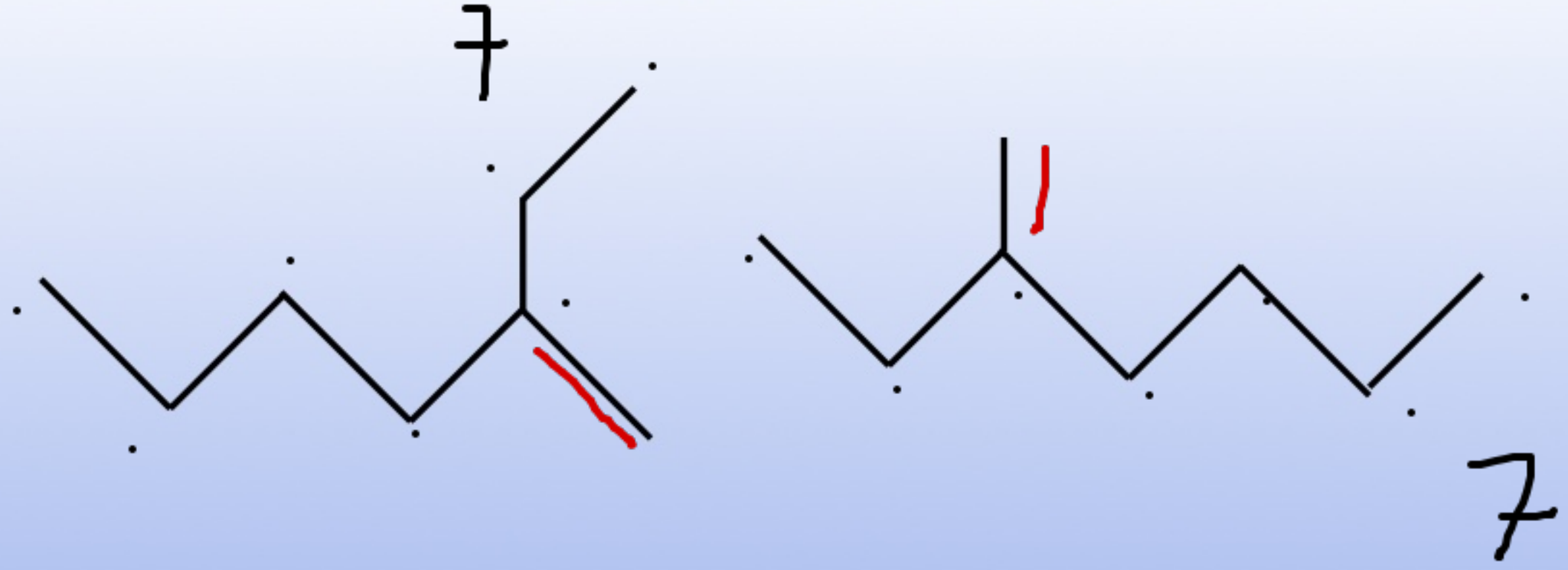
Today

Functional Groups

Reactions

Are these the same molecule?

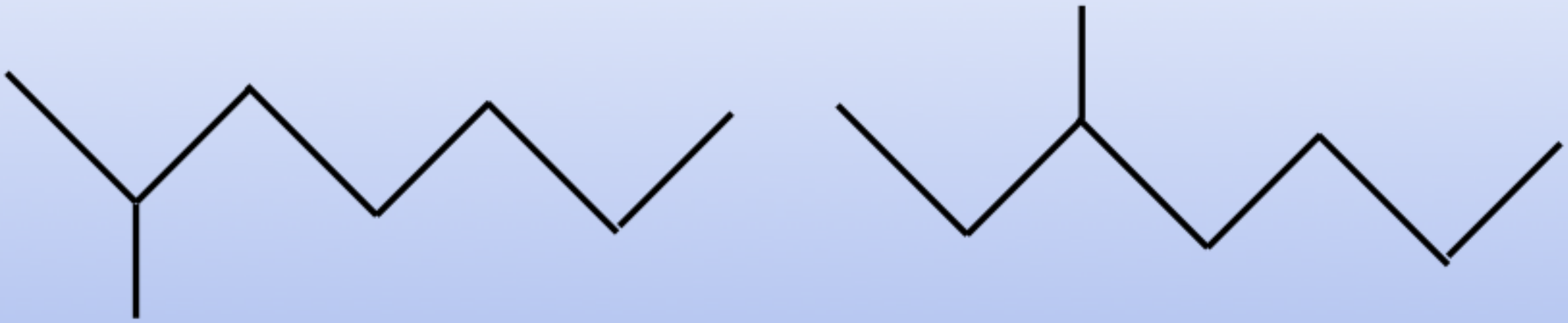


A. Yes
B. No

Sidechain

2C from end

# Are these the same molecule?



A. Yes
B. No

Structural Isomer
(constitutional isomers)

Same atoms and bonds, different bonding pattern

Stereo Isomer
(spatial isomers)

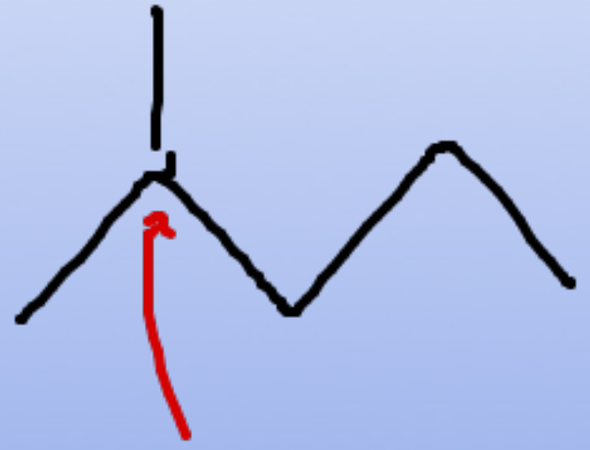
Same bonding pattern, different orientations in space

# Structural isomers

n-hexane



2 methyl pentane

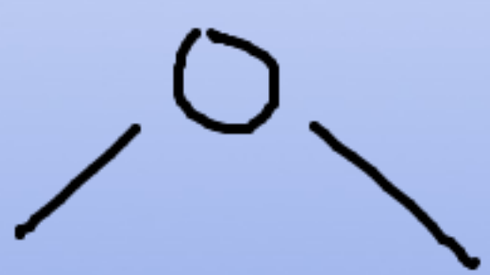


# Structural isomers
# (functional isomers)

ethanol

dimethyl ether

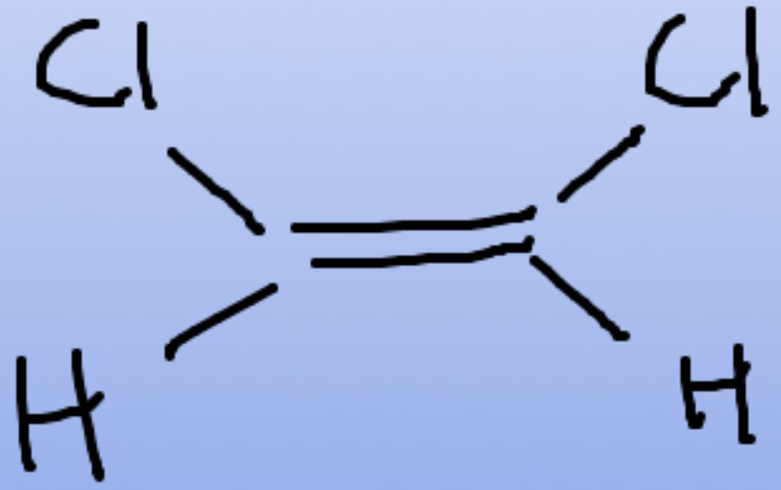
$C_2H_6O$

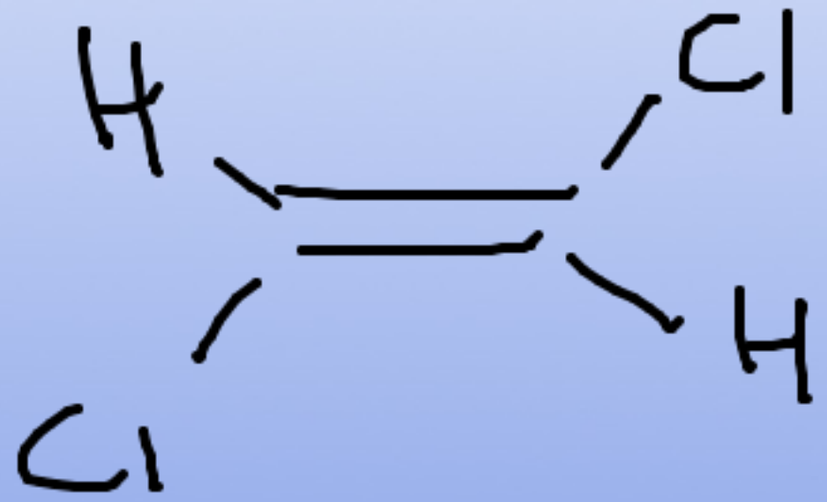
# Stereoisomers

Diastereomer
(can interconvert)

cis dichloro ethene



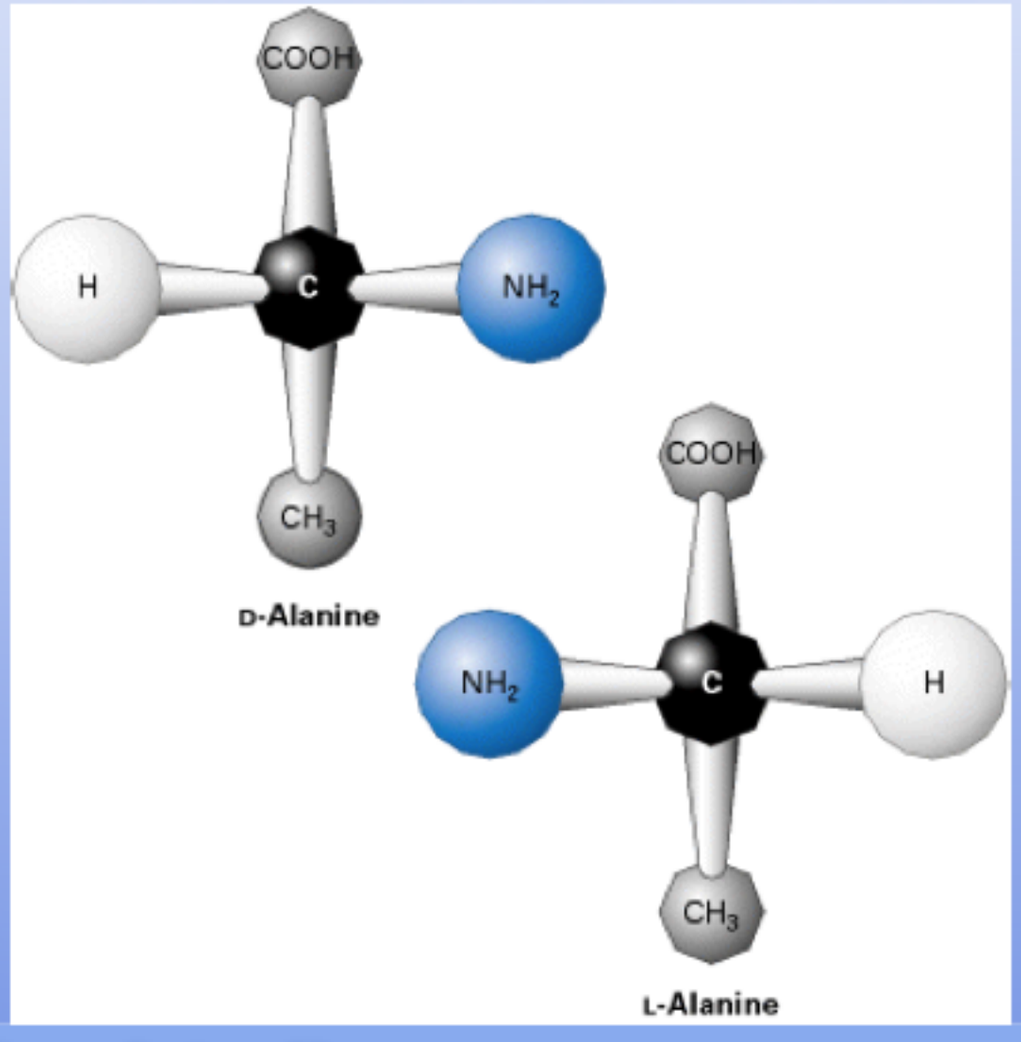

trans dichloroethene



Stereoisomers

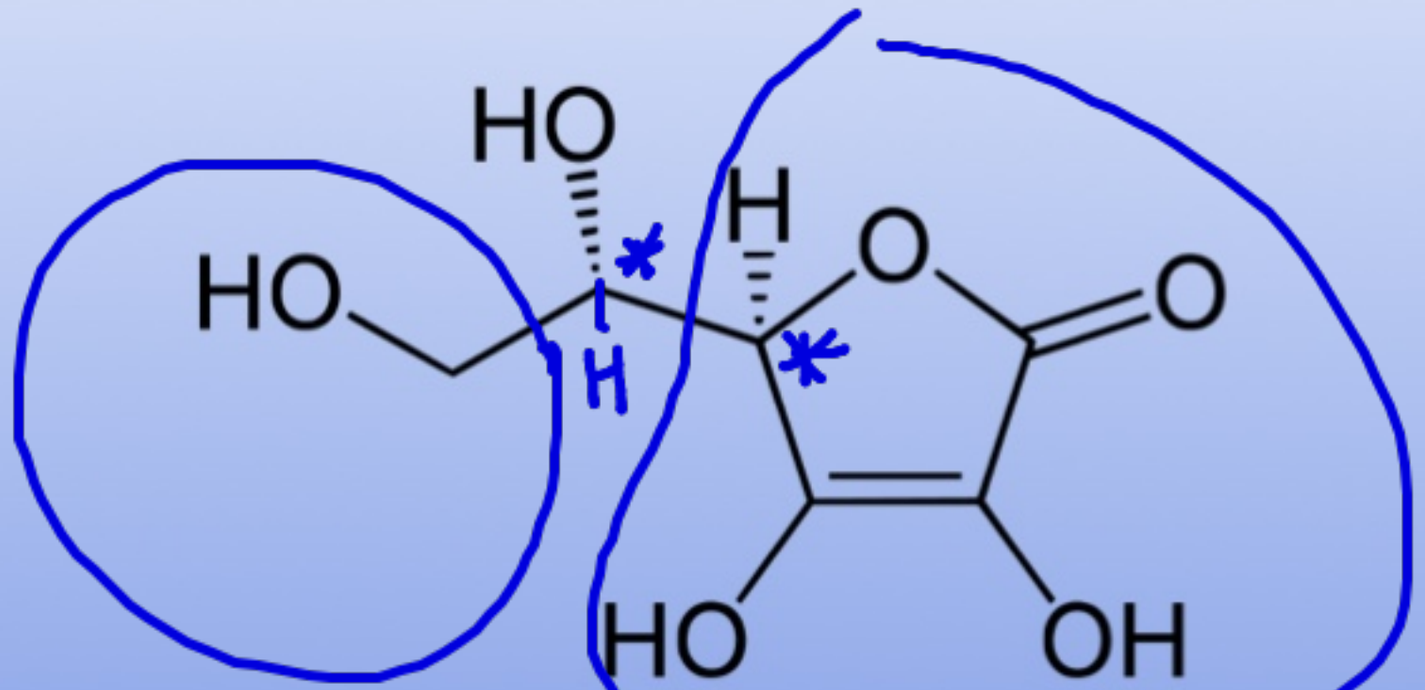
Enantiomers
(chiral molecules)

Molecules cannot be superimposed
(left and right hand versions)



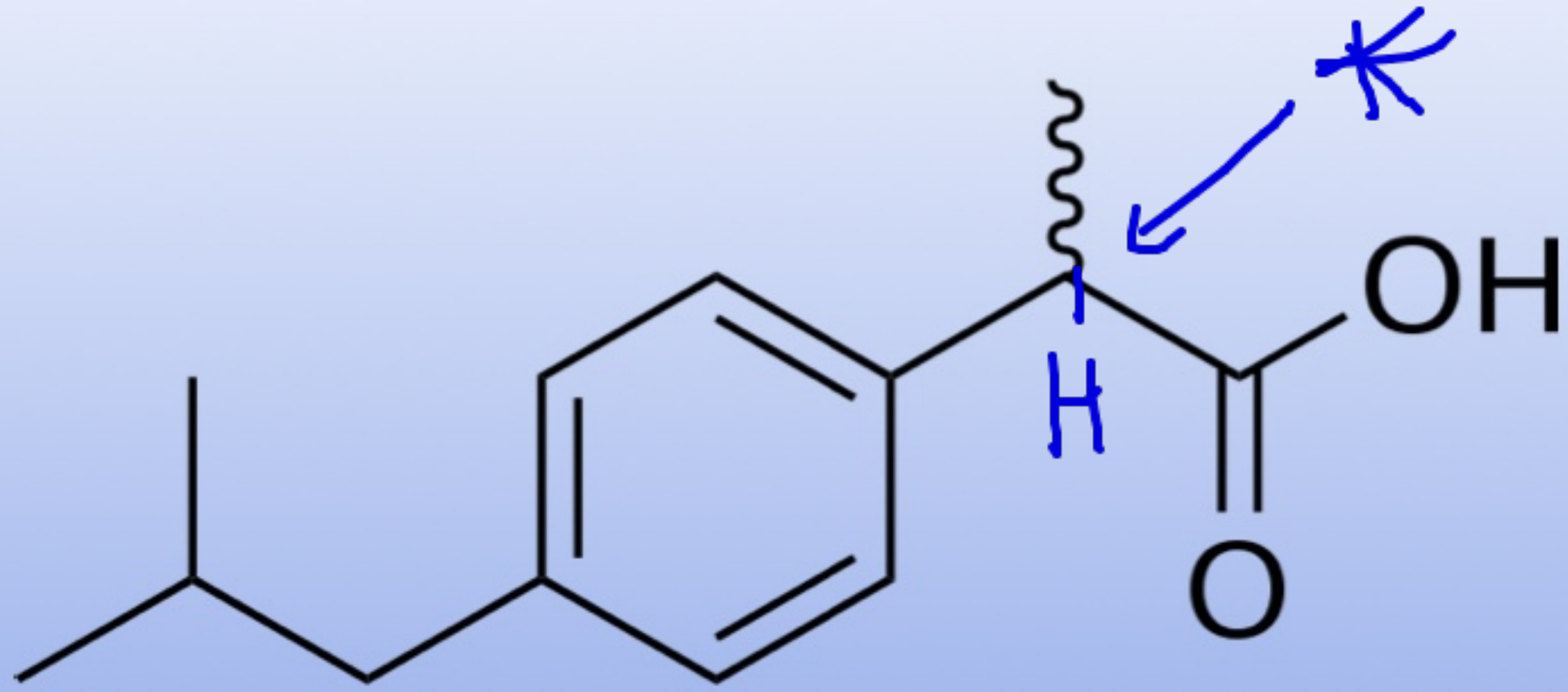
Chiral Center
(place where the chirality arises)

Carbon (or other atom)
with 4 different substituents




**vitamin C** **L-ascorbic acid**

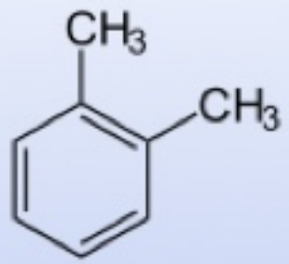
(*R*)-3,4-dihydroxy-5-((*S*)- 1,2-dihydroxyethyl)furan-2(5*H*)-one



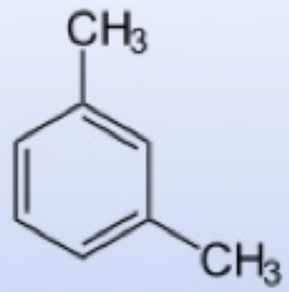

Ibuprofen

*RS*)-2-(4-(2-methylpropyl)phenyl)propanoic acid

# These two molecules are




ORTHO




META


PARA

A. structural isomers

B. stereo isomers

C. functional isomers

D. A & C

E. B & C

Xylene

= dimethyl Benzene

# Dienes

Two double bonds

5 carbon chain, parent
penta

no side chains

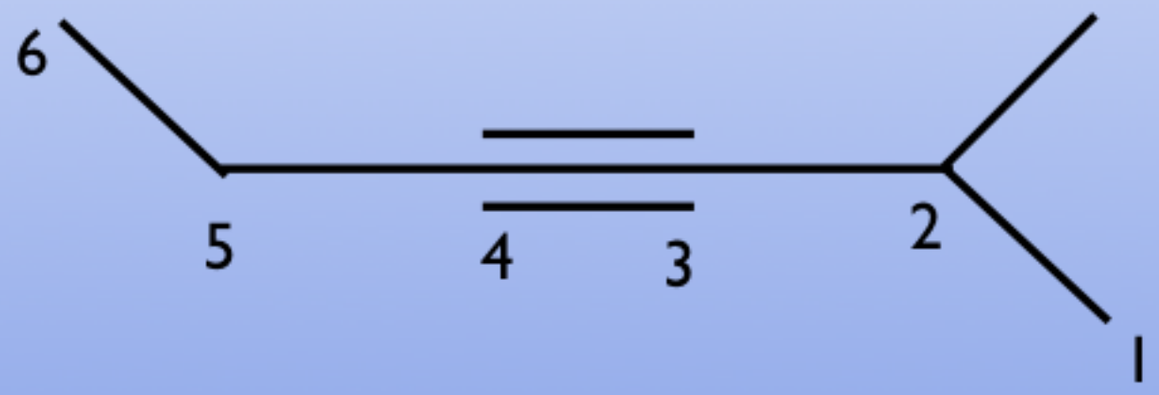
two double bonds diene
position 1 and 3

penta-1,3-diene

Alkyne

Carbon Carbon Triple Bond

Suffix -yne




2 methyl 3 hexyne

Different functional groups
Different properties
Different Chemistry

For example

In hydrocarbons (All C and H)
most reactivity is at double or triple bonds

Hydrocarbons with all single bonds are called "saturated"

# Other functional groups


Common
Ethanol

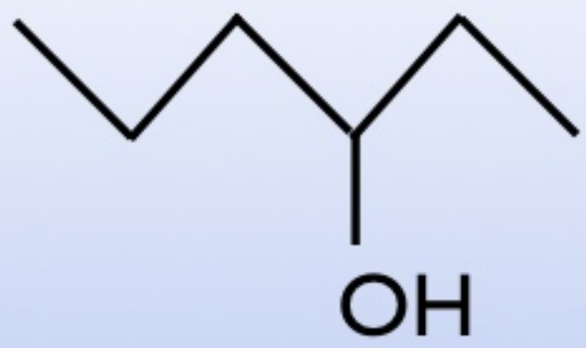
R = Generic representation
of the rest of the molecule

functional group

-OH group is an alcohol
suffix is -ol

Primary alcohol at the end R-$CH_2OH$
Secondary at a carbon with one H (mid chain) R,R'CHOH
Tertiary three carbon chains R,R',R"COH

# Name this compound




A. 2 heptanol

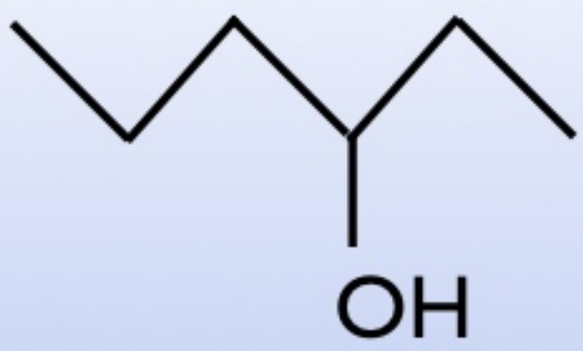
B. 4 hexanol

C. 2-ethyl 1-butanol

D. 2-ethyl 1-pentanol

E. 3 hexanol

This compound is a

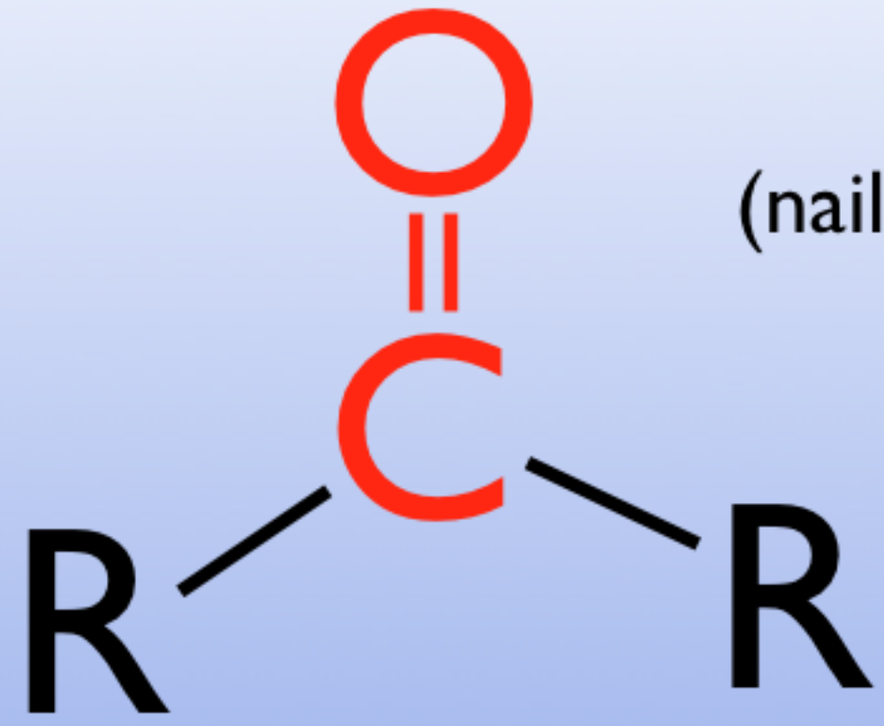



A. primary alcohol

B. secondary alcohol

C. tertiary alcohol

# Ketone

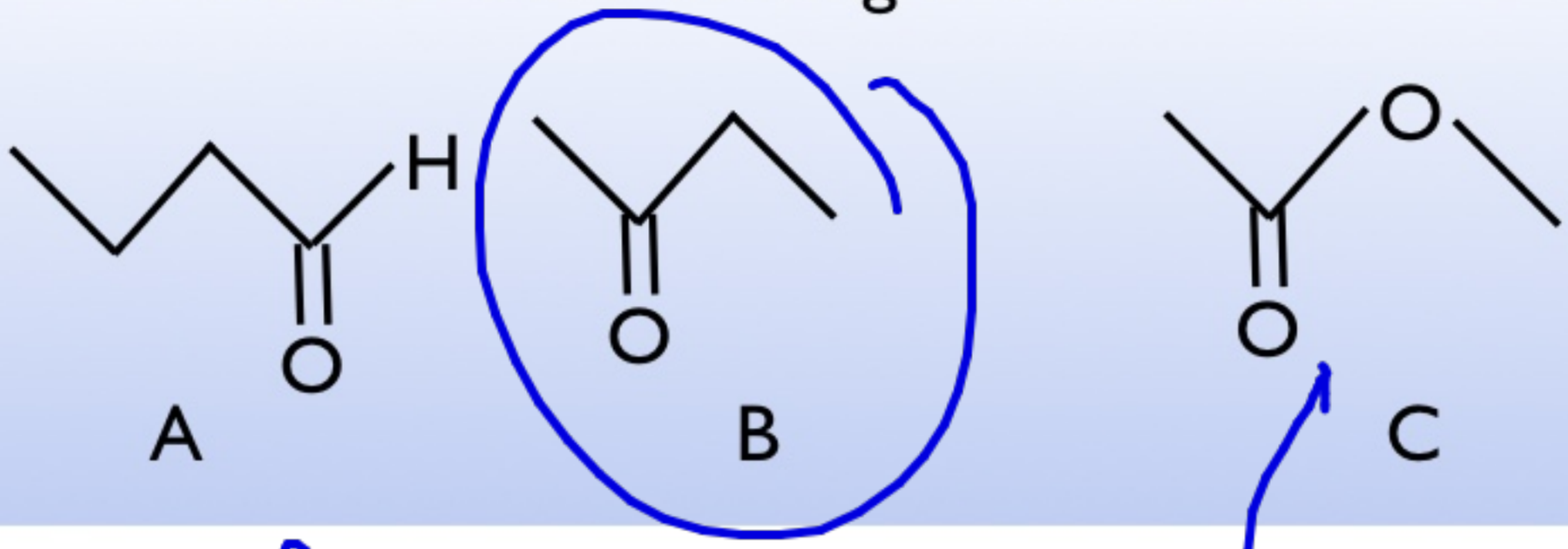



Common
Acetone
(nail polish remover)

carbon double bonded to an oxygen
bonded to carbons on either side

suffix is -one

Which of the following is a ketone?




A. A

B. B

C. C

D. A & B

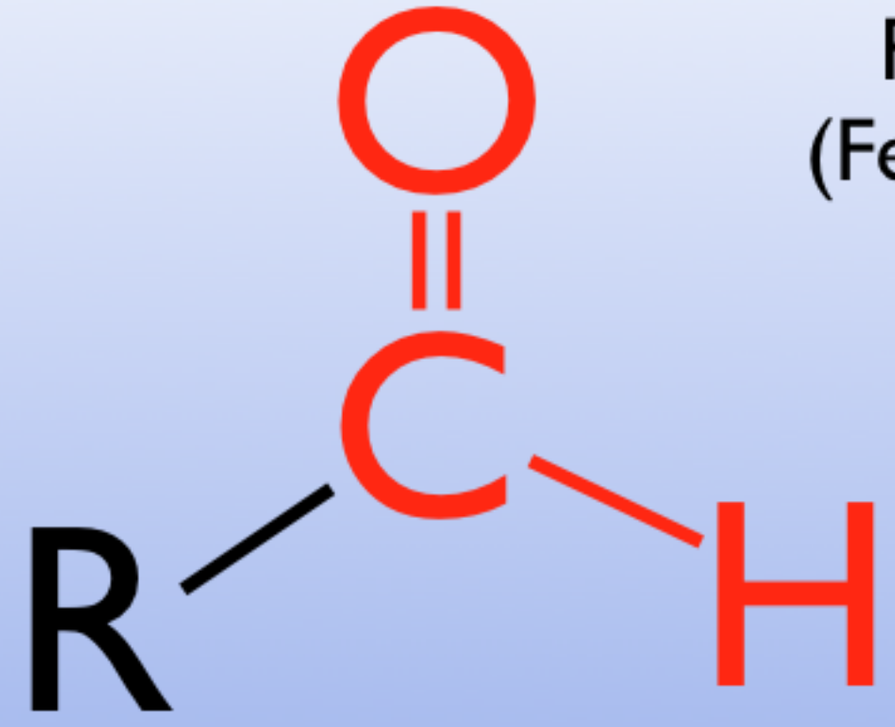
E. all three

Aldehyde

Ester

# Aldehyde

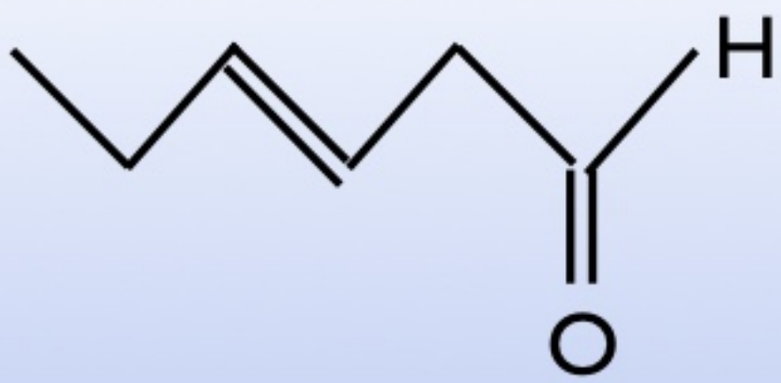
Common
Formaldehyde
(Fetal Pig Storage)




carbon double bonded to an oxygen
bonded to carbon on one side
(like a ketone at the end of a chain)

suffix is -al

# Name this compound




A. 3 hexenal

B. 3,1-hexenal

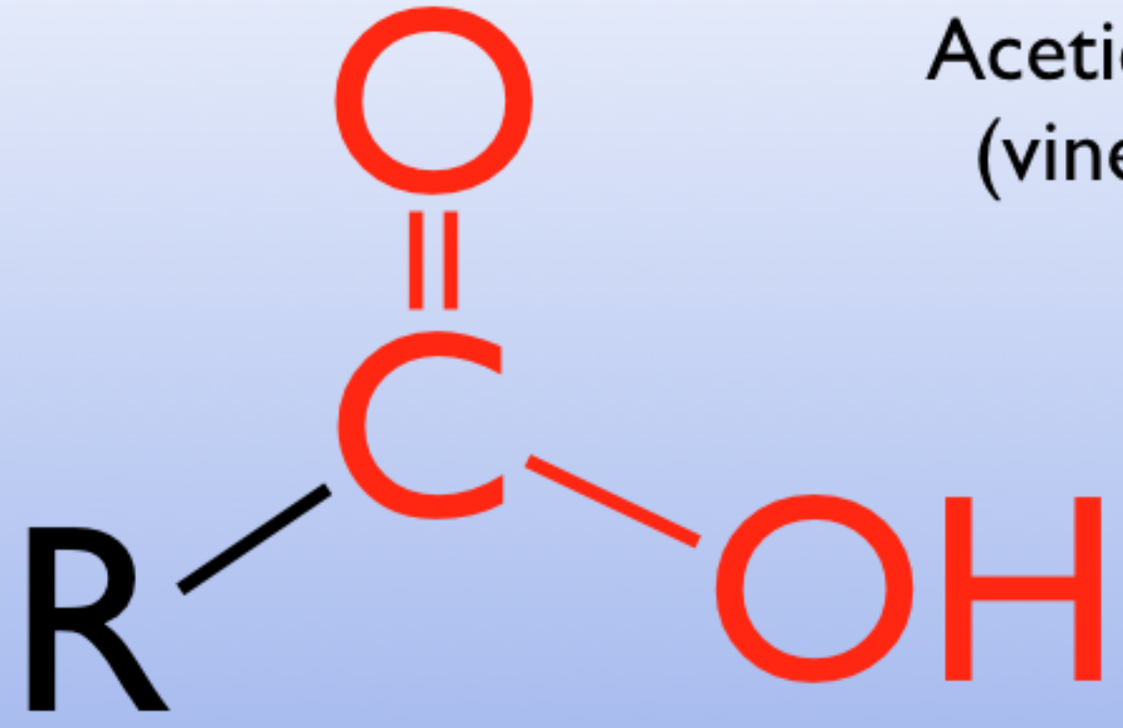
C. 3,6 hexenal

D. 6,3 hexalene

E. 1,3 hexene-al

Aldehyde always at the end ∴ no need to say it is carbon #1

# Carboxylic Acid

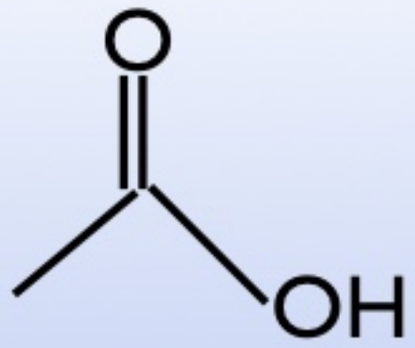



Common
Acetic Acid
(vinegar)

carbon double bonded to an oxygen
bonded to carbon on one side
OH on the other side

suffix is -oic acid

Name this compound




A. methanoic acid

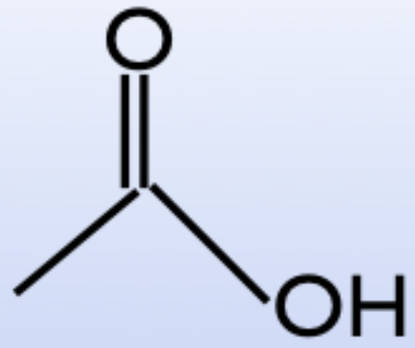
B. ethanoic acid

C. propanoic acid

D. 3 hydroxy 2 propanone

E. propanol

# Name this compound




A. methanoic acid

B. ethanoic acid

C. propanoic acid

D. 3 hydroxy 2 propanone

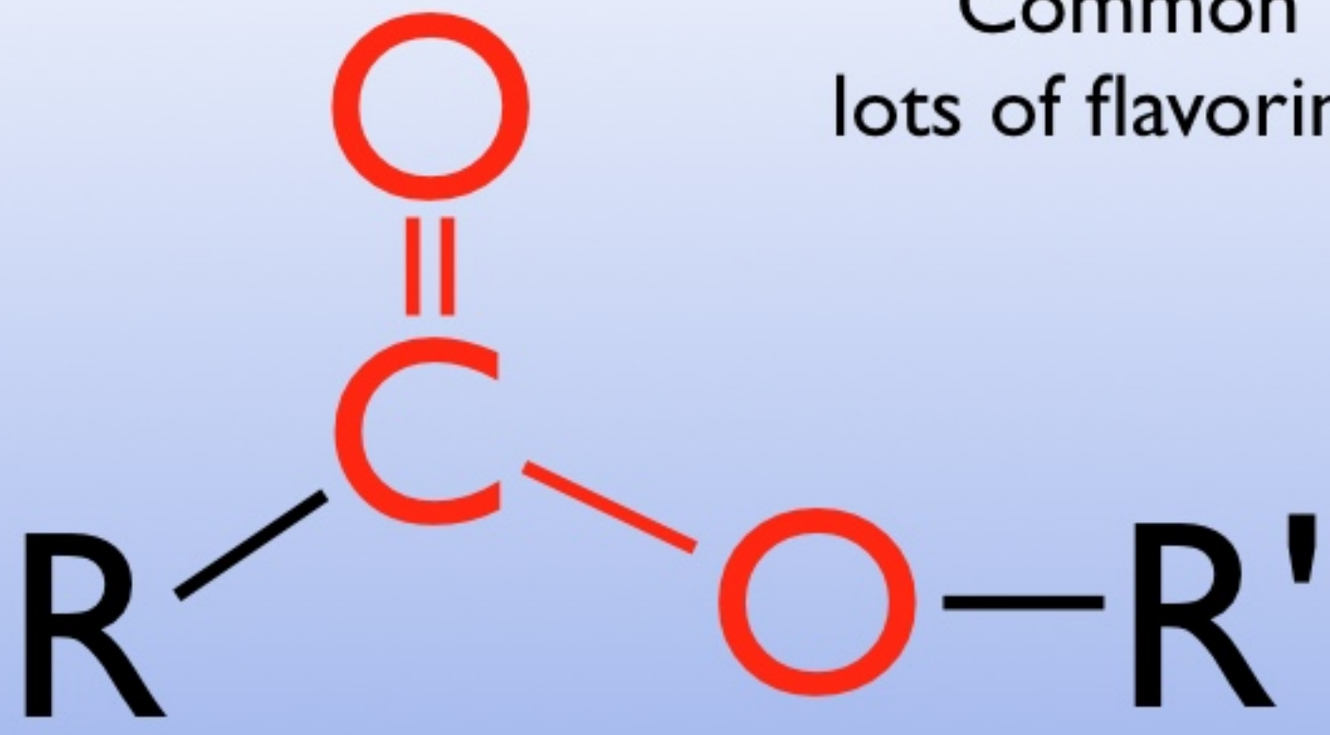
E. propanol

No need to number carboxylic acid its always at the end

this compound is also commonly known as acetic acid

# Ester

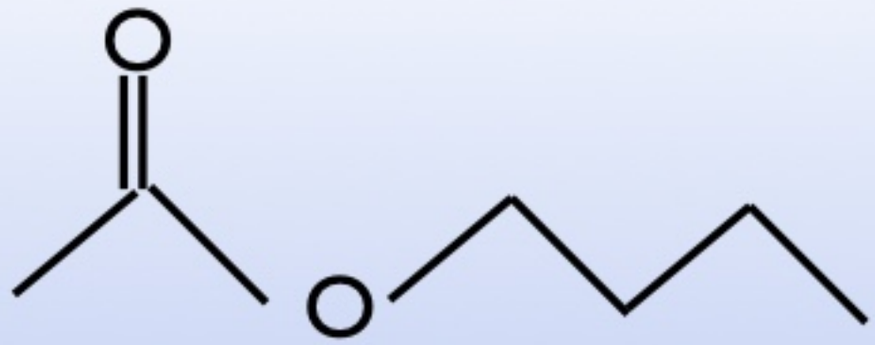
Common
lots of flavorings




carbon double bonded to an oxygen
bonded to carbon on one side
OR on the other side

suffix is ~~-oic acid~~ -oate

# Name this compound



A. ethyl butanoate

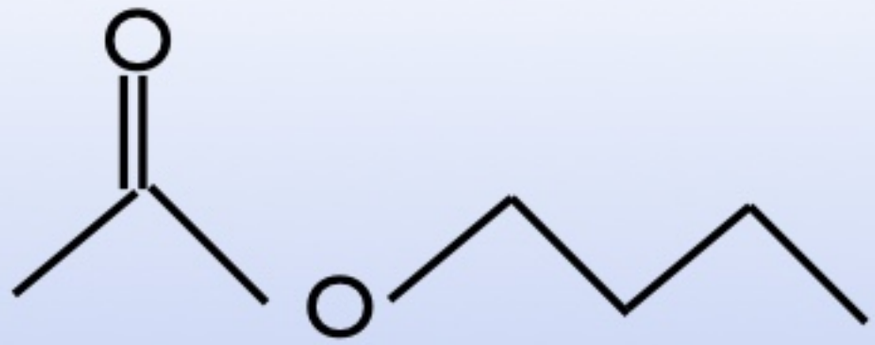
B. butyl methanoate

C. methyl heptanoate

D. butyl ethanoate

E. pentyl ethanoate

# Name this compound



A. ethyl butanoate

B. butyl methanoate

C. methyl heptanoate

D. butyl ethanoate

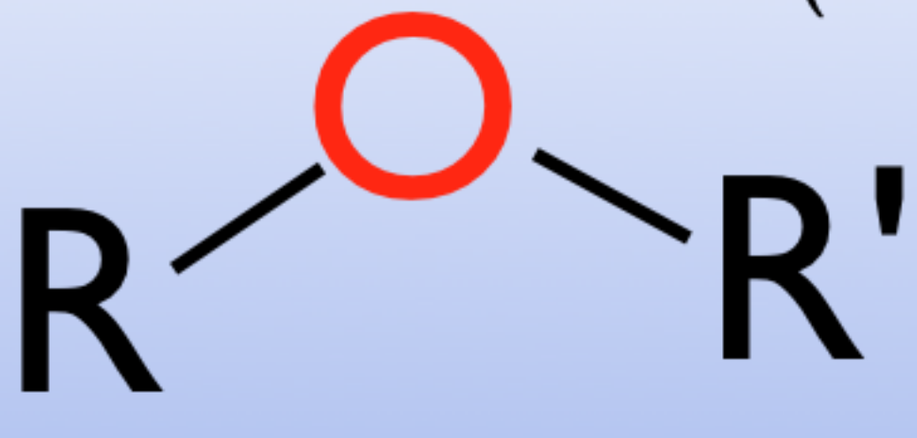
E. pentyl ethanoate

No need to number ester
name the two sides

part with the ~~carboxyl~~ carbonyl (C=O)
is the parent
other part is like the side chain

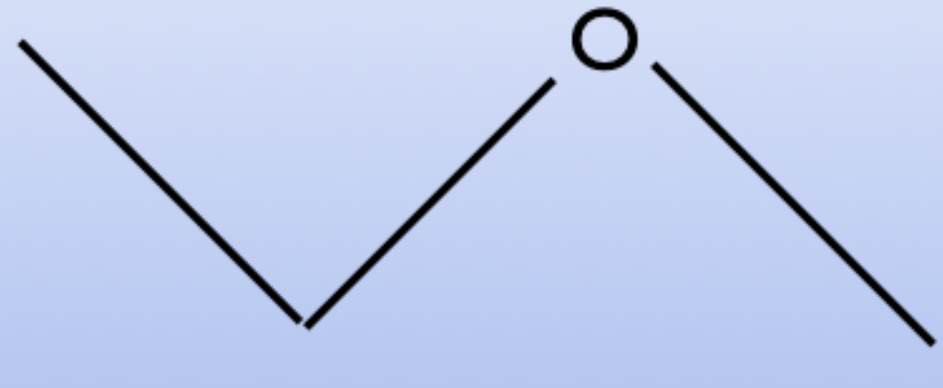
# Ether

Diethyl Ether
(knocks you out)




carbon oxygen in the middle of the chain

suffix is -ether




Treat as two "side chains"

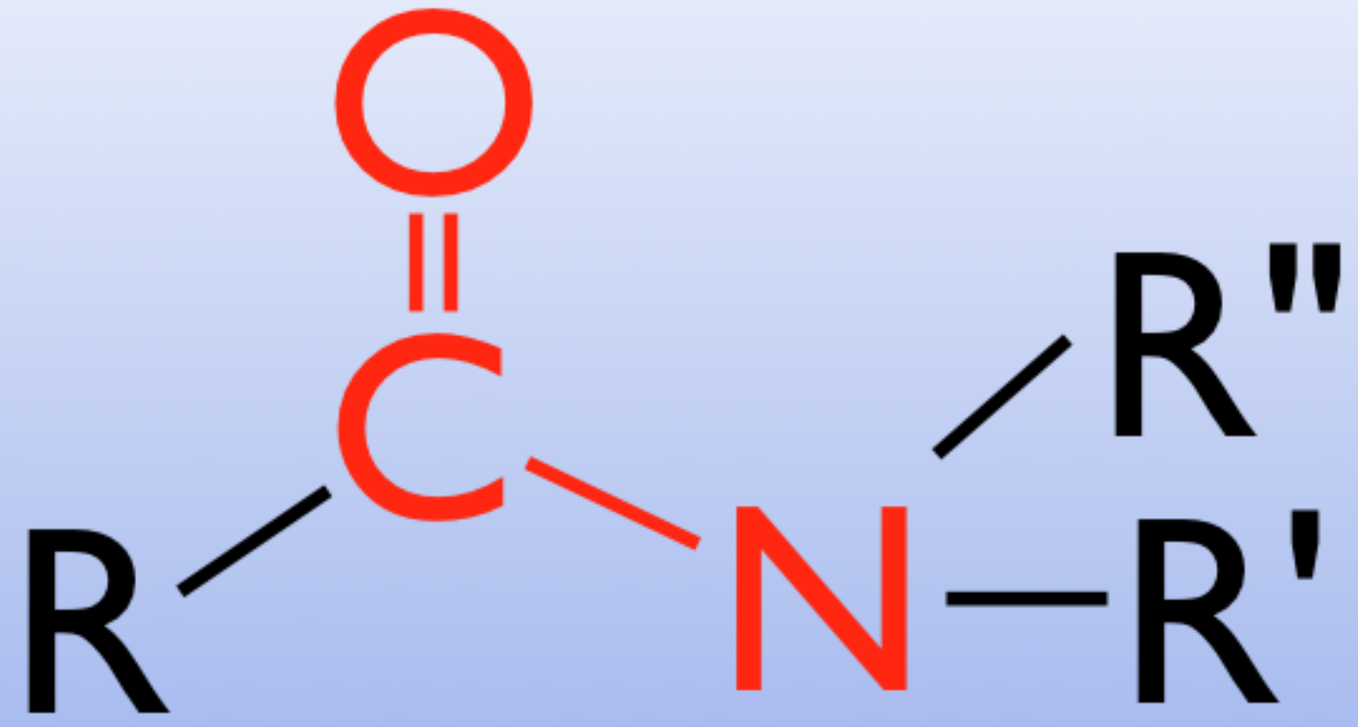
methyl ethyl ether

## Primary Amine


-$NH_2$ group is an amine
suffix is -amine

Primary amine one carbons chain
Secondary amine two carbons chains
Tertiary amine three carbon chains

# Amide

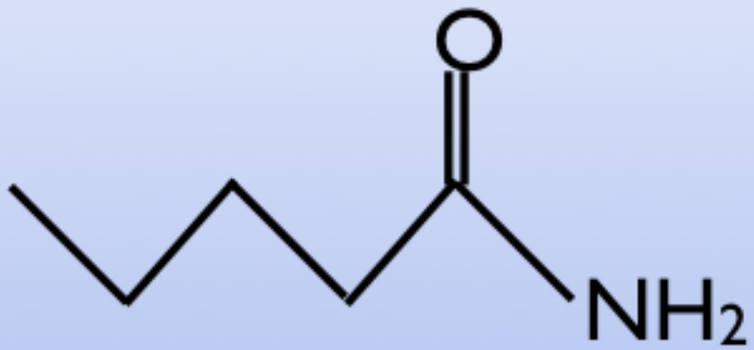



carbon double bonded to an oxygen
bonded to carbon on one side
N on the other side
suffix is -amide

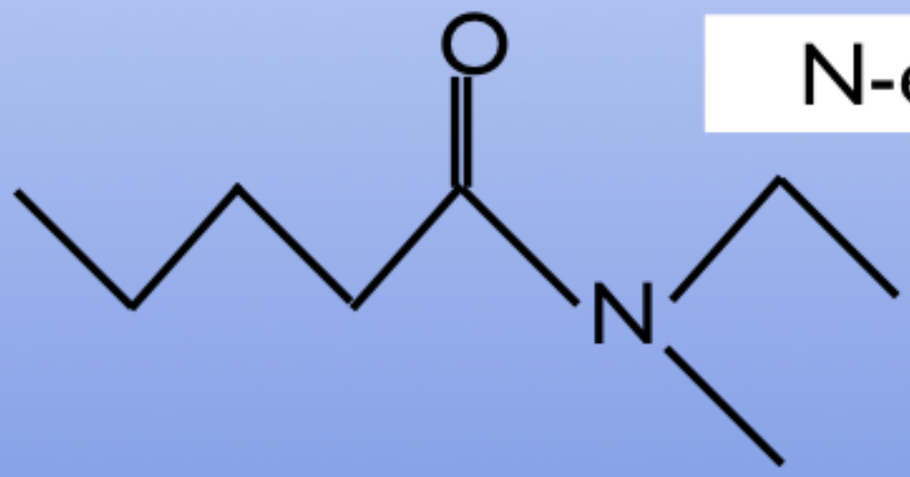
# Naming amide

Treat part with C=O as parent

parts on the N as sidechains

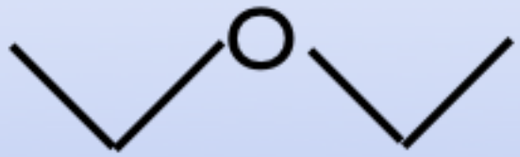



pentanamide

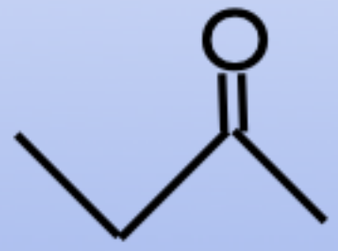



N-ethyl-N-methylpentanamide

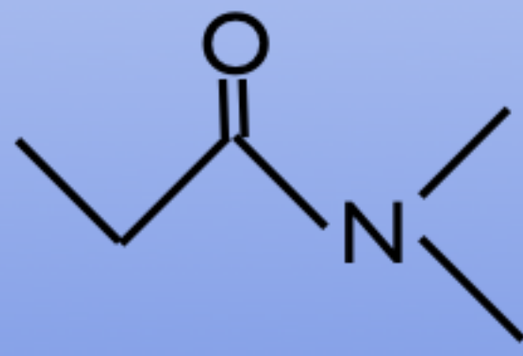

Amine




Ether

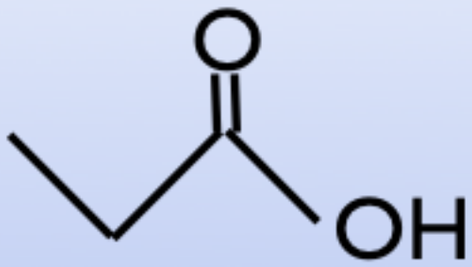



Ketone

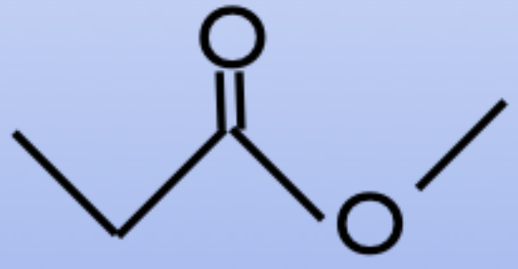



Amide


Alcohol




Carboxylic Acid




Ester

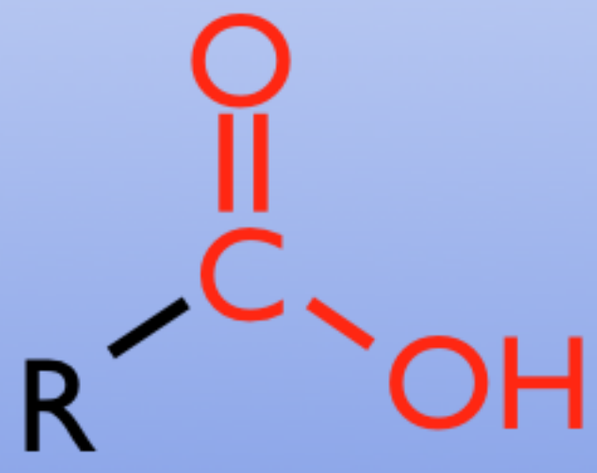
Alkene

Important Reaction for Biochemistry

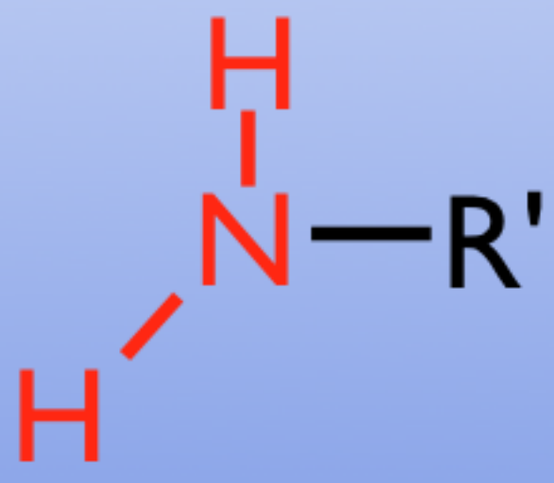
Formation of an Amide

The don't call them functional groups for nothing

Carboxylic Acid

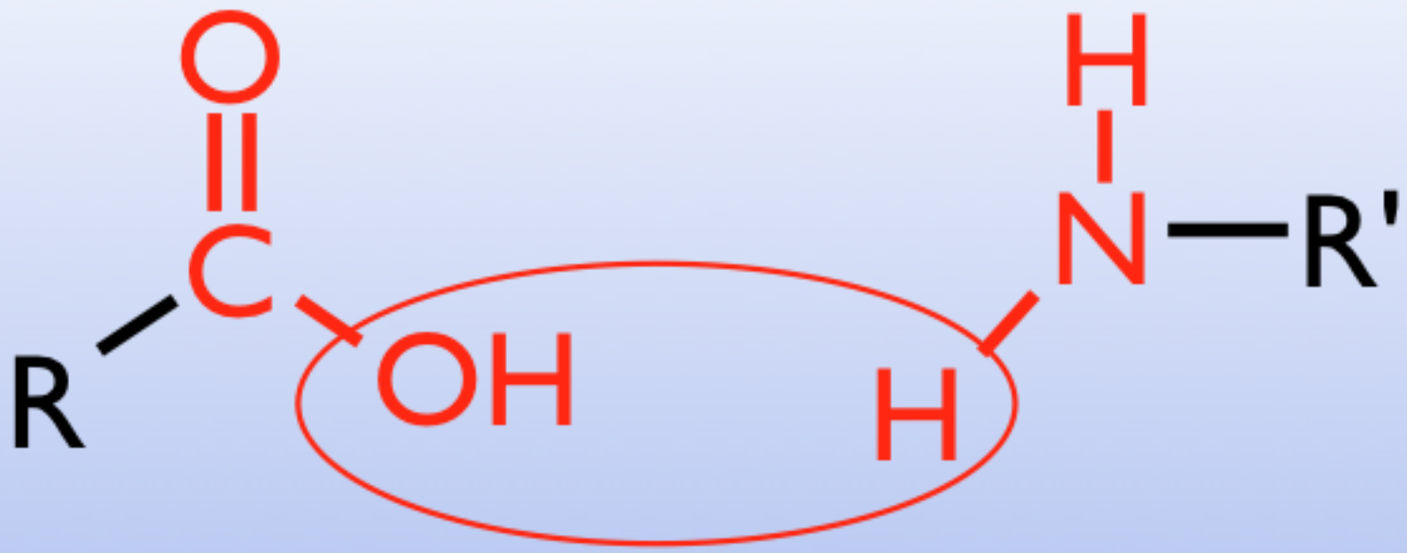


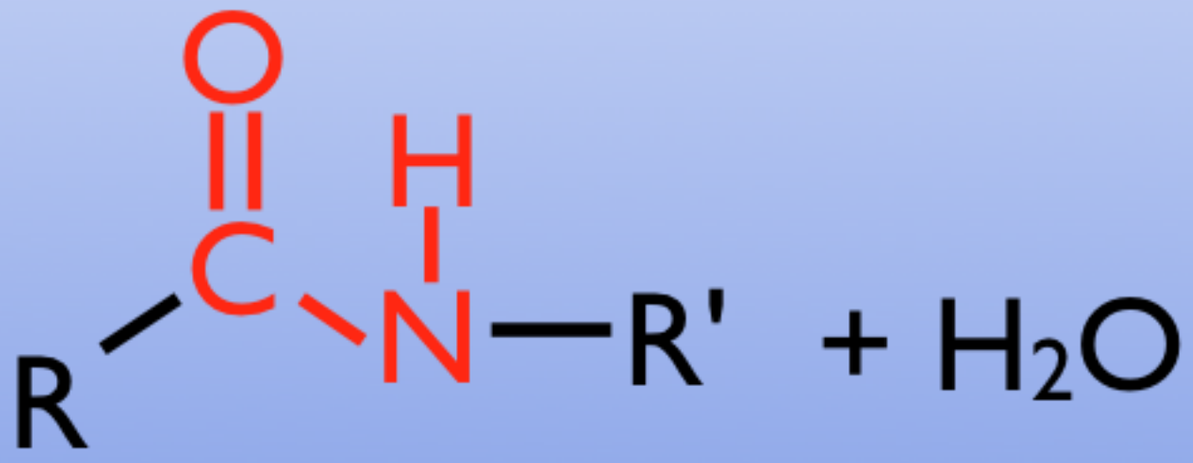

Primary Amine



Carboxylic Acid

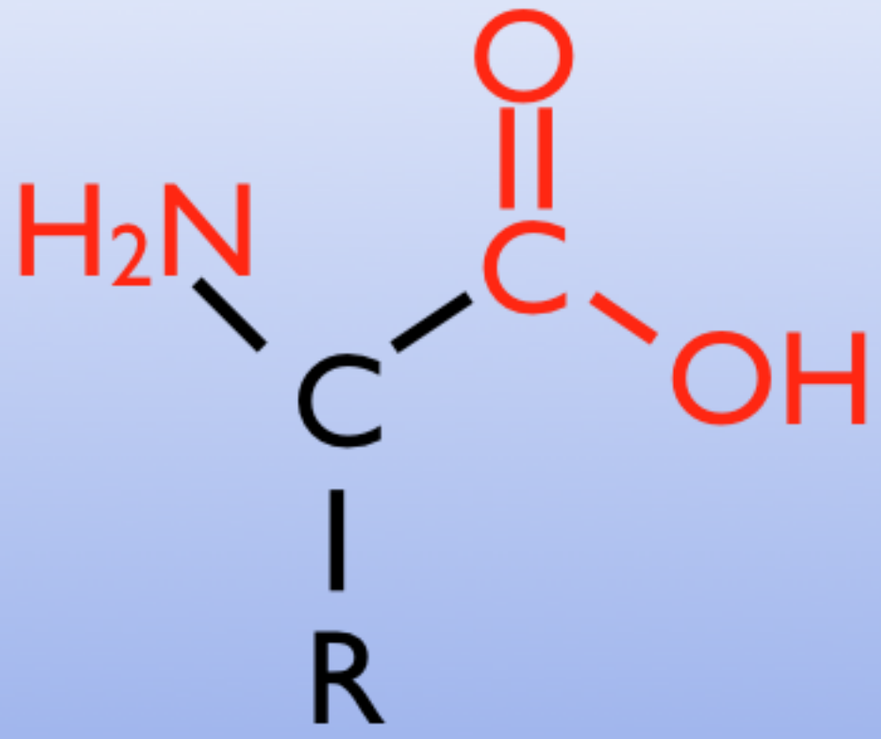
Primary Amine



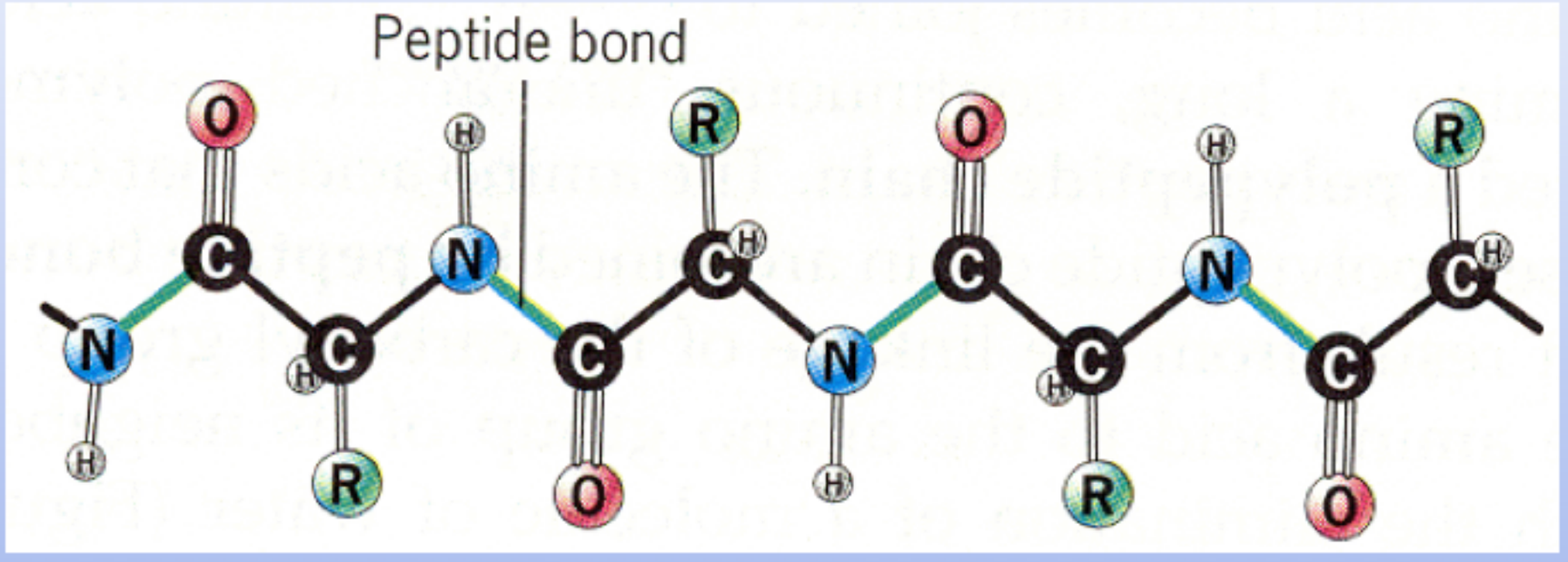

Amide + Water

# Amino Acid




Carboxylic End and Amine End
Can react with itself
(or similar molecules) in a chain

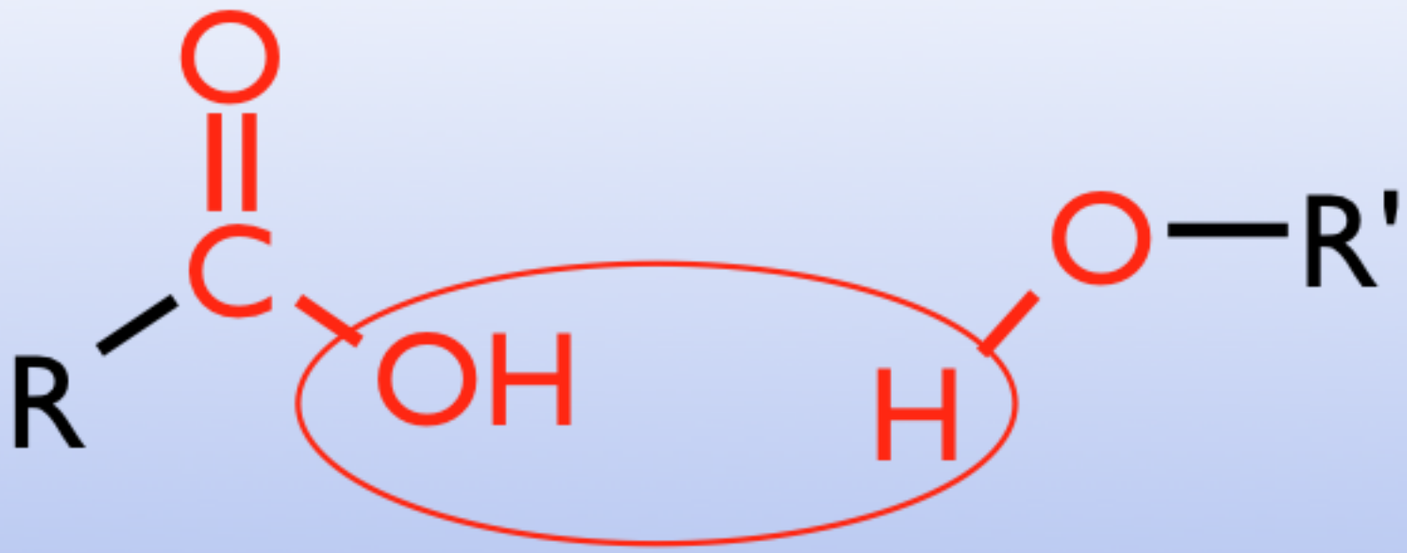
# Polypeptide

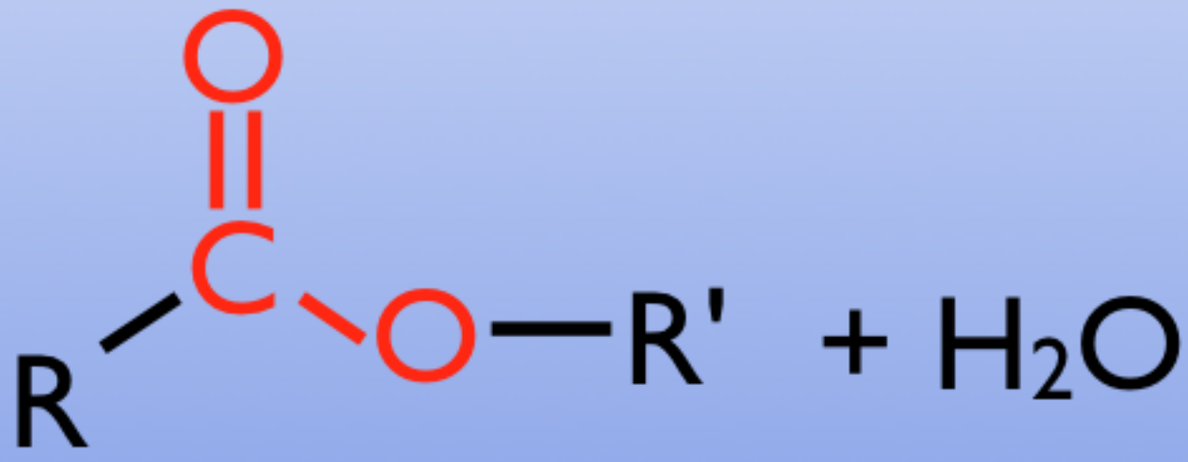



Two distinct ends
N-terminus is an amine
C-terminus is a carboxylic acid

Carboxylic Acid

Alcohol

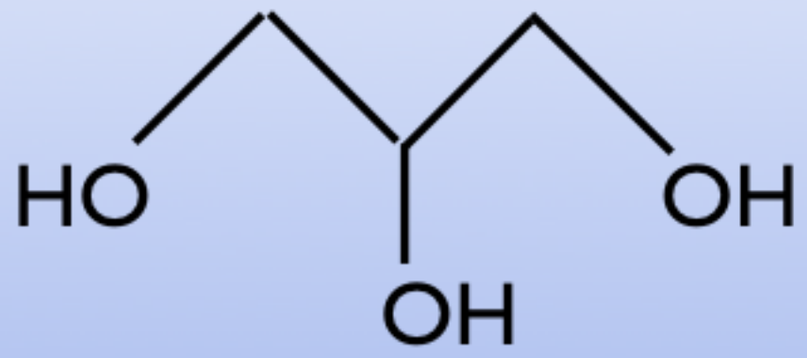



Ester + Water

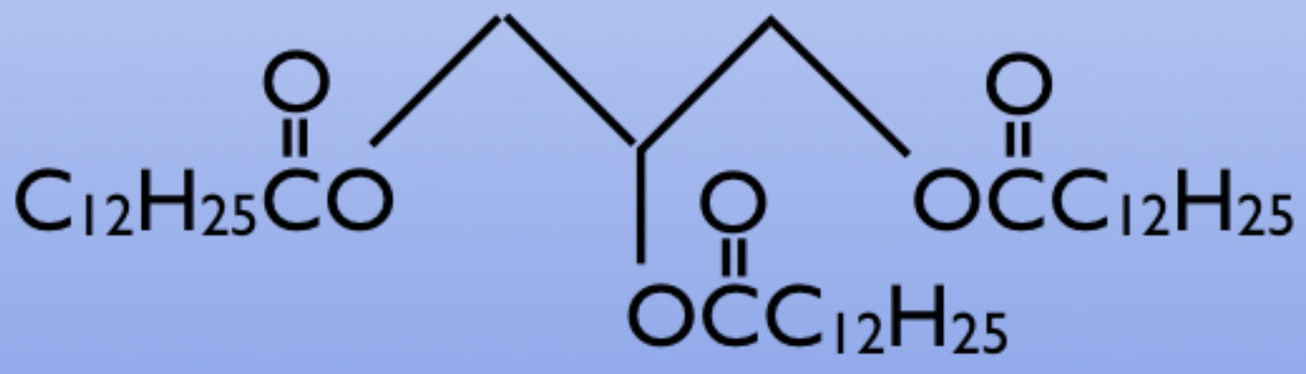
# Triglycerides

Gylcerol




Fatty Acid
(carboxylic acid with long chain)

$C_{12}H_{25}COOH$

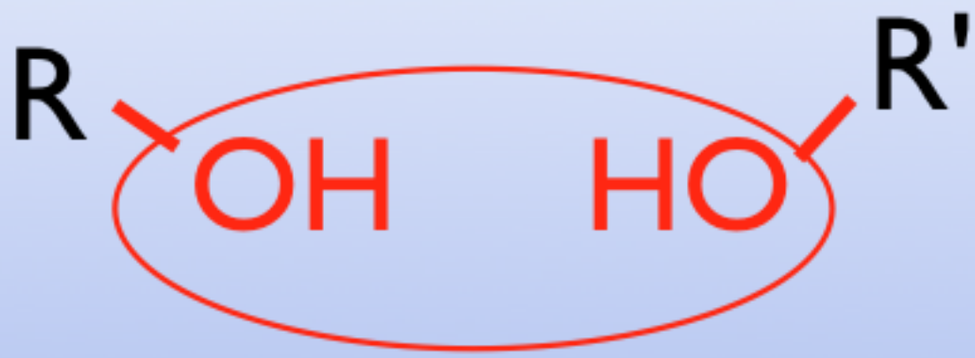



Makes Trigylceride

The three fatty acids can
all be the same or different

High levels of triglycerides is linked to
build up of plaque in the arteries
= heart disease

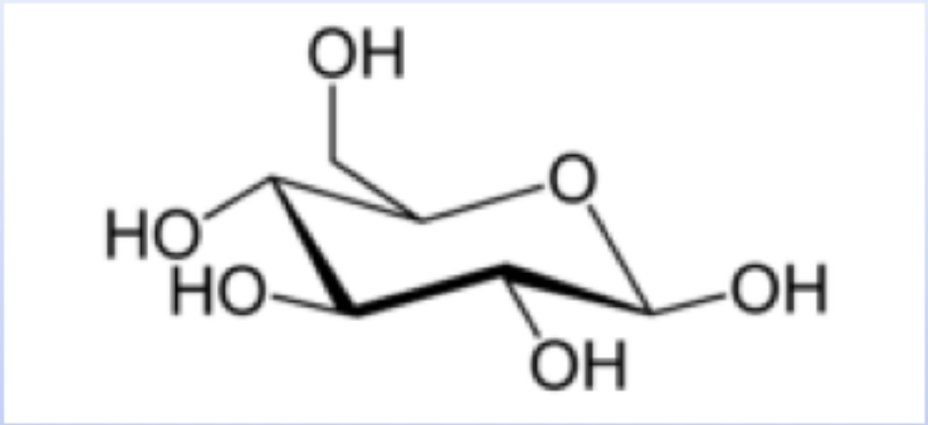
Alcohol Alcohol





Ether + Water

# Sugars



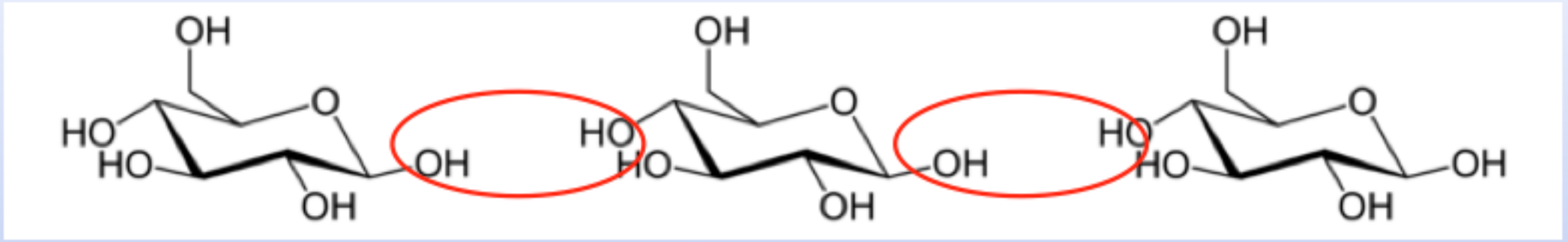

Glucose

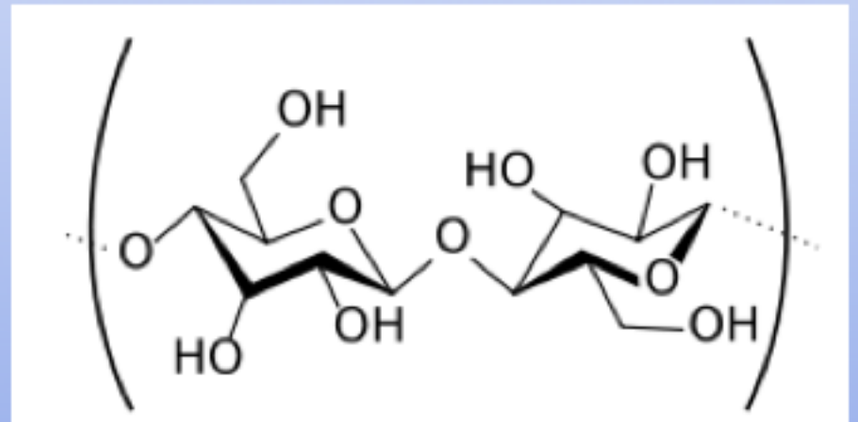
(key factor for sugars lots of hydroxyls)

They can react to form chains of sugars

polysaccharide

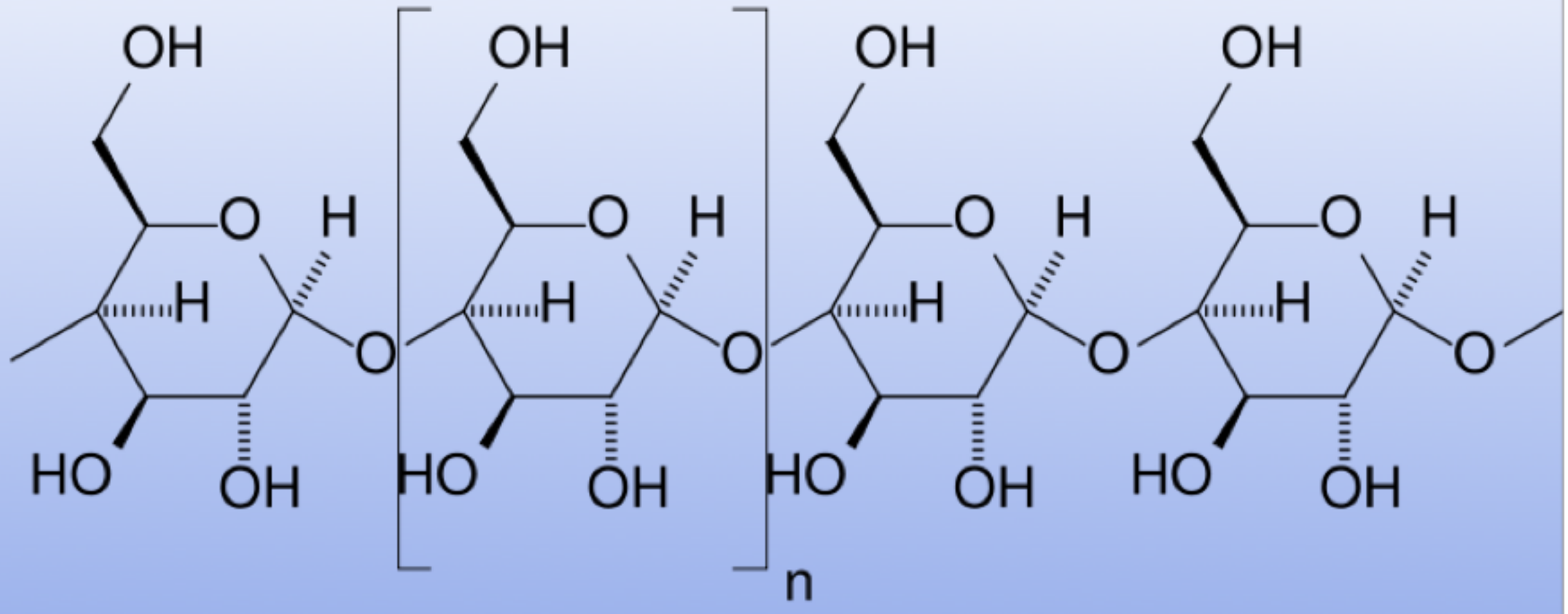
# Celluose




Very long ether chain
(pretty much all plant material)

# Polysaccharide (Starch)




Sugars, Carbohydrates
monosaccharides (one)
disaccharides (two)
polysaccharides (many)

## Condensation Reactions
(two molecules make one + water)

Carboxylic Acid + Amine = Amide + water

Carboxylic Acid + Alcohol = Ester + water

Alcohol + Alcohol = Ether + water