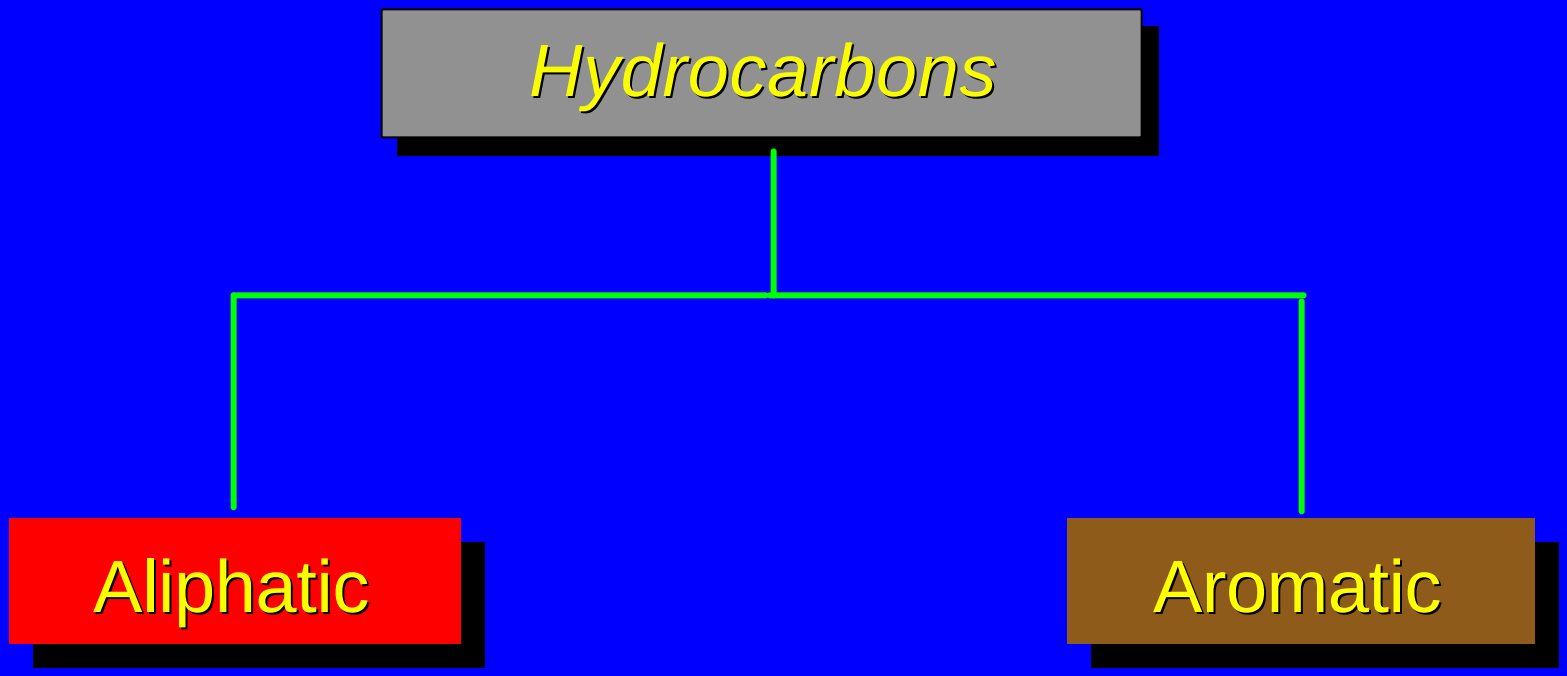
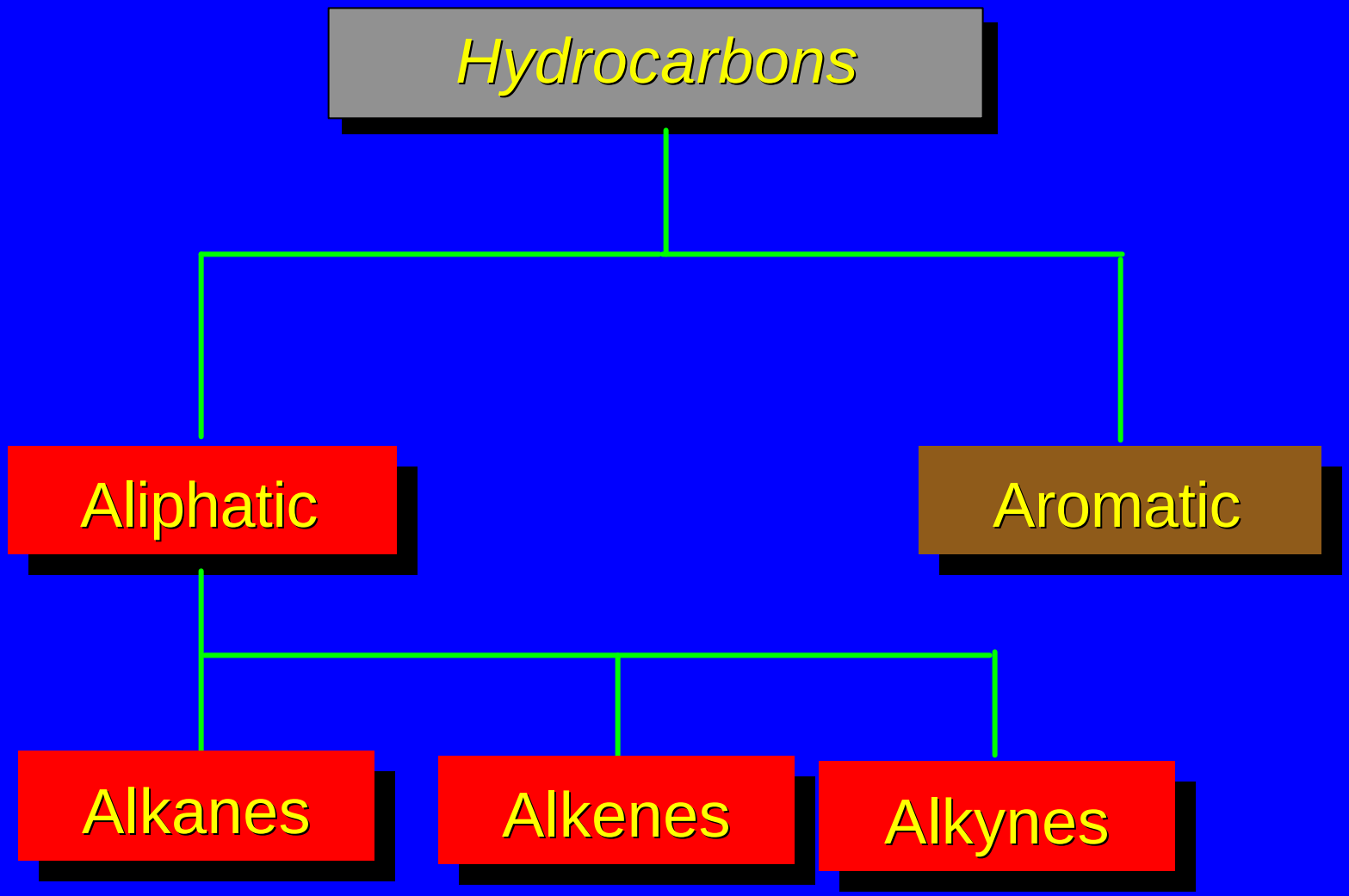
Chapter 2
Alkanes

2.1
Classes of Hydrocarbons


Hydrocarbons
Aliphatic
Aromatic

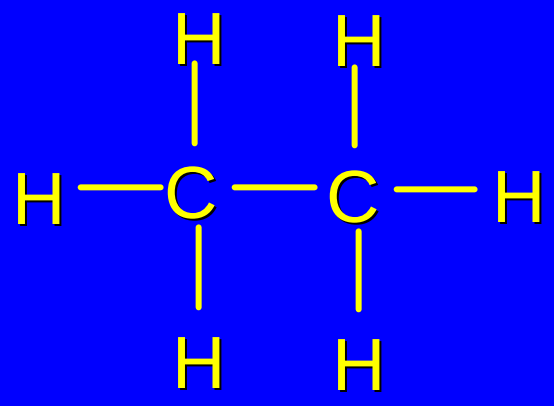

Hydrocarbons
Aliphatic
Aromatic
Alkanes
Alkenes
Alkynes

Hydrocarbons

Aliphatic

Alkanes

Alkanes are hydrocarbons in which all of the bonds are *single* bonds.

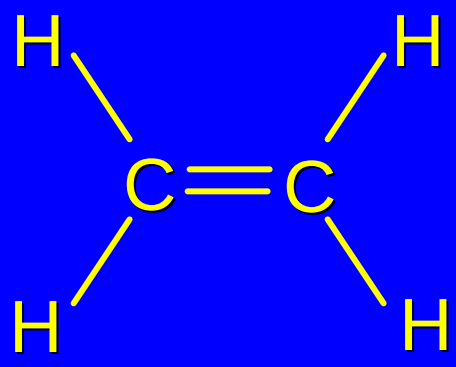


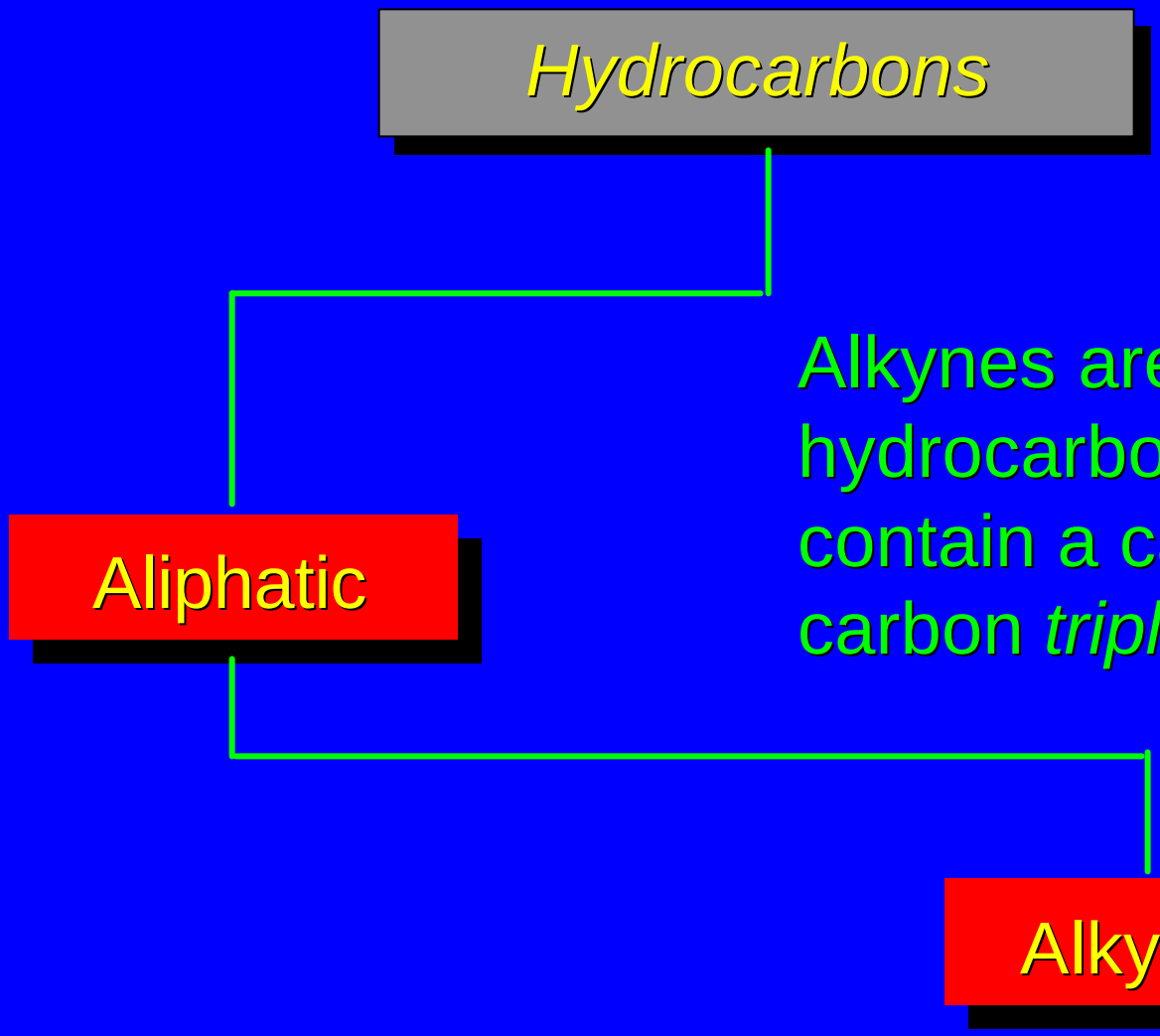
Hydrocarbons

Aliphatic

Alkenes

Alkenes are hydrocarbons that contain a carbon-carbon *double* bond.





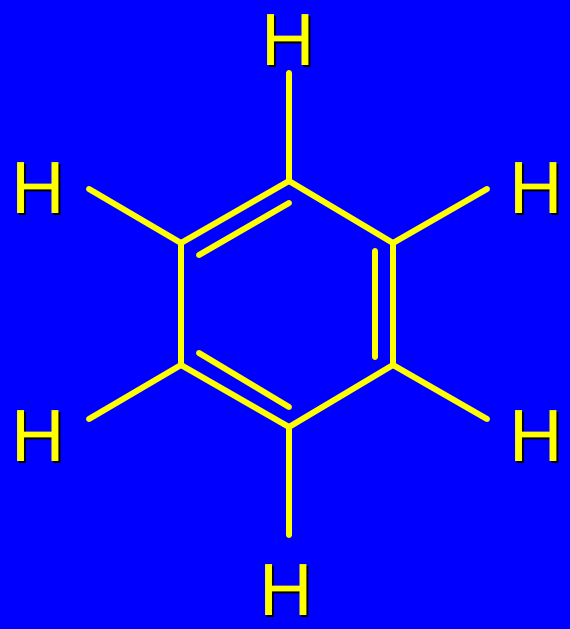
Alkynes are hydrocarbons that contain a carbon-carbon *triple* bond.

$HC \equiv CH$

Hydrocarbons

Aromatic

The most common aromatic hydrocarbons are those that contain a benzene ring.



2.2
Reactive Sites in Hydrocarbons

Functional Group

a structural unit in a molecule responsible for its characteristic behavior under a particular set of reaction conditions

Alkanes

functional group is a hydrogen

reaction that takes place is substitution

__one of the hydrogens is replaced
by some other atom or group

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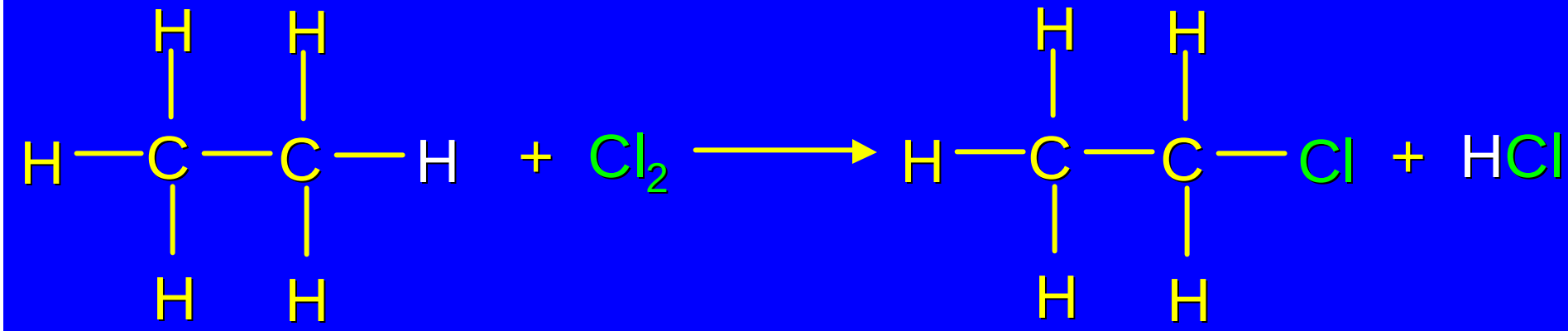


Functional Groups in Hydrocarbons

alkanes	RH
alkenes	double bond
alkynes	triple bond
arenes	ArH

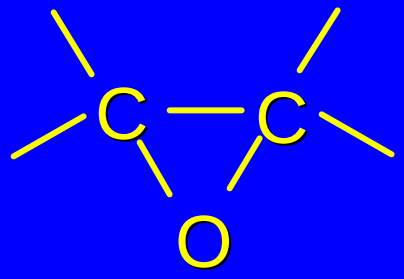
2.3
The Key Functional Groups

Families of organic compounds and their functional groups

Alcohols	ROH
Alkyl halides	RX (X = F, Cl, Br, I)
Amines	primary amine: RNH_2
	secondary amine: R_2NH
	tertiary amine: R_3N

Families of organic compounds and their functional groups

Epoxides



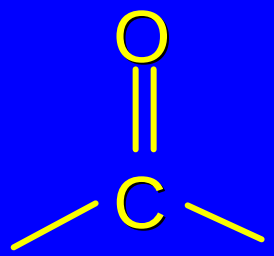
Ethers ROR'

Nitriles $RC{\equiv}N$

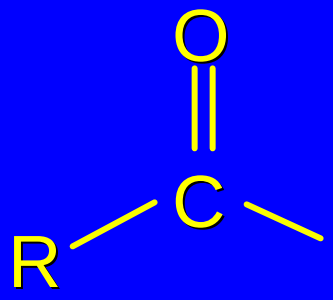
Nitroalkanes RNO_2

Thiols RSH

Many classes of organic compounds contain a carbonyl group

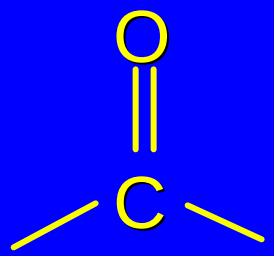


Carbonyl group

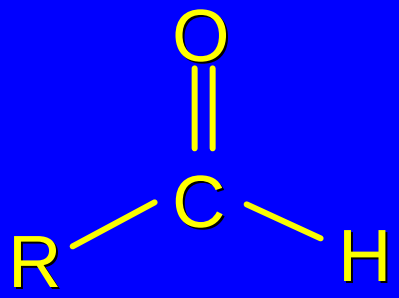


Acyl group

Many classes of organic compounds contain a carbonyl group

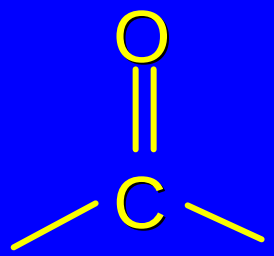


Carbonyl group

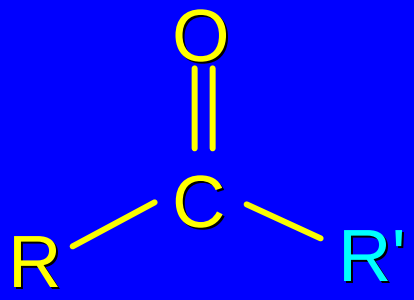


Aldehyde

Many classes of organic compounds contain a carbonyl group

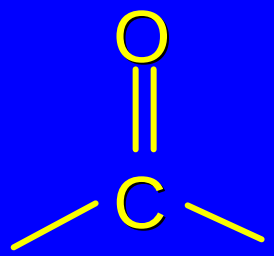


Carbonyl group

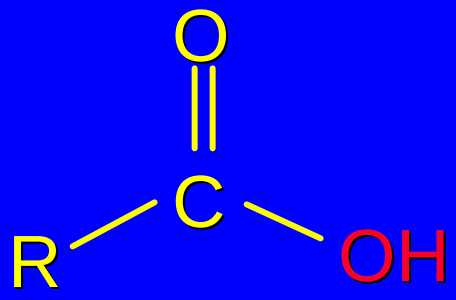


Ketone

Many classes of organic compounds contain a carbonyl group

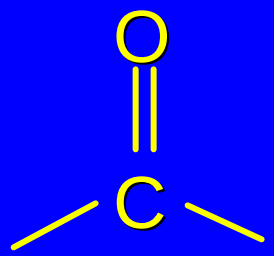


Carbonyl group

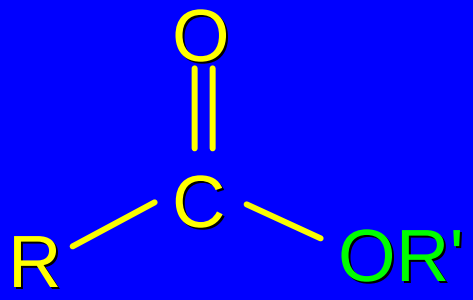


Carboxylic acid

Many classes of organic compounds contain a carbonyl group

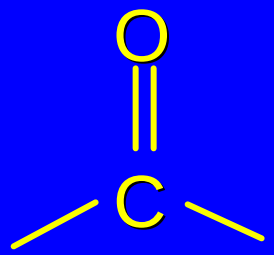


Carbonyl group

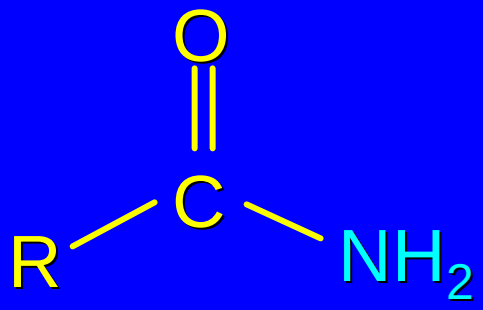


Ester

Many classes of organic compounds contain a carbonyl group



Carbonyl group



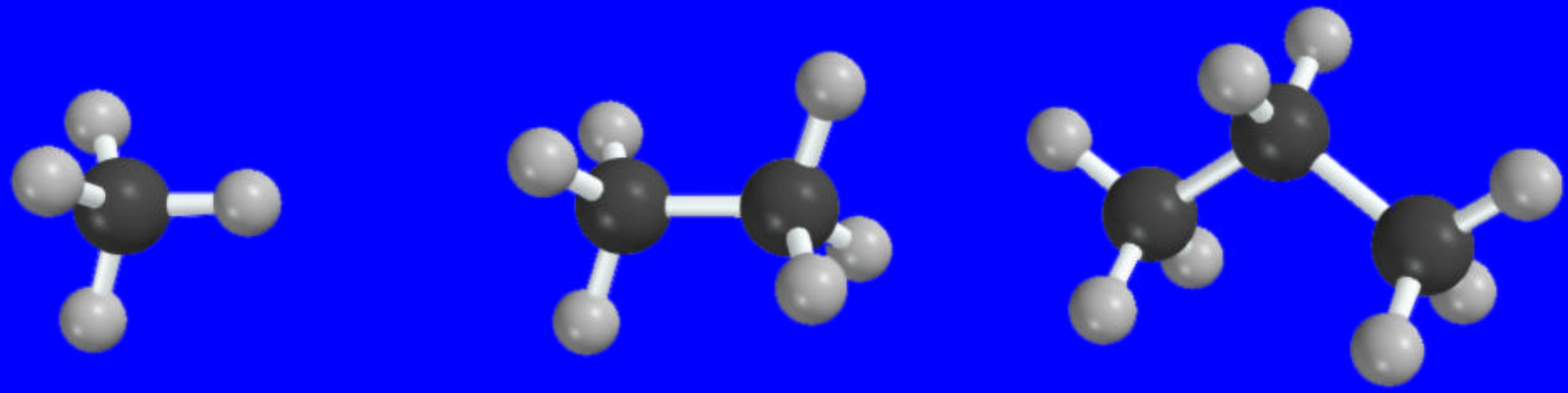
Amide

C_nH_{2n+2}

2.4
Introduction to Alkanes: Methane, Ethane, and Propane

The Simplest Alkanes

Methane (CH_4)	CH_4
Ethane (C_2H_6)	CH_3CH_3
Propane (C_3H_8)	$CH_3CH_2CH_3$



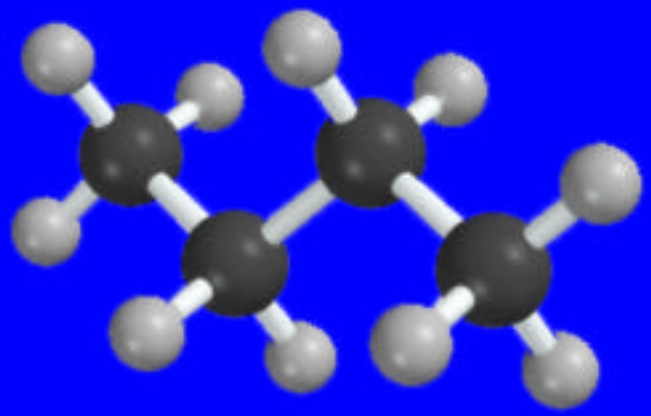
bp -160°C bp -89°C bp -42°C

C_4H_{10}

2.5
Isomeric Alkanes: The Butanes

n-Butane $CH_3CH_2CH_2CH_3$

Isobutane $(CH_3)_3CH$



bp -0.4°C

bp -10.2°C

2.6
Higher n-Alkanes

$CH_3CH_2CH_2CH_2CH_3$

n-Pentane

$CH_3CH_2CH_2CH_2CH_2CH_3$

n-Hexane

$CH_3CH_2CH_2CH_2CH_2CH_2CH_3$

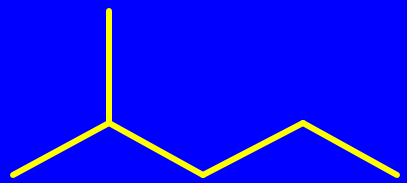
n-Heptane

2.7
The C_5H_{12} Isomers

C_5H_{12}

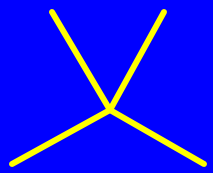
$CH_3CH_2CH_2CH_2CH_3$

n-Pentane



$(CH_3)_2CHCH_2CH_3$

Isopentane



$(CH_3)_4C$

Neopentane

How many isomers?

The number of isomeric alkanes increases as the number of carbons increase.

There is no simple way to predict how many isomers there are for a particular molecular formula.

Table 2.3
Number of Constitutionally Isomeric Alkanes

CH_4	1
C_2H_6	1
C_3H_8	1
C_4H_{10}	2
C_5H_{12}	3
C_6H_{14}	5
C_7H_{16}	9

Table 2.3
Number of Constitutionally Isomeric Alkanes

CH_4	1	C_8H_{18}	18
C_2H_6	1	C_9H_{20}	35
C_3H_8	1	$C_{10}H_{22}$	75
C_4H_{10}	2	$C_{15}H_{32}$	4,347
C_5H_{12}	3	$C_{20}H_{42}$	366,319
C_6H_{14}	5	$C_{40}H_{82}$	62,491,178,805,831
C_7H_{16}	9		