

ORGANIC CHEMISTRY

Organic can be biological or chemical term

Biology: anything living or has lived

Chemistry: any substance containing carbon

ORGANIC CHEMISTRY

Many areas rely on organic chemistry

biology

petroleum industry

polymers

genetic engineering

agriculture

pharmacology

consumer products

Carbon exists in several forms:

- 1. Graphite** **Sheets of rings which can slip over each other**
Soft - pencils

- 2. Diamond** **Tetrahedral arrangement of atoms**

Hard

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Most atoms form small molecules

Carbon unique: forms huge molecules

1 carbon atom combines with 4 other atoms

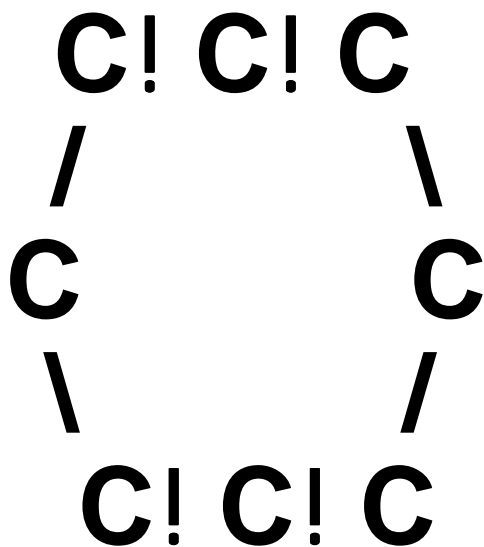
Readily combines with other carbon atoms

Forms chains and rings

Long chain molecules



Rings



ORGANIC CHEMISTRY

chemistry of carbon compounds

Classify compounds:

By how carbon atom are arranged and what other groups attached

Simplest: hydrocarbons Methane: CH₄

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Series of similar C & H compounds

CH_4 methane

C_2H_6 ethane

C_3H_8 propane

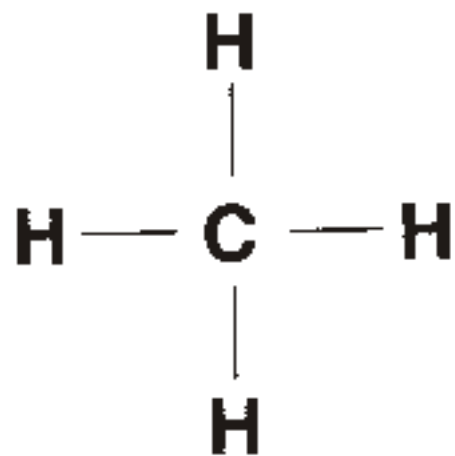
C_4H_{10} butane

C_5H_{12} pentane

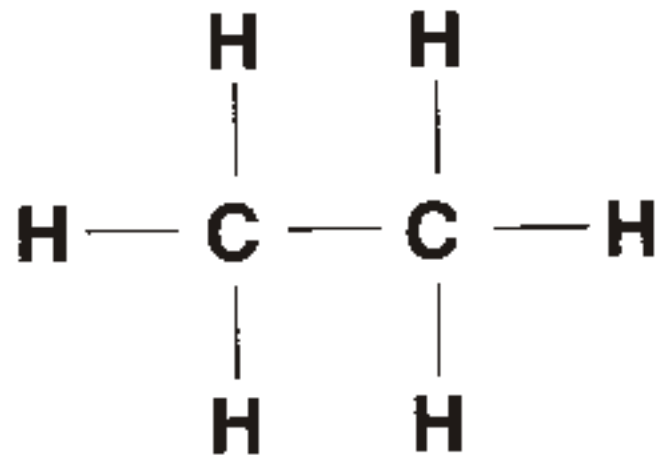
C_6H_{14} hexane

Alkanes

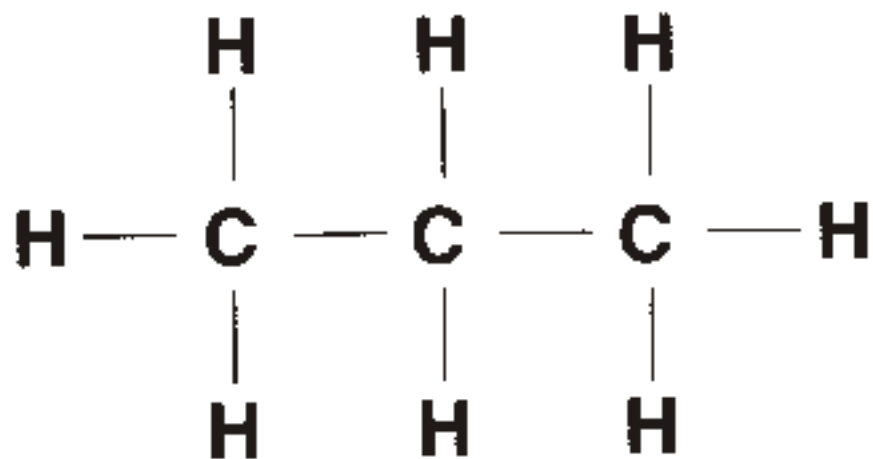




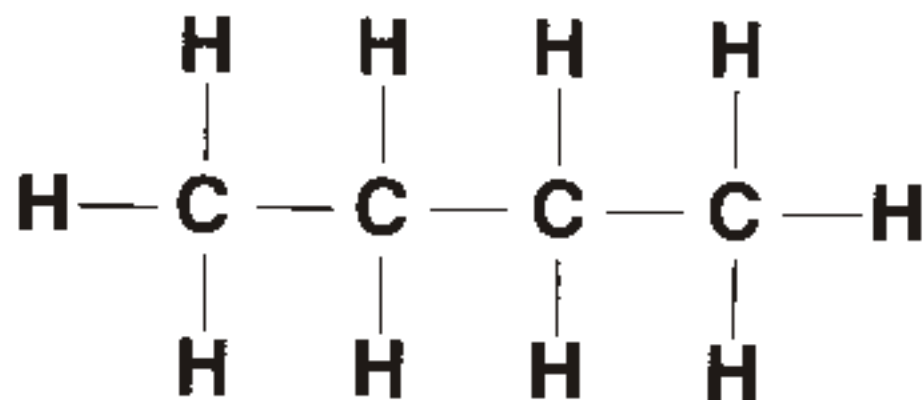
Methane



Ethane



Propane



Butane

SOURCES

**Hydrogenation of:
petroleum
shale oil
coal**

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Formula and name for 8 carbons ?

use standard prefixes
and -ane ending

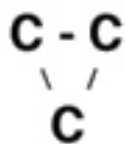
C_8H_{18} octane

CYCLOALKANES

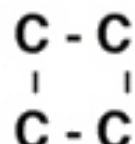
Cyclic alkanes

General formula: C_nH_{2n}

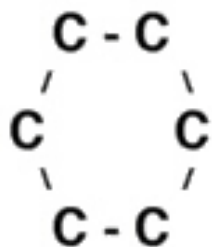
Named as parent alkane
with **cyclo** prefix



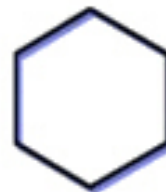
cyclopropane



cyclobutane



cyclohexane



REACTIONS OF ALKANES

Combustion



Many alkanes used as fuel

Methane: natural gas

Propane: cooking

Butane: lighters

Gasoline: mixture of hydrocarbons

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Other series of hydrocarbons:

Alkenes C_nH_{2n} C_2H_4 ethene

Alkynes C_nH_{2n-2} C_2H_2 ethyne

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What do alkanes, alkenes, alkynes have in common?

Contain C and H

C atoms joined in chains

ALKENES AND ALKYNES

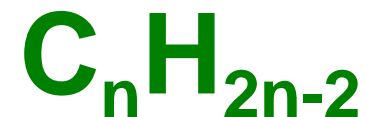
Unsaturated hydrocarbons

Contain C=C multiple bonds

Alkenes: C=C



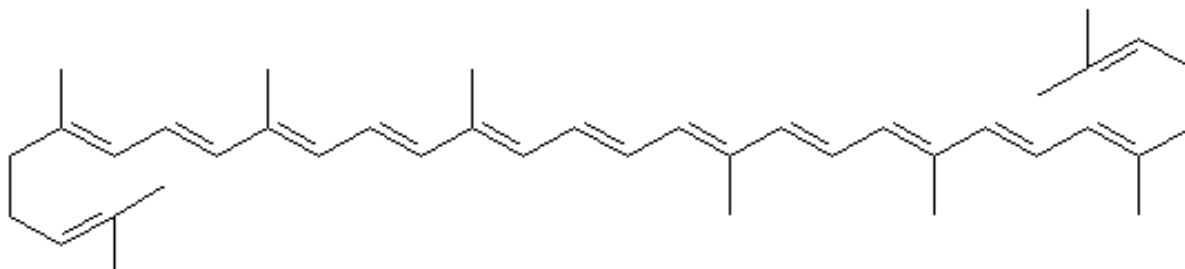
Alkynes: C≡C



Examples: steroids, unsaturated fats, polymers, prostaglandins

COLORED ALKENES

Molecules with many double bonds can be colored



Molecular Weight: 536.89

Molecular Formula: $C_{40}H_{56}$



100mg Organic
Tomato Concentrate

10mg Lycopene
Nutritional Factor

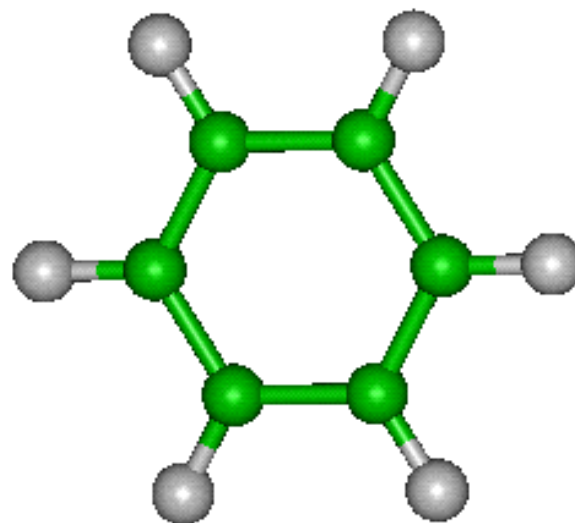
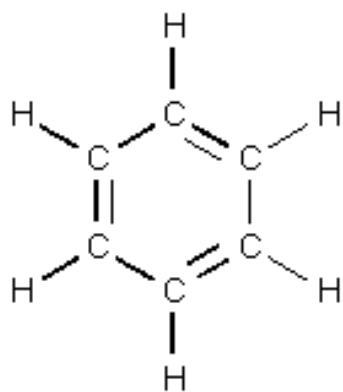
Lycopene

AROMATIC COMPOUNDS

Hydrocarbons joined in rings:

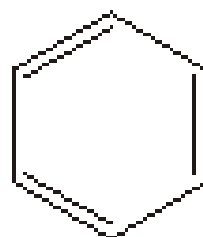
C_6H_6 benzene

$C_{10}H_{10}$ naphthalene

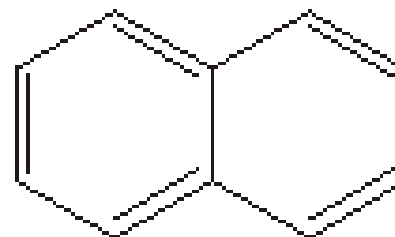


C_6H_6

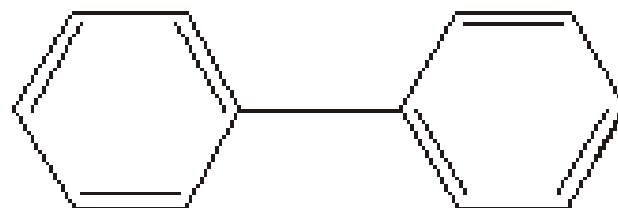
benzene



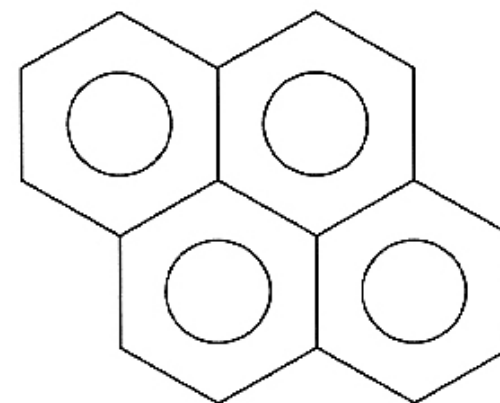
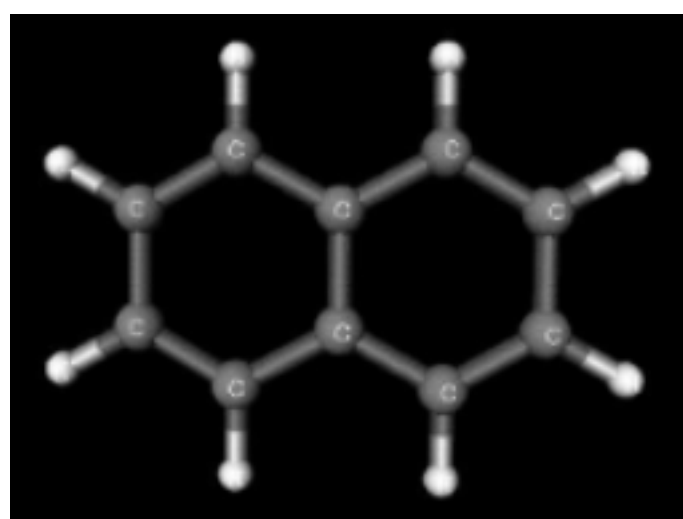
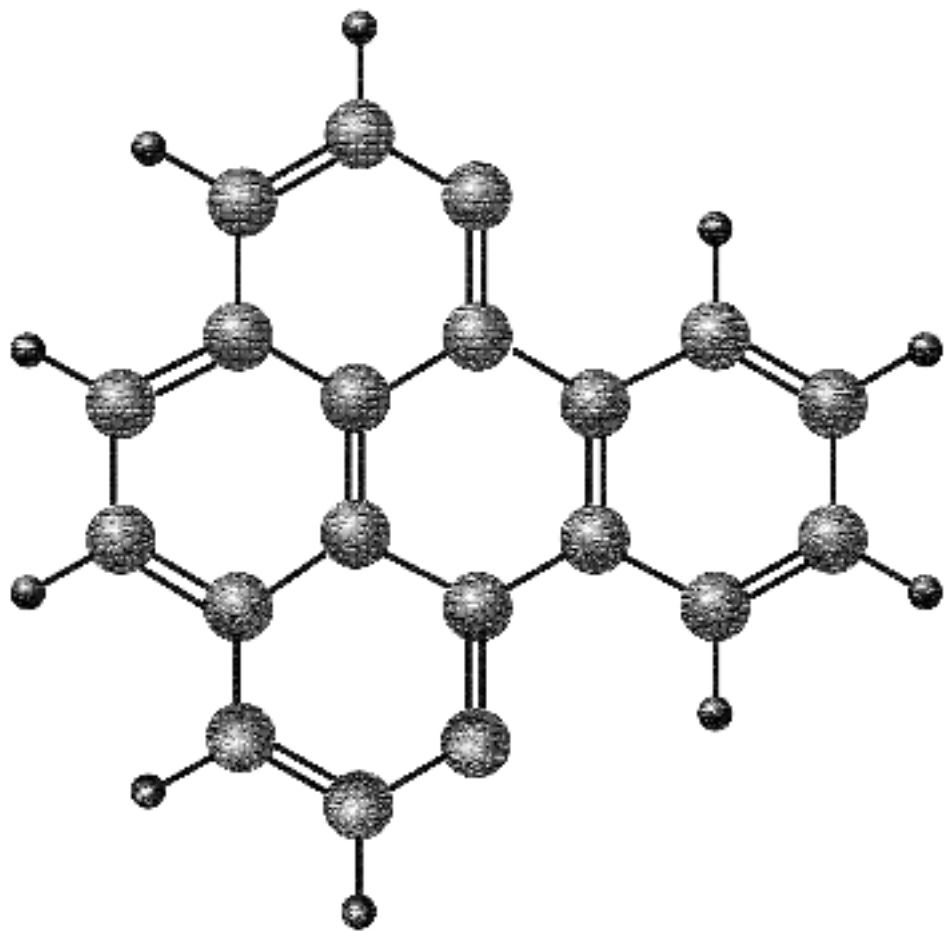
Benzene



Naphthalene



Phenylbenzene



Pyrene
 $C_{16}H_{10}$

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**Many organic compounds
contain oxygen**

Alcohols: ! OH

Ethers: C! O! C

Fatty acids: ! COOH

Alcohols

Methanol: CH₃OH

**Synonyms: methyl alcohol,
wood alcohol**

**Uses: solvent, perfumes, industrial
precursor**

Toxicity: blindness, death

Properties: colorless, odorless, liquid

Alcohols

Ethanol: $\text{CH}_3\text{CH}_2\text{OH}$

**Synonyms: ethyl alcohol,
grain alcohol**

**Uses: solvent in medicines, beverages
industrial precursor**

Toxicity: safe, low levels

Properties: colorless, odorless, liquid

ORGANIC CHEMISTRY

Many organic compounds
can contain: O N P S



CHEMISTRY AND MEDICINES

Prior to 1938, US drug manufacturers not required to test new drugs on animals/people

US FDA sought legislation to test drugs after numerous “horror cases” reported

Radium water

Elixir of sulfanilamide

Dr. Francis Kelsey

CHEMISTRY AND MEDICINES

Medicines for chronic pain

Analgesics: OTC for minor pain

Narcotics: for major pain

Gk. *narkotikos*

CHEMISTRY AND MEDICINES

Opium poppy, *papaver somniferum*

L, somnus = sleep; fere = to bring

20 alkaloids, e.g. morphine, codeine

**alkaloid: alkaline, N-containing
compounds from plants**

opiates: narcotic analgesics in opium

Opium Harvesting

**Cut unripe seed capsules
Releases milky white sap**

Sap scraped into ball



Opium

Use and acceptance of a medicine varies from culture to culture and generation to generation

**Sumerians - 4000 BC
first to use dried sap of poppy**

Opium

**Prior to 1914, opium
smoking widespread
& tolerated in US**

**150,000 pounds
legally imported**

**Harrison Narcotics Act of 1914 was
beginning federal control**

Morphine

Pure morphine isolated 1803

Named after

Roman god of dreams

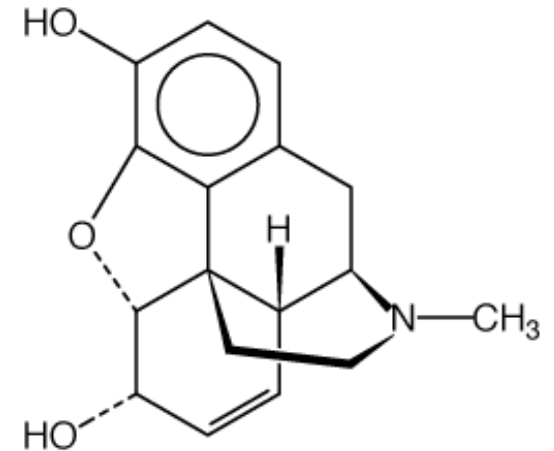
(Morpheus)

**Potent analgesic, cough suppressant,
induces apathy & euphoria, addictive**

Medical use in Civil War

Morphine

Pure morphine isolated 1803
Named after
Roman god of dreams
(Morpheus)



Potent analgesic, cough suppressant,
induces apathy & euphoria, addictive
Medical use in Civil War

Heroin

Acetylation of 2 OH morphine groups

German, *heroisch* = heroic

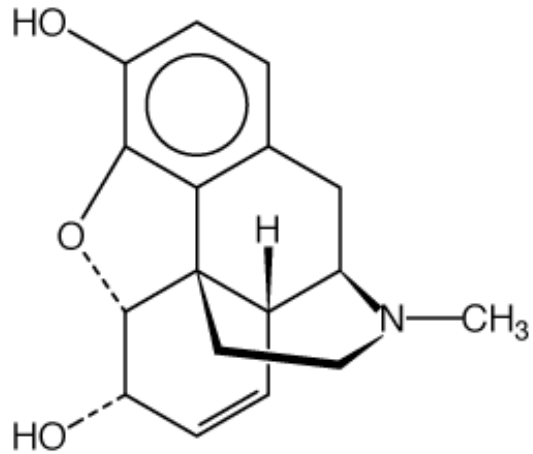
1898: cough suppressent & pain relief

Within 12 years, dangers realized

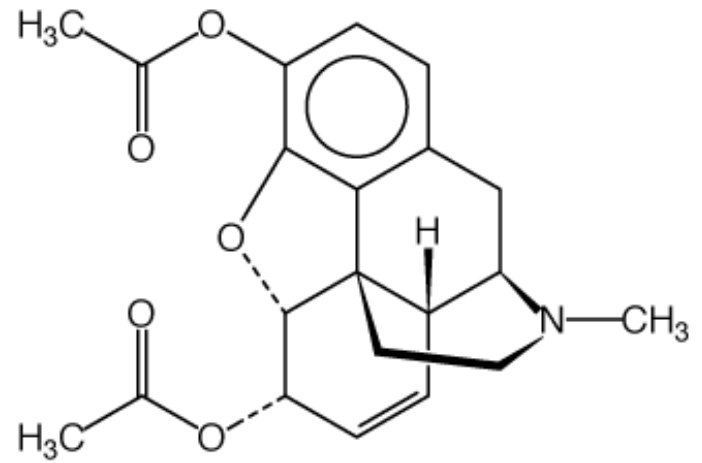
Medical use in 30 countries

Body converts to morphine

Structures



Morphine



Heroin

Chemicals in war

Definition

History

Ethics

Chemicals

Chemicals in war

Definition

What is a Chemical Weapon Agent?

Substances having direct toxic effects on humans, animals and plants

Chemicals in war

Definition

What is a Chemical Weapon Agent?

Physical Forms of Chemical Agents

- Solid
- Liquid
- Gas
- Vapor
- Aerosol



Chemicals in war

History

Used since ancient times

AD 600: Greek fire

burning sulfur & pitch

Chemicals in war

History



Used since ancient times

**1812: British navy
admiral proposed
loading ships with
burning sulfur**

Chemicals in war

History

Modern warfare

WW I - chlorine gas

Phosgene and mustard gas

90,000 killed

Gas masks

Chemicals in war

History

Between WW I & WW II

After WW I eliminate C W

Geneva Protocol: 1925

Chemicals in war

History

World War II

Expectations high
chemicals would be used

Not used by any country

Chemicals in war

History

WW II - CW never used

Sarin found in Germany

Chemicals in war

History

Since WW II > 200 wars

CW used

Ethiopia, China,

Yemen, Iraq,

Afghanistan

Chemicals in war

Ethics

Proponents

Opponents

Chemicals in war

Ethics Proponents

1. Deterrent
2. Inanimate objects
3. Effective in many situations
4. Cumbersome protection
5. Containment
6. Injuries

Chemicals in war

Ethics Opponents

- 1. Insidious nature**
- 2. Ineffective if protected**
- 3. Weather**
- 4. Inexpensive**
- 5. Manufacture, storage, transport, disposal**

Chemicals in war

Chemicals

5 types

Nerve agents

VX, sarin

Blister agents

Mustard gas

Choking agents

Phosgene, Cl

Blood agents

HCN

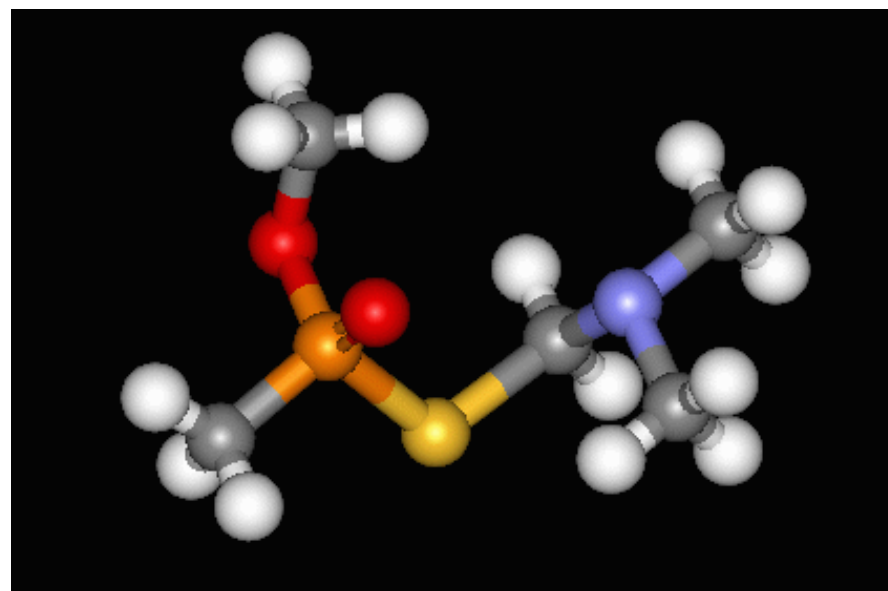
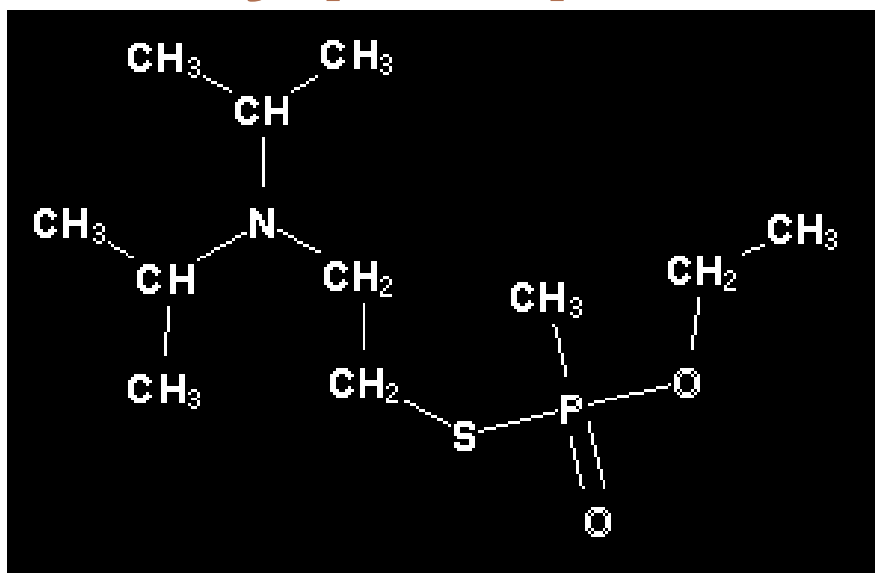
Riot control

Chemicals in war

Chemicals

VX

(O-ethyl S-(2-diisopropylaminoethyl)-methylphosphonothioate)

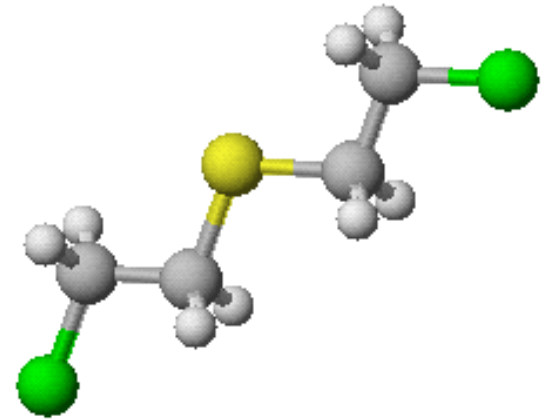
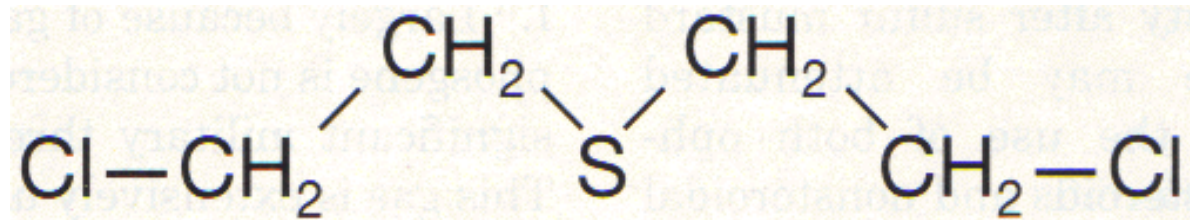


Chemicals in war

Chemicals

Mustard gas

(bis- (2-chloroethyl) sulfide)



Chemicals in war

Chemicals

Phosgene COCl_2

