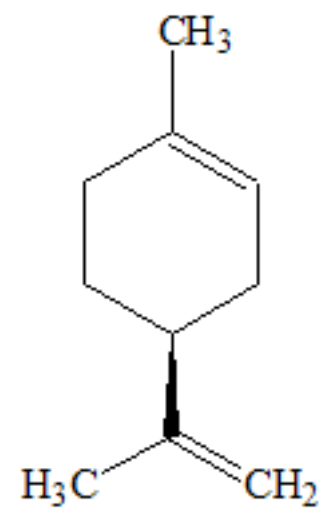


limonene

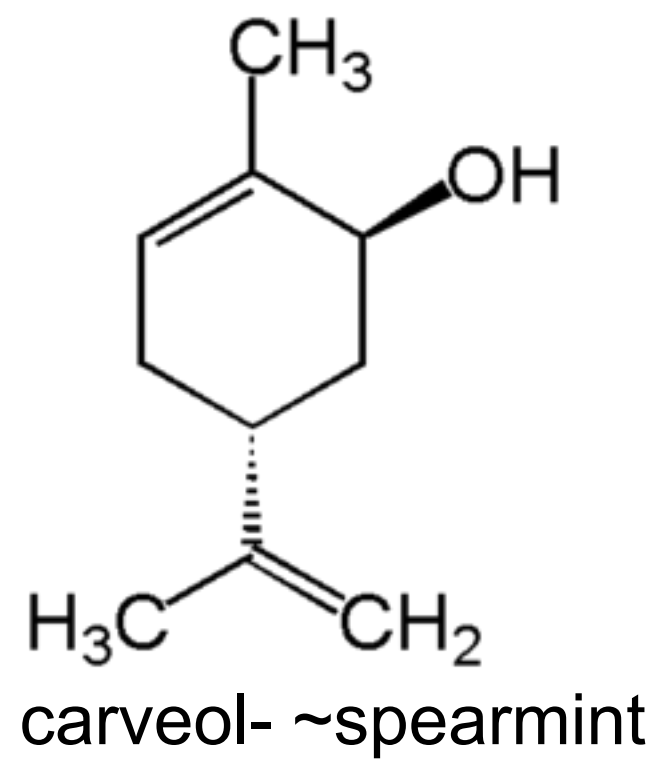


(R)

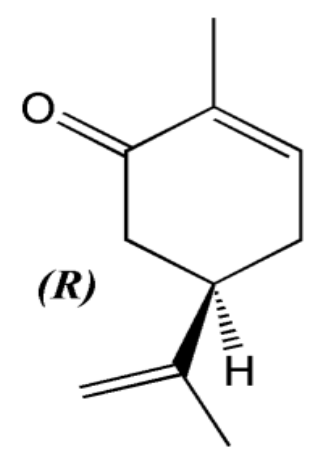
orange citrus



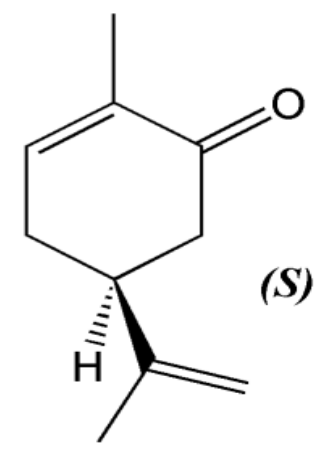
(S)



carveol- ~spearmint



(R)



(S)

carvone R=spearmint S=caraway

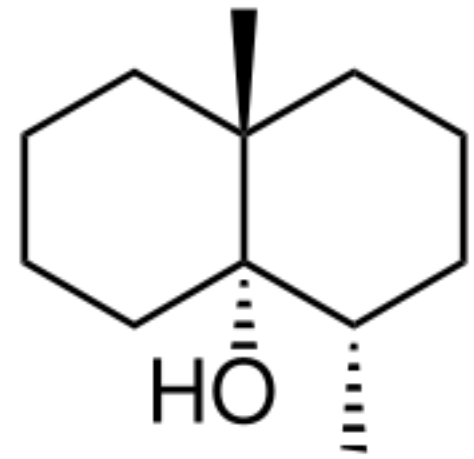
ferric chloride



hydrochloric acid smell

Earthy smells

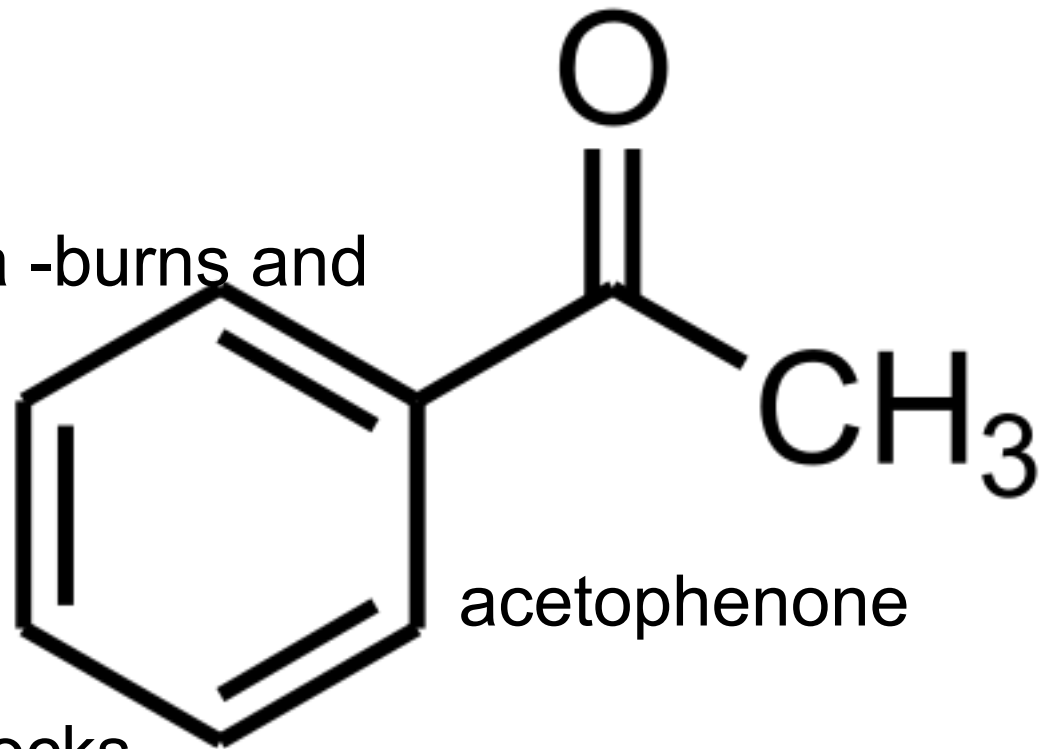
actinomycetes bacteria



geosmin

acetophenone -sweetish smell

Pseudomonas aeruginosa -burns and
diabetic wounds
masa corn flour -tortillas
Mexican freetailed bat



acetophenone

pseudomonas and stinky socks

sniff examples

corn tortilla-like pseudomonas

thioglycolate-Nair- Thiol smell

trimethylamine- Fishy

baby formula-just stinks

amyl acetate-ester "Banana oil"

ethyl acetate-ester

acetone

Dettol/Lysol -phenol odor

Chloroseptic-phenol odor

Windex -2butoxyethanol

acetic acid

garlic -pleasant thiol smell

Dirt-geosmin

camphophenique -camphor
and Phenol

ferric chloride

Durian -thiol/fecal odor

fish oil -amine fishy

