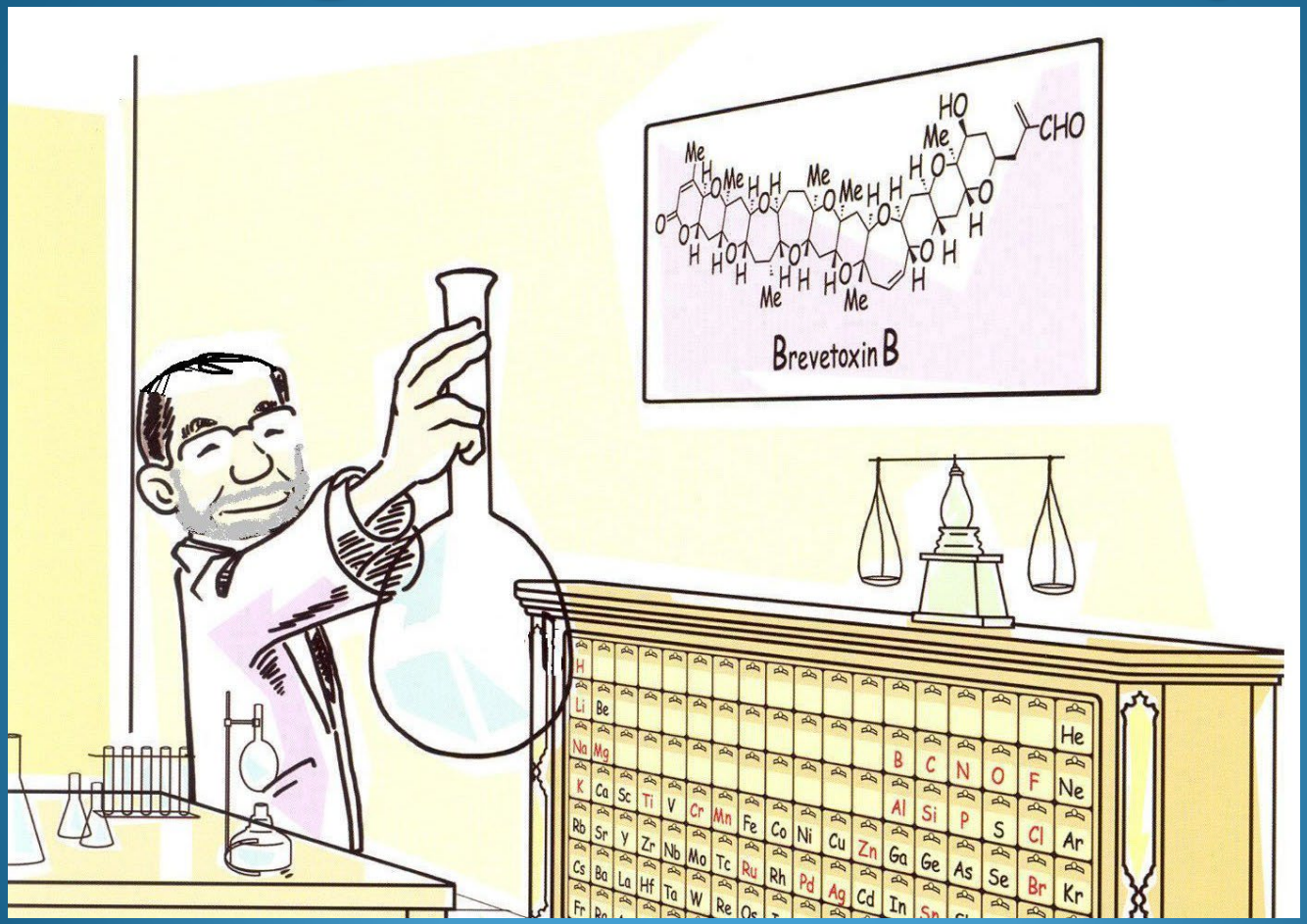
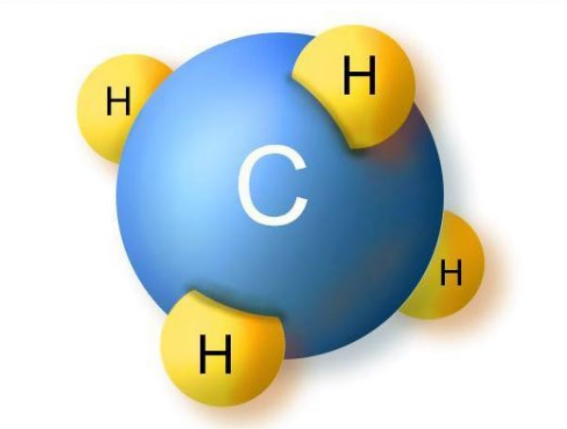
Organic Chemistry

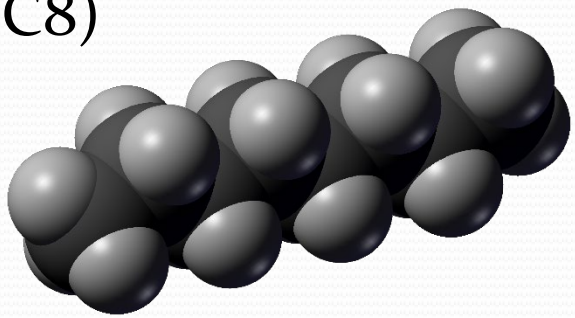


hydrocarbons

- The simplest hydrocarbon is methane (also known as natural gas)
- Hydrocarbons are the main components of fossil fuels
  - Used to heat our homes
  - Produces greenhouse gas when combusted

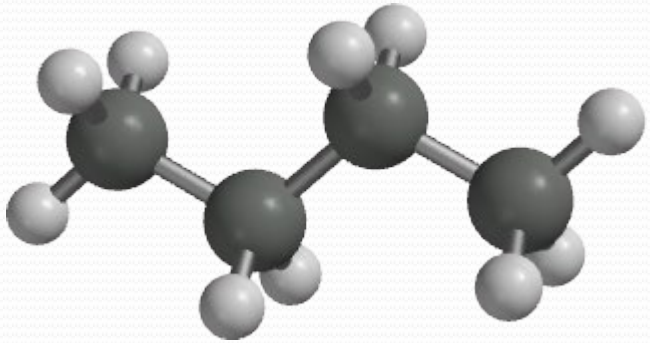


Main component of gasoline is octane (C8)

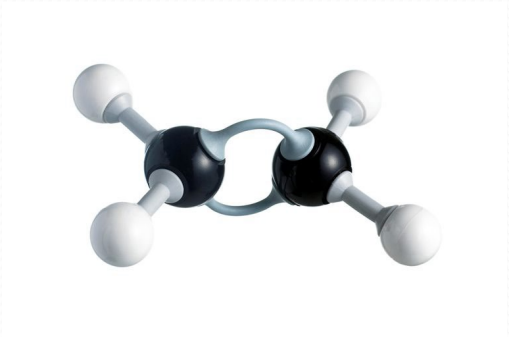


Simple organic molecules:

- Butane is used as a fuel in BBQ lighters



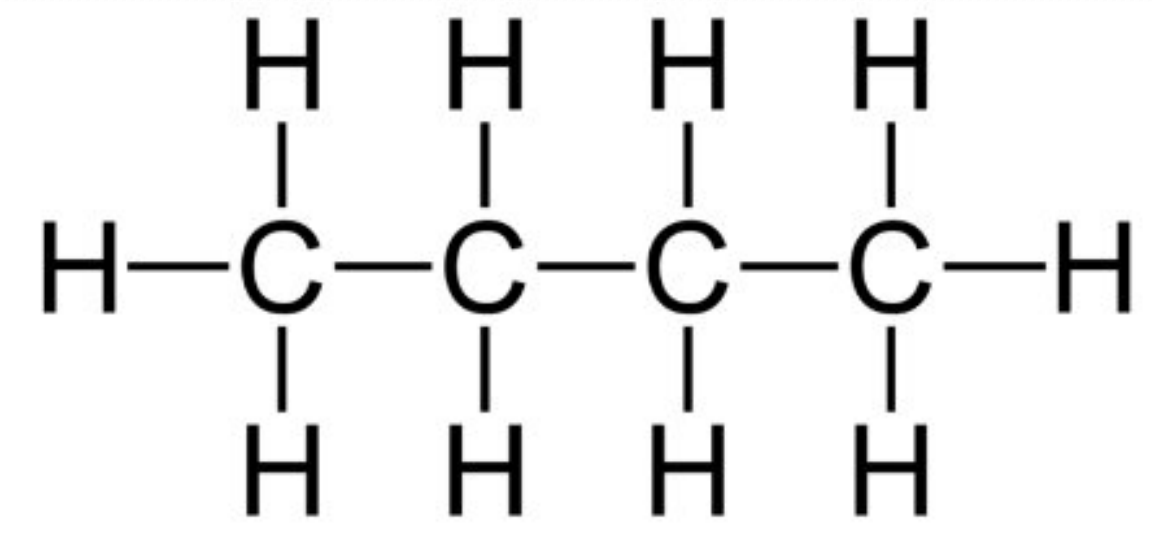
- Ethene is the starting component used to produce polyethylene (plastic bags)



- Ethyne is the starting component for polyvinyl chloride (PVC), which is used to make rain gear

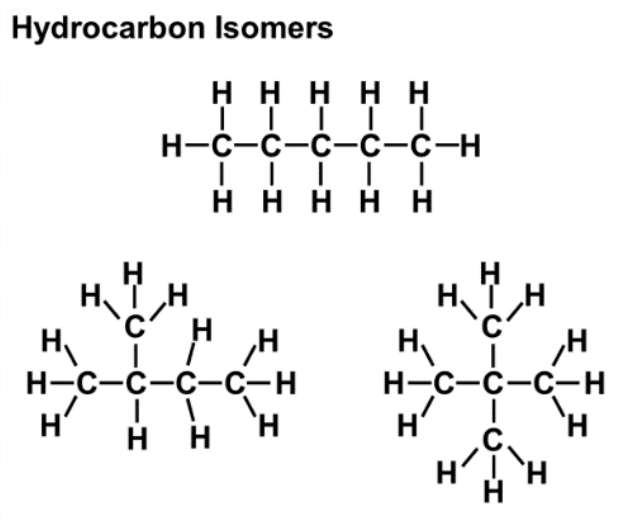
Organic Compounds

- Substances are most likely organic if they contain carbon bonded to itself or hydrogen



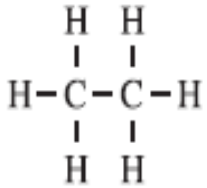
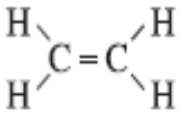
Drawing

- Structural diagram show a bond as a line
- In a structural diagram double bonds are shown with a double line and triple bonds with a triple line



Alkanes Alkenes Alkynes

- Single-bonded carbons in yield groups known as **alkanes.**
- Double-bonded carbons in yield groups known as **alkenes.**
- Triple-bonded carbons in yield groups known as **alkynes.**

General Formula	Classification	Example Formula	Example Name
$C_nH_{(2n+2)}$	alkane		ethane
$C_nH_{(2n)}$	alkene		ethene
$C_nH_{(2n-2)}$	alkyne		ethyne

Alkanes

- All alkanes follow the general formula, C_nH_{2n+2}

1 carbon	Meth+ane	
2 carbons	Eth+ane	
3 carbons	Prop+ane	
4 carbons	But+ane	
5 carbons	Pent+ane	
6 carbons	Hex+ane	
7 carbons	Hept+ane	
8 carbons	Oct+ane	
9 carbons	Non+ane	
10 carbons	Dec+ane	

Data Booklet Page 9

Homologous Series of Alkanes at 25°C and 101.325 kPa

Name*	Formula	Name*	Formula
*meth*ane	$CH_4(g)$	*hex*ane	$C_6H_{14}(l)$
*eth*ane	$C_2H_6(g)$	*hept*ane	$C_7H_{16}(l)$
*prop*ane	$C_3H_8(g)$	*oct*ane	$C_8H_{18}(l)$
*but*ane	$C_4H_{10}(g)$	*non*ane	$C_9H_{20}(l)$
*pent*ane	$C_5H_{12}(l)$	*dec*ane	$C_{10}H_{22}(l)$

Different Ways to Depict Organic Compounds

Molecular Formula

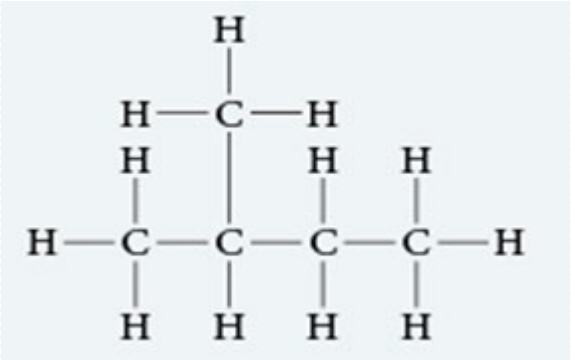
C_5H_{12}

Expanded Molecular Formula

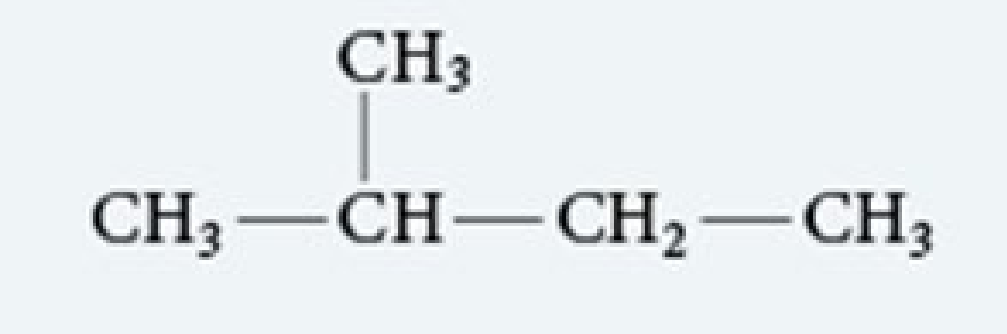
$CH_3CH(CH_3)CH_2CH_3$

Different Ways to Depict Organic Compounds

Structural Formula

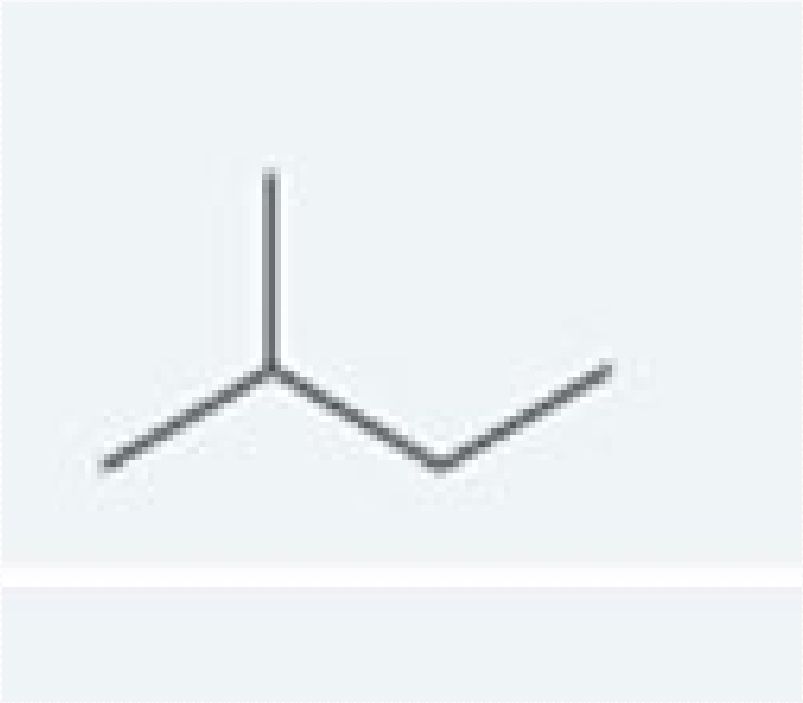


Condensed Structural Formula



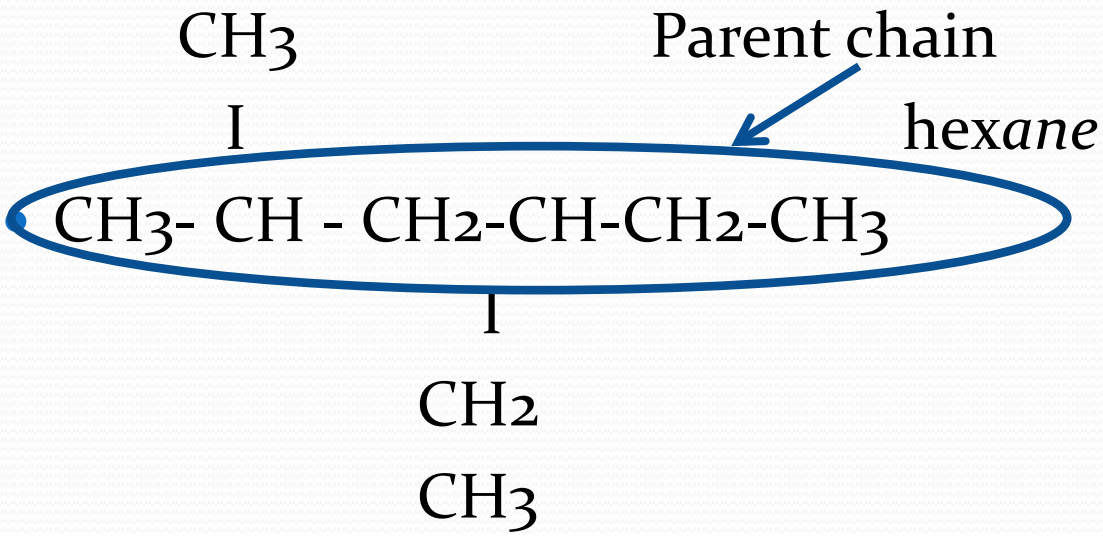
Different Ways to Depict Organic Compounds

Line Formula

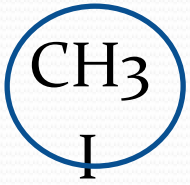


Naming Branched Alkanes

- Step 1: find the longest chain (circle it)
  - This is known as the parent chain

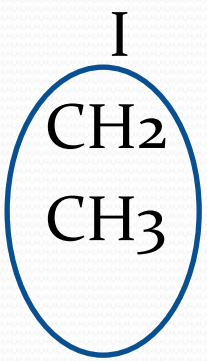


- Step 2: Find all of the branches (circle them)
  - Each branch ends with –yl



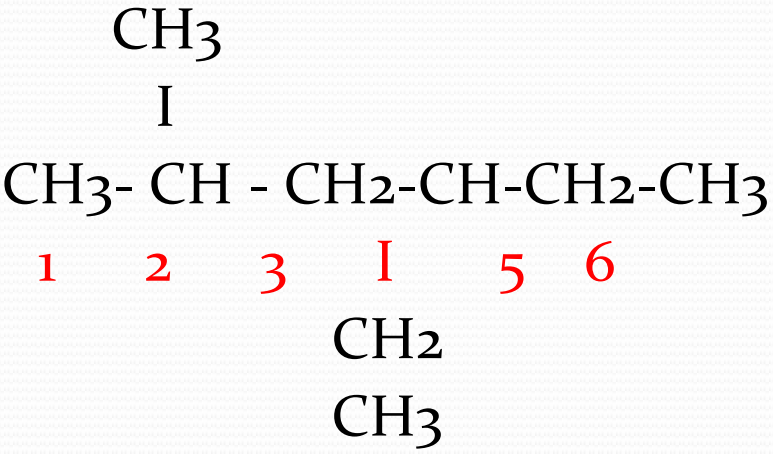
methyl

  - CH_3- CH - CH_2-CH-CH_2-CH_3



ethyl

- Step 3: to communicate where each branch is on the parent chain, number the carbons on the parent chain starting at the end with the closest branch.



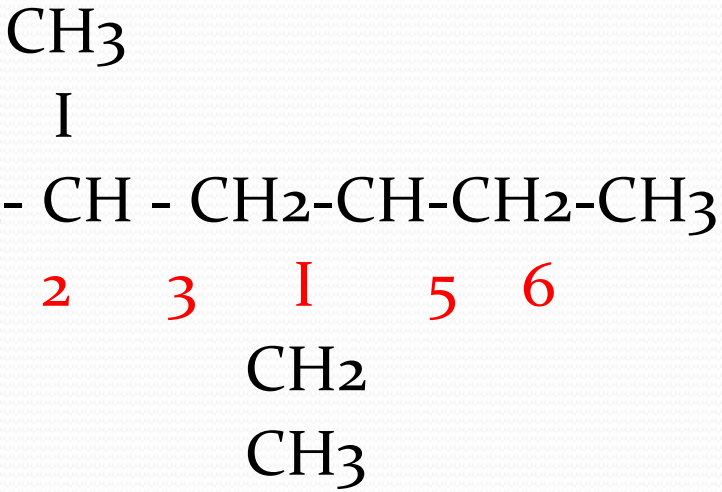
Communicating Branches

Step 4: Naming of the alkyl groups is done alphabetically.

- Commas are used to separate numbers.
- Hyphens are used to separate numbers from words or word fragments eg: 2-methylpropane
- Di and tri prefixes are used when more than one of the same alkyl group is present
- *If two groups would have the same numbering, the smaller number goes to the branch which is lower alphabetically (see example 2)

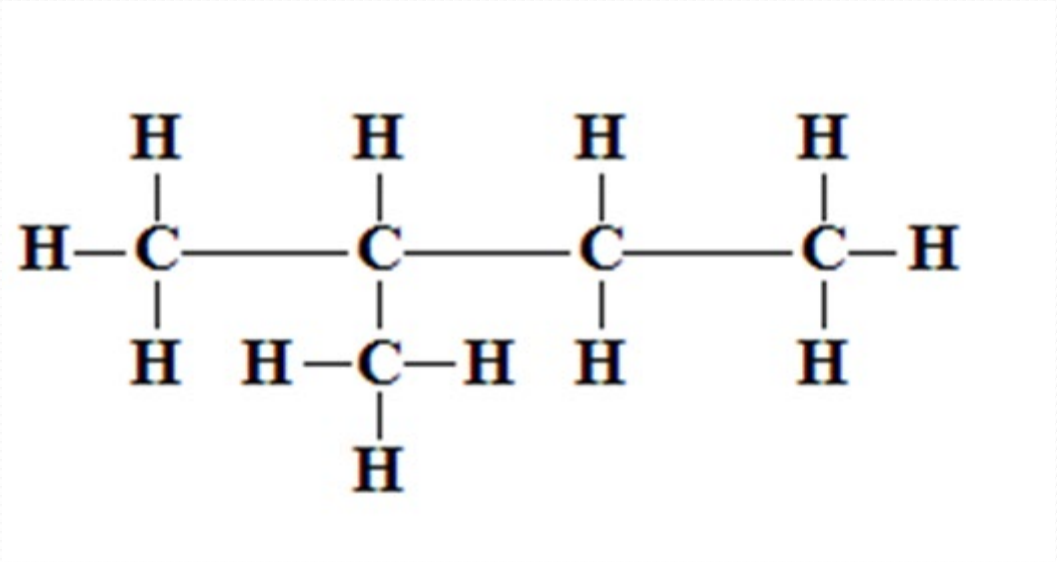
- Step 5: put the name together (in alphabetical order) and ending with the parent chain

4-ethyl-2-methylhexane

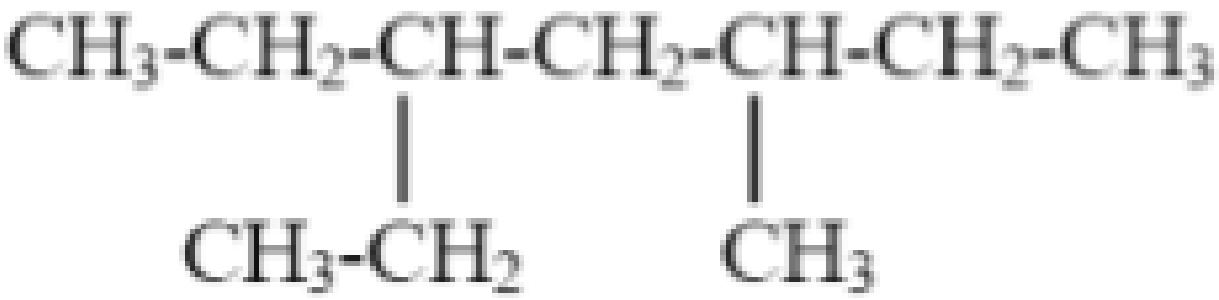


Example

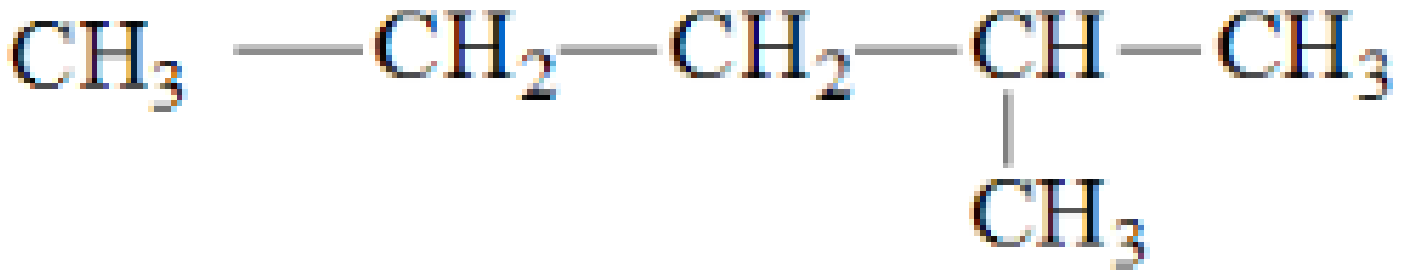
- Draw this compound using line structure
- Name this compound



Example

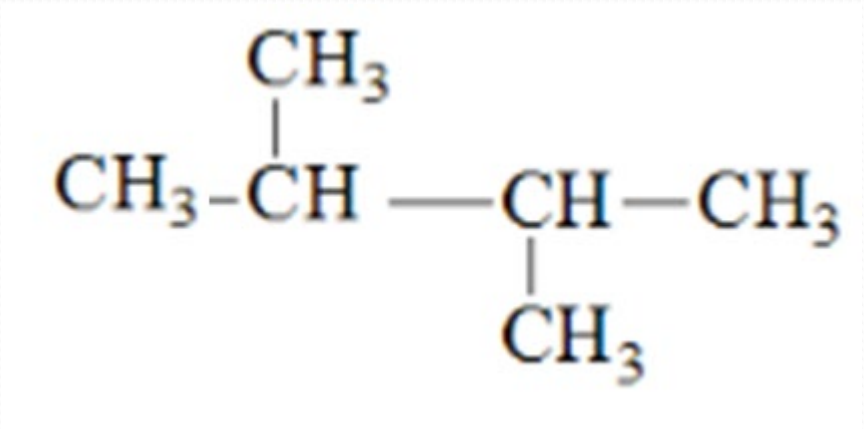


Board Question



2- Methyl pentane

Board Question



2,3 – dimethyl butane

Saturated and Unsaturated Hydrocarbon

- **Saturated hydrocarbon** - compounds of carbon and hydrogen containing only carbon-carbon single bonds with a maximum number of hydrogen atoms bound to each carbon (**alkanes**)
- **Unsaturated hydrocarbon** - compounds of carbon and hydrogen containing carbon-carbon double and/or triple bonds (**alkenes and alkynes**)
- Unsaturated hydrocarbons are important in the petrochemical industry because they are the starting molecules for the manufacture of many derivatives, including plastic.

Debbie Meyer Green Bags

- "How DEBBIE MEYER™ Green Bags® Work Fruits, vegetables and flowers release ~~ethylene~~ (we call this ETHENE) gas while ripening after harvesting or picking
- Ethylene gas accelerates ripening, aging and rotting
- DEBBIE MEYER™ Green Bags® absorb and remove this damaging gas, dramatically extending the life of fruits, vegetables and flowers."

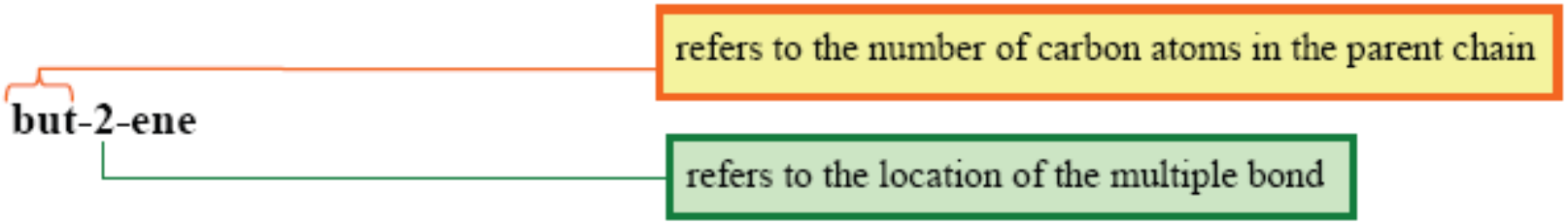
End of day 1 - Alkanes

Alkenes

- Alkenes have the general formula, $\mathbf{C_nH_{2n}}$
- Alkenes can be identified by the presence of at least one double bond found between carbon atoms.
- The first member of the alkene family cannot be a one-carbon structure since at least one double bond must exist between two carbons.
- What is the simplest alkene? Ethene

Naming Rules

- Establish the longest continuous chain including the double bond.
- Carbon #1 is the one closest to the double bond.
- The parent name ends with “ene” and has a number added directly before it to indicate after which carbon the double bond follows.
- Branches are named just as we did with alkanes.
- *When alkyl group can be list on two or 3 always use the smaller number



Different ways to express alkenes

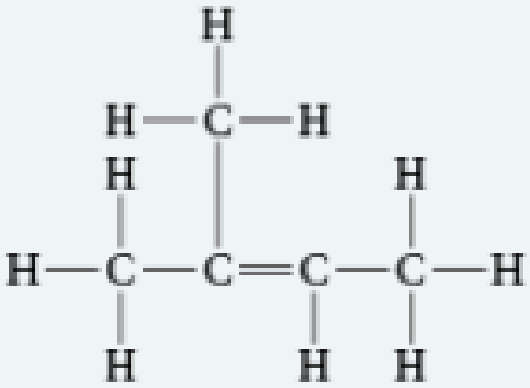
Empirical molecular formula

C_5H_{10}

Expanded molecular formula

$CH_3C(CH_3)CHCH_3$

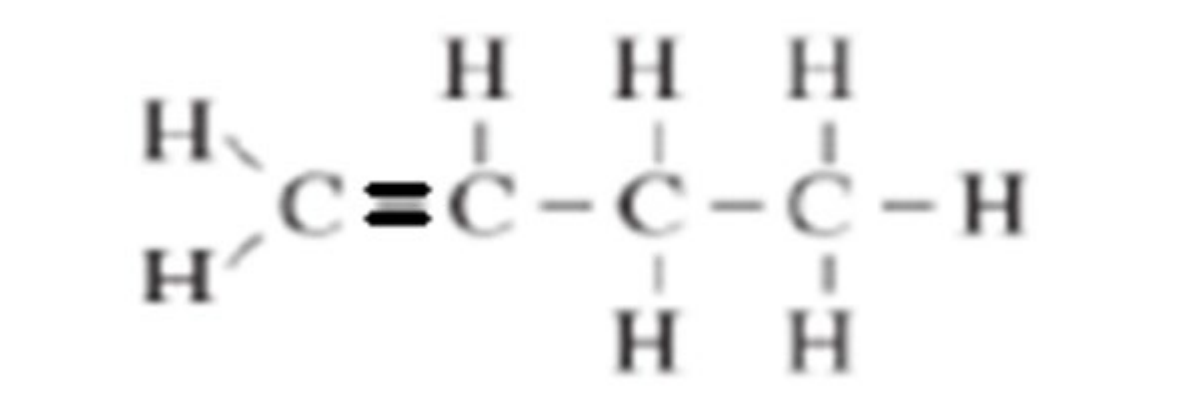
Structural formula



Condensed structural formula

Line structural formula

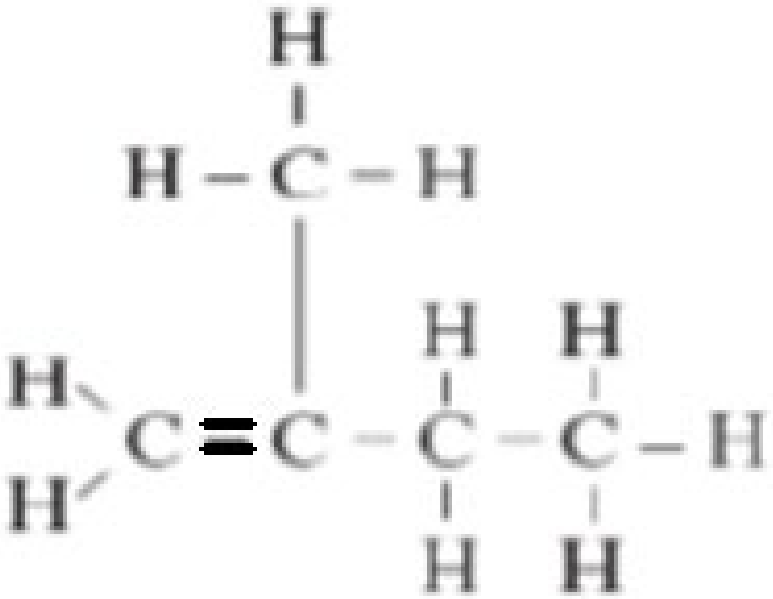
Board Question



Board Question

$$CH_3CHCHCH_3$$

Board Question



$CH_2C(CH_3)CH_2CH_3$

Board Question

Board Question

Draw a structural formula for 2-methylbut-2-ene.

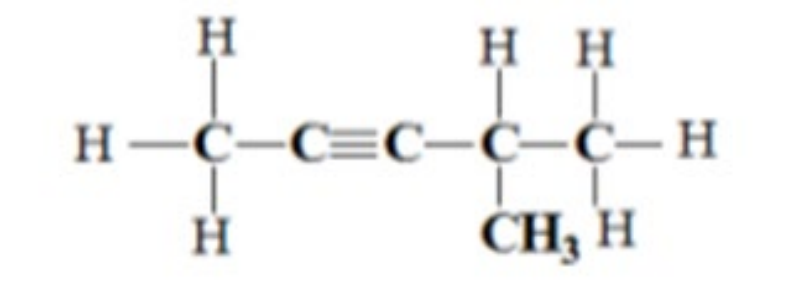
Alkynes

- Alkynes have the general formula, C_nH_{2n-2}
- Alkynes can be identified by the presence of at least one triple bond found between carbon atoms.
- We apply the same rules for alkynes as we did for alkenes.
- The simplest alkyne is Ethyne.

Alkyne naming rules:

- The same naming rules as alkenes with the exception that the ending will **contain -yne.**
- The numbering begins at the end **closest to the triple bond.**

- Alkyne examples:



Examples

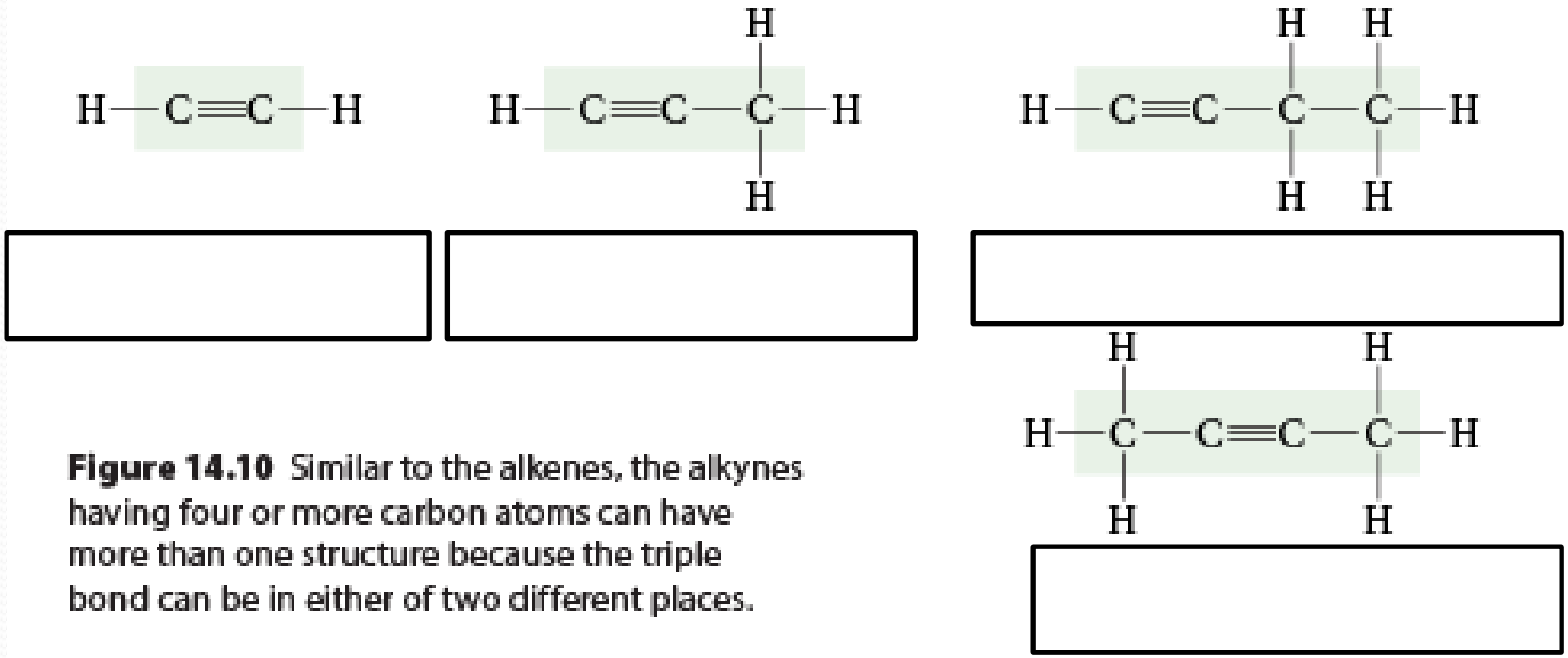
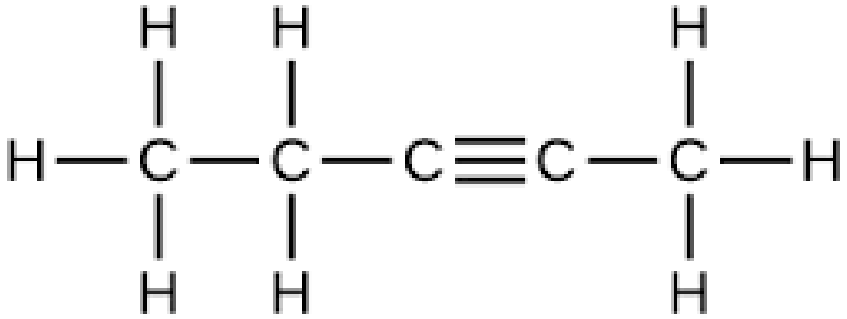


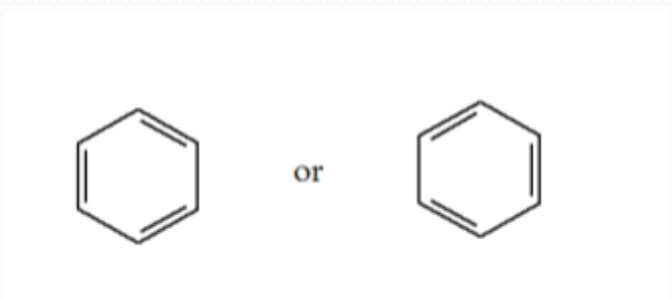
Figure 14.10 Similar to the alkenes, the alkynes having four or more carbon atoms can have more than one structure because the triple bond can be in either of two different places.

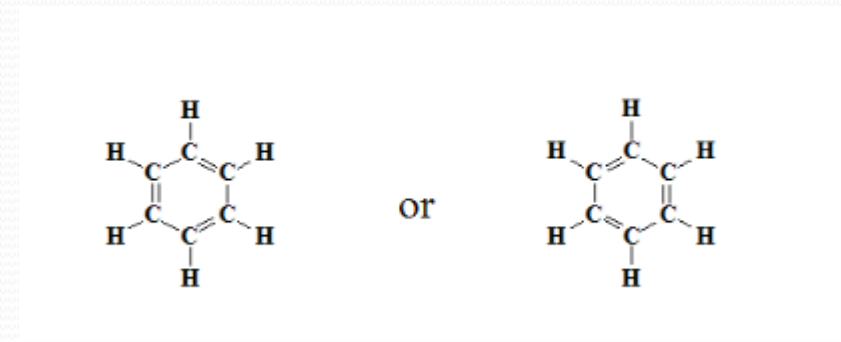
example



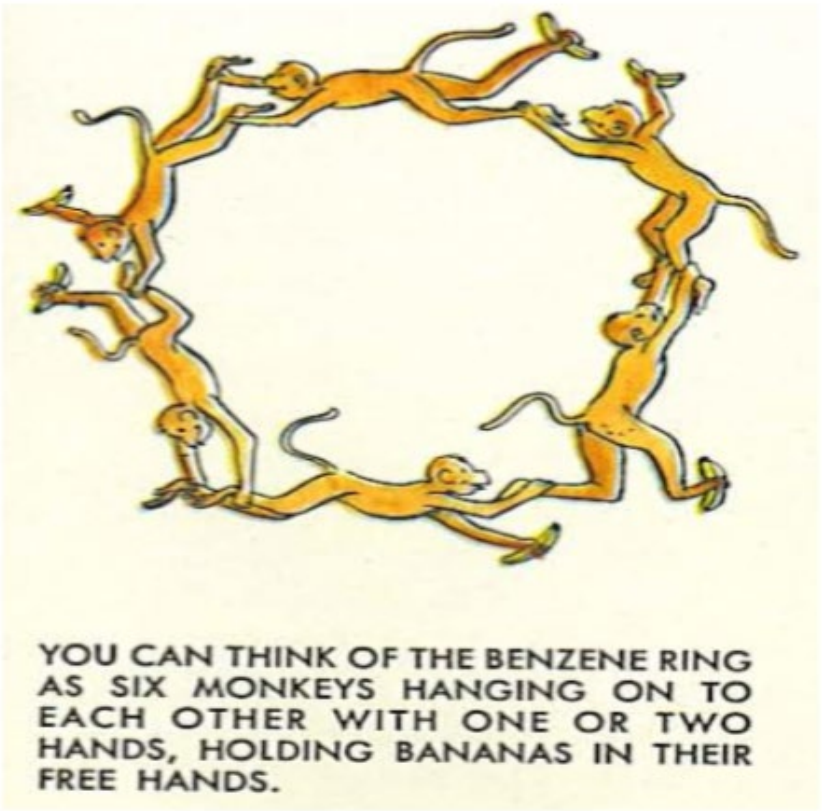
Aromatics

- Aromatics are a classification of organic compounds that are derived from the parent organic compound called **benzene**, $\mathbf{C_6H_{6(l)}}$
- Benzene is a cyclic compound where six carbons are arranged in a ring structure.
- The first classical vision of what benzene was supposed to look like is below:



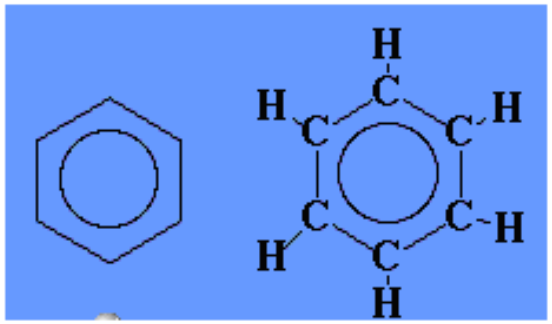


Benzene

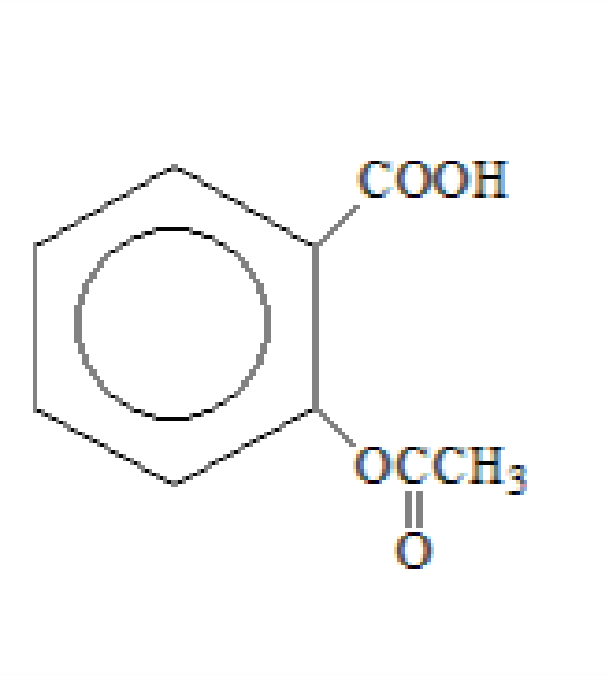

YOU CAN THINK OF THE BENZENE RING AS SIX MONKEYS HANGING ON TO EACH OTHER WITH ONE OR TWO HANDS, HOLDING BANANAS IN THEIR FREE HANDS.

Modern Day Evidence

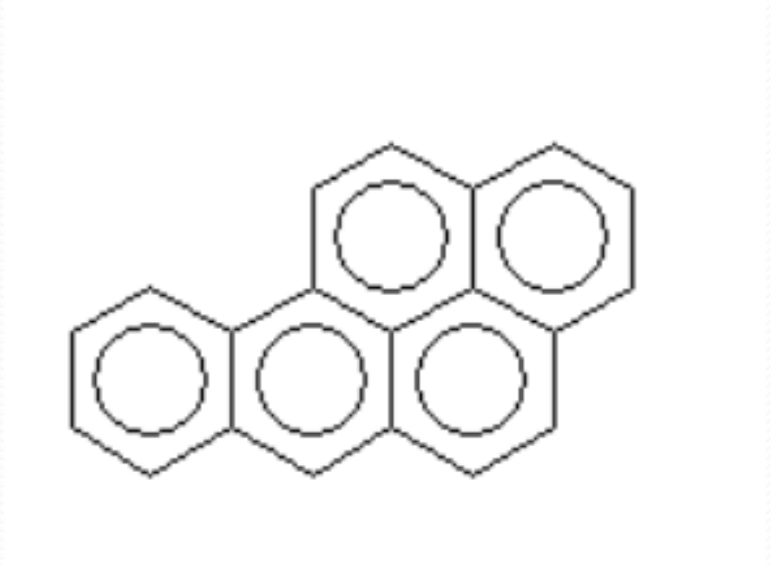
- Modern day evidence suggests that single and double bonds do not exist in benzene
- Electrons are evenly distributed and shared among the carbons
- It is a hybrid, or resonance structure, of the diagrams above.
- For this reason a new conventional diagram is used for benzene.



Examples of Benzene Rings



aspirin

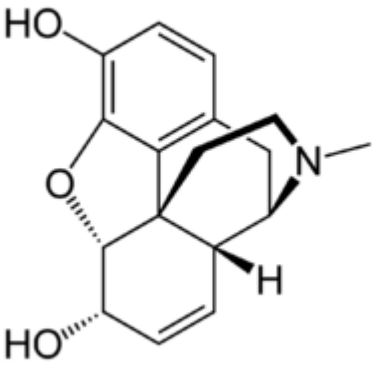


carcinogen found in cigarette smoke

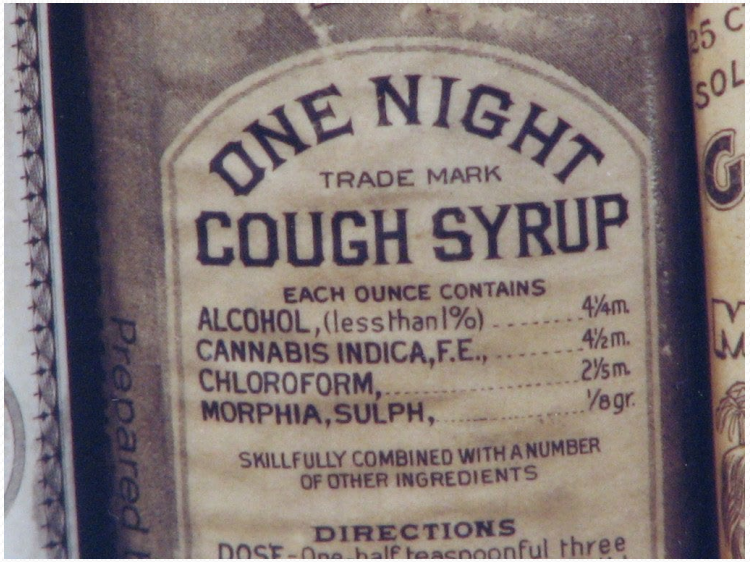
Opium Poppies

- These produce the poppy seeds we eat
- They can also produce a variety of narcotics
- 93% of the poppy plants grown for opium are in Afghanistan

Morphine

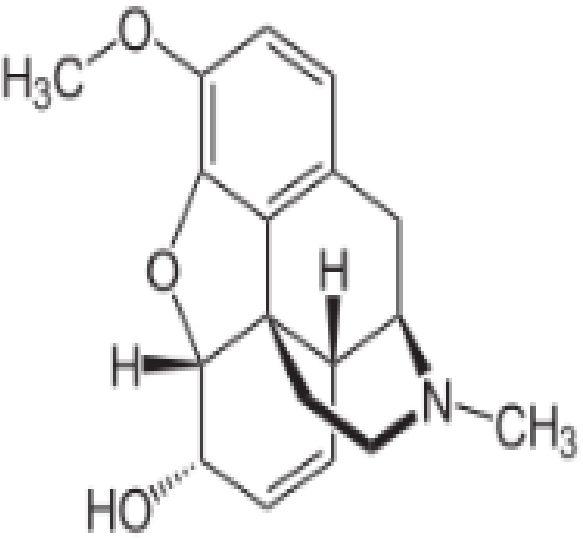


- Is a pain medication derived from the opium poppy
- It acts directly on the central nervous system to decrease the feeling of pain
- Can be administered orally, intramuscularly, intravenously, or everyone's favorite, rectally

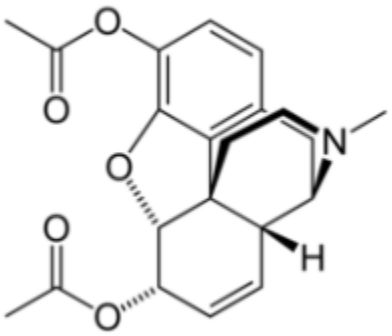


Codeine

- Another opiate used to treat pain and commonly found in medical grade cough syrup



Heroin



- Was originally developed as a non addictive form of morphine
- Heroin turned out to be much more addictive than morphine
- When people overdose on heroin it is usually due to lack of oxygen because it causes people to stop breathing
- People also die from heroin due to choking on vomit in their sleep