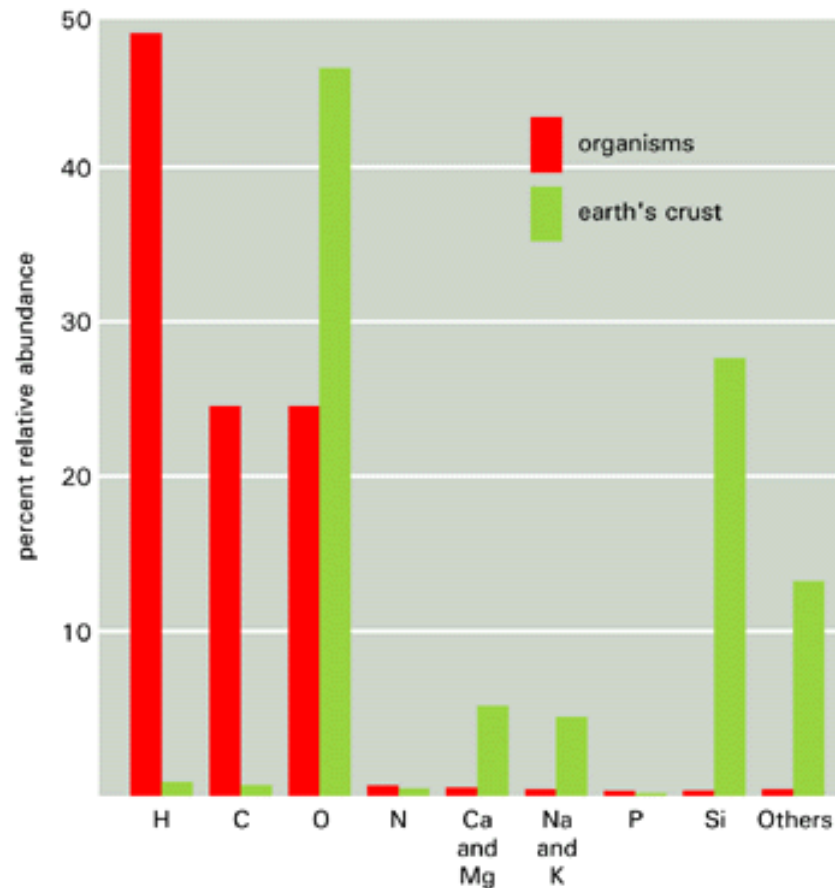


# ORGANISMOS VIVOS FORMADOS POR C,H,O,N

Composición muy diferente a la de la corteza terrestre



Por qué???

1. Forman gases
2. Solubles en agua
3. Forman enlaces covalentes

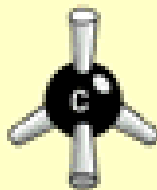
Abundancia relativa de elementos de la corteza terrestre

# Enlace covalente: se comparten electrones

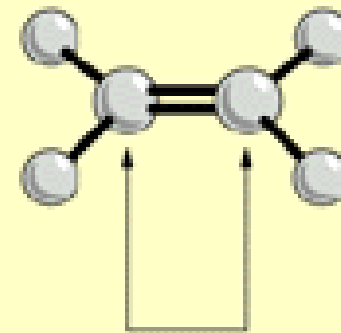
## COVALENT BONDS

A covalent bond forms when two atoms come very close together and share one or more of their electrons. In a single bond one electron from each of the two atoms is shared; in a double bond a total of four electrons are shared.

Each atom forms a fixed number of covalent bonds in a defined spatial arrangement. For example, carbon forms four single bonds arranged tetrahedrally, whereas nitrogen forms three single bonds and oxygen forms two single bonds arranged as shown below.

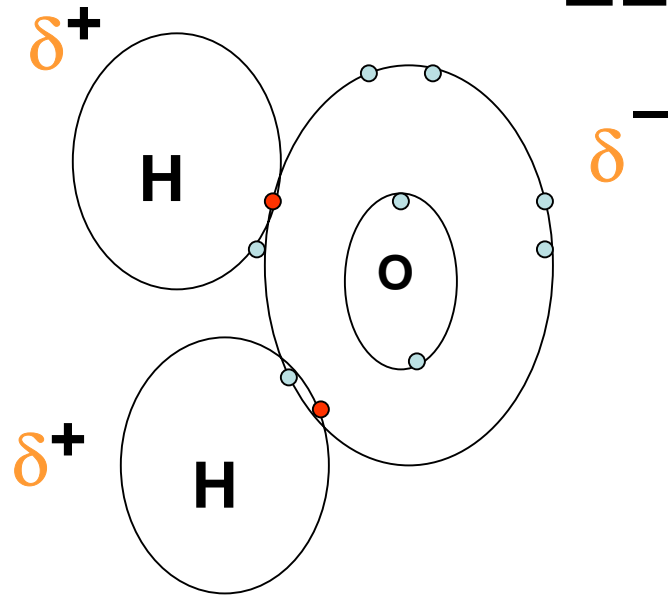


Double bonds exist and have a different spatial arrangement.



Atoms joined by two or more covalent bonds cannot rotate freely about the bond axis. This restriction is a major influence on the three-dimensional shape of many macromolecules.

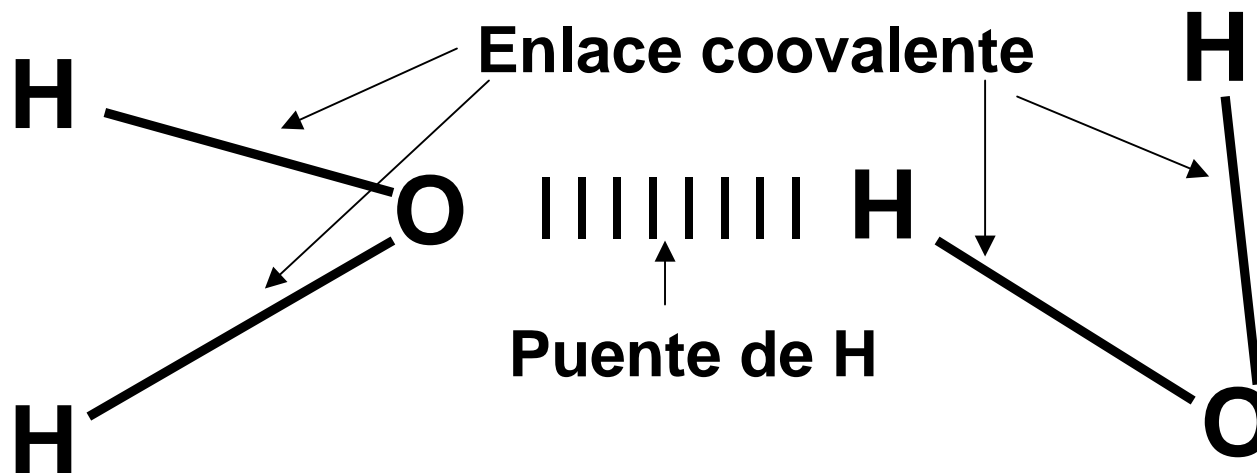
# EL AGUA



## Estructura-Función

### Características:

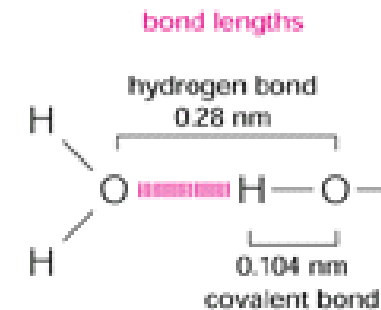
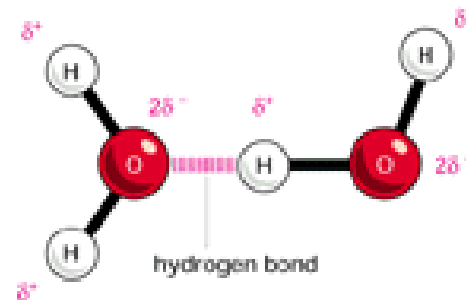
1. Sin carga
2. No hay electrones desapareados
3. Dipolo



## HYDROGEN BONDS

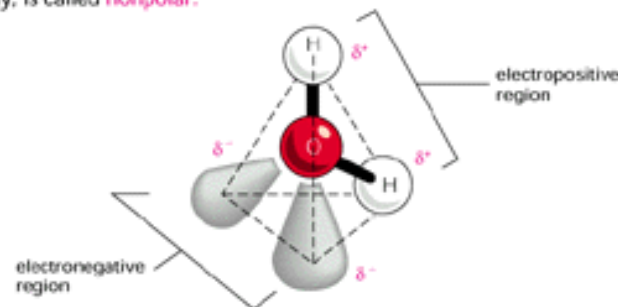
Because they are polarized, two adjacent  $\text{H}_2\text{O}$  molecules can form a linkage known as a **hydrogen bond**. Hydrogen bonds have only about 1/20 the strength of a covalent bond.

Hydrogen bonds are strongest when the three atoms lie in a straight line.



## WATER

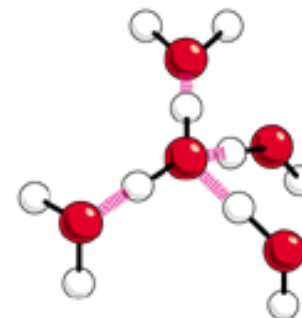
Two atoms, connected by a covalent bond, may exert different attractions for the electrons of the bond. In such cases the bond is **dipolar**, with one end slightly negatively charged ( $\delta^-$ ) and the other slightly positively charged ( $\delta^+$ ). A bond in which both atoms are the same, or in which they attract electrons equally, is called **nonpolar**.



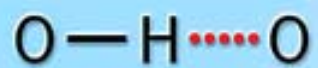
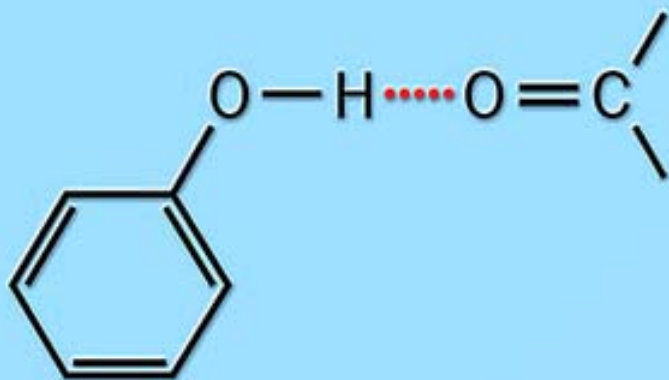
Although a water molecule has an overall neutral charge (having the same number of electrons and protons), the electrons are asymmetrically distributed, which makes the molecule polar. The oxygen nucleus draws electrons away from the hydrogen nuclei, leaving these nuclei with a small net positive charge. The excess of electron density on the oxygen atom creates weakly negative regions at the other two corners of an imaginary tetrahedron.

## WATER STRUCTURE

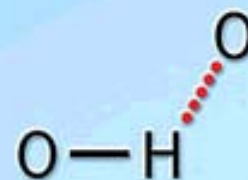
Molecules of water join together transiently in a hydrogen-bonded lattice. Even at  $37^\circ\text{C}$ , 15% of the water molecules are joined to four others in a short-lived assembly known as a "flickering cluster."



The cohesive nature of water is responsible for many of its unusual properties, such as high surface tension, specific heat, and heat of vaporization.



Strong hydrogen  
bonds



Weak hydrogen  
bond

# PROPIEDADES DEL AGUA

NOMBRE	PROPIEDAD QUÍMICA	BENEFICIO
Elevada polaridad	Atrae iones y compuestos polares	Solubilidad interacción
Elevado CE	Absorbe y libera calor	Estabiliza t°
Elevado CV	Se rompen muchos enlaces de H	Evaporación disminución t° cuerpo
Cohesión	Enlaces de H mantienen moléculas unidas	Germinación
Menor densidad de hielo	Moléculas de agua están más separadas	Evita congelamiento de lagos y mares

## Propiedades del H<sub>2</sub>O derivadas de la ruptura de sus enlaces covalentes



$$[\text{H}^+] = 1 \times 10^{-7} \text{ mol/L (M)}$$

$$\text{pH} = -\log [\text{H}^+]$$

$$\text{pH} = 7$$

A < pH > Acidez

pH= concentración relativa de H<sup>+</sup> en solución

# Función del H<sub>2</sub>O en la formación de TAMPONES

pH sangre: 7.4

Uno de los mejores tampones de la sangre es H<sub>2</sub>O + CO<sub>2</sub>



$A > [\text{H}^+] < \text{pH}$  equilibrio hacia la izquierda

$A < [\text{H}^+] > \text{pH}$  equilibrio hacia la derecha



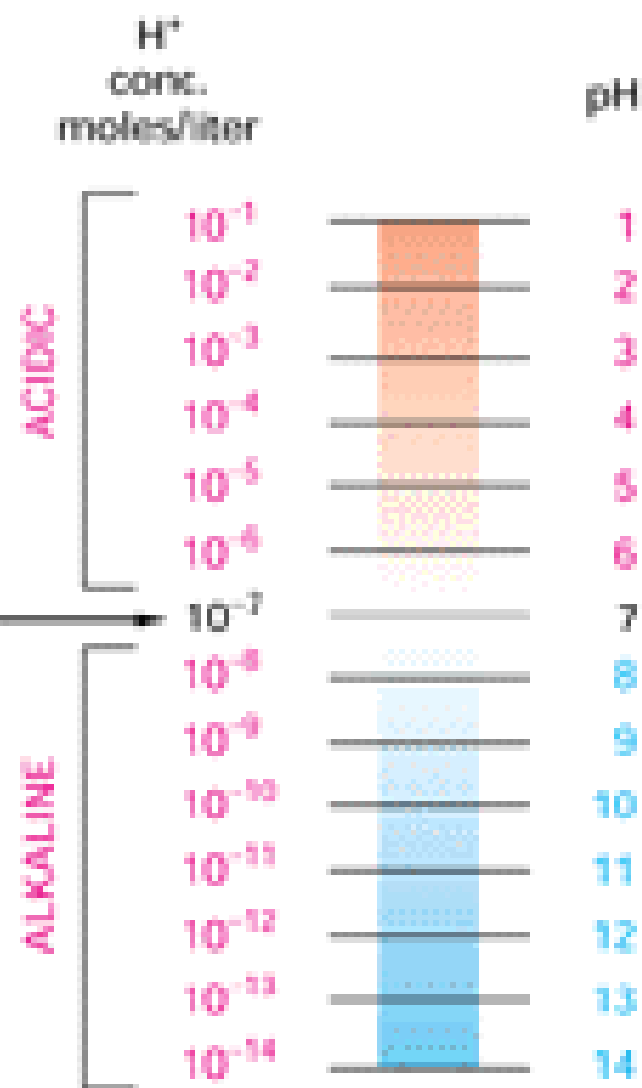
# pH

The acidity of a solution is defined by the concentration of  $H^+$  ions it possesses. For convenience we use the pH scale where

$$pH = -\log_{10}[H^+]$$

For pure water

$$[H^+] = 10^{-7} \text{ moles/liter}$$



# MOLECULAS ORGÁNICAS: POSEEN C

**CORE**

**GRUPO FUNCIONAL**

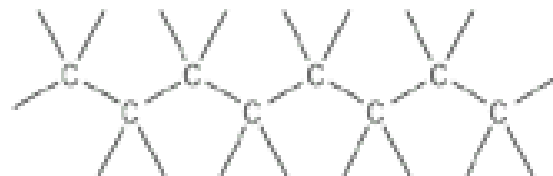
**Mayor reactividad**

**Define las características  
químicas de las moléculas**

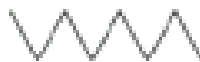
- 1.- Transferencia de grupo funcional**
- 2.- Ruptura enlaces C-C**

## CARBON SKELETONS

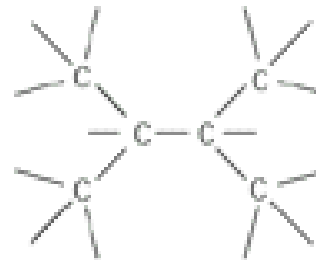
The unique role of carbon in the cell comes from its ability to form strong covalent bonds with other carbon atoms. Thus carbon atoms can join to form chains.



also written as



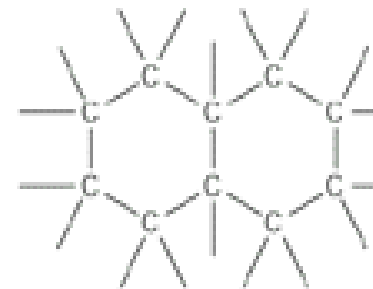
or branched trees



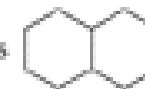
also written as



or rings



also written as



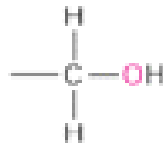
# GRUPOS FUNCIONALES

<b>HIDROXILO</b>	<b>OH</b>
<b>CARBONILO</b>	<b>C=O</b>
<b>CARBOXILO</b>	<b>COOH</b>
<b>AMINO</b>	<b>NH<sub>2</sub></b>
<b>SULFHIDRILO</b>	<b>SH</b>
<b>FOSFATO</b>	<b>PO<sub>4</sub><sup>-3</sup></b>

## C—O COMPOUNDS

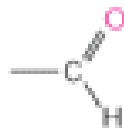
Many biological compounds contain a carbon bonded to an oxygen. For example,

alcohol

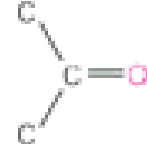


The —OH is called a **hydroxyl** group.

aldehyde

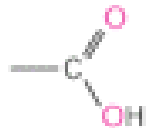


ketone



The C=O is called a **carbonyl** group.

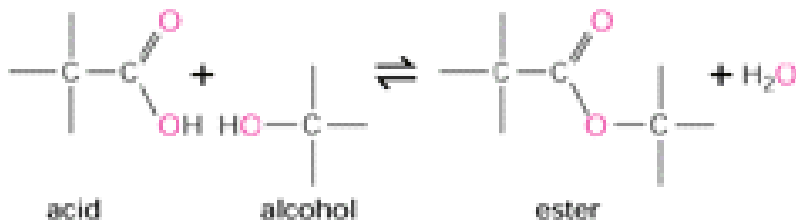
carboxylic acid



The —COOH is called a **carboxyl** group. In water this loses an H<sup>+</sup> ion to become —COO<sup>−</sup>.

esters

Esters are formed by combining an acid and an alcohol.



## C—N COMPOUNDS

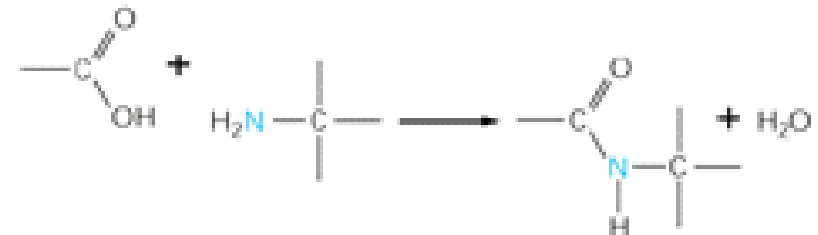
Amines and amides are two important examples of compounds containing a carbon linked to a nitrogen.

**Amines** in water combine with an H<sup>+</sup> ion to become positively charged.

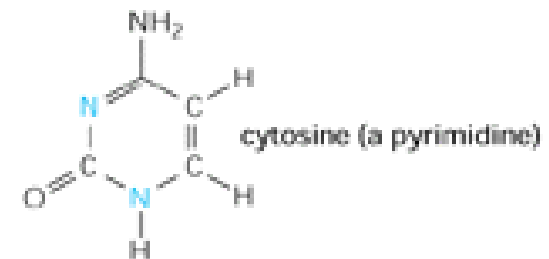


They are therefore basic.

**Amides** are formed by combining an acid and an amine. They are more stable than esters. Unlike amines, they are uncharged in water. An example is the peptide bond.

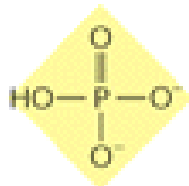


Nitrogen also occurs in several ring compounds, including important constituents of nucleic acids: purines and pyrimidines.

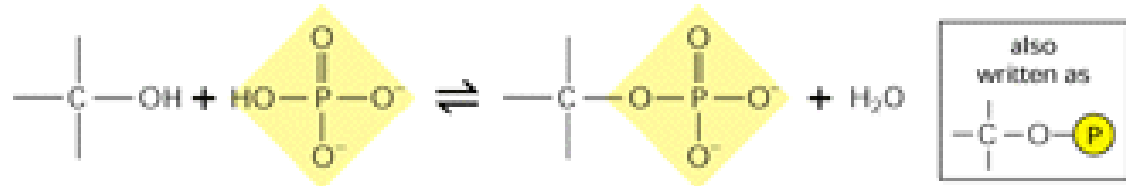


## PHOSPHATES

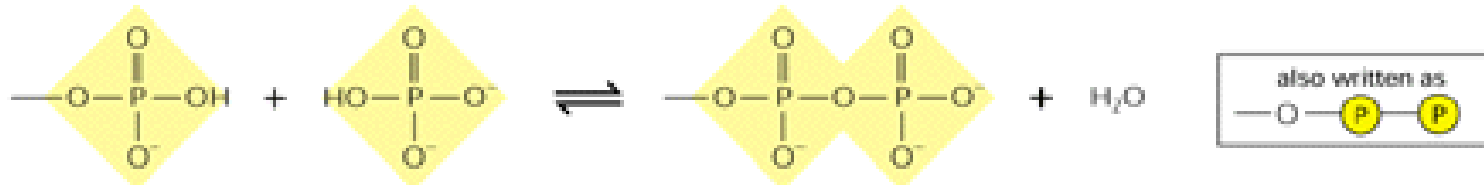
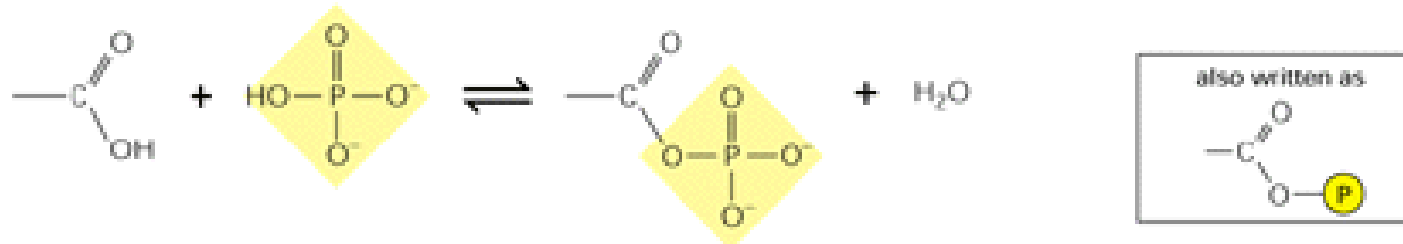
Inorganic phosphate is a stable ion formed from phosphoric acid,  $\text{H}_3\text{PO}_4$ . It is often written as  $\text{P}_i$ .



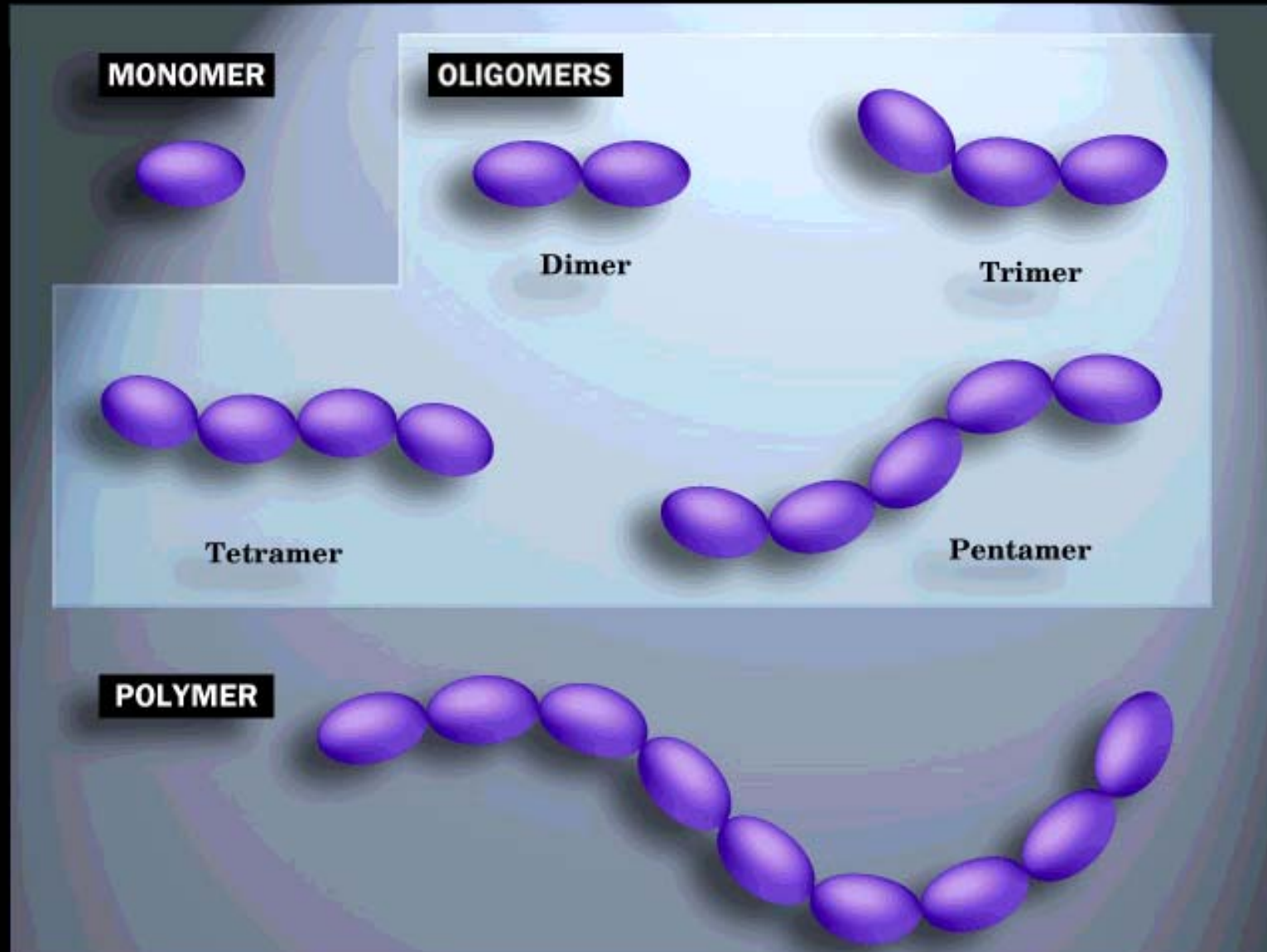
Phosphate esters can form between a phosphate and a free hydroxyl group.



The combination of a phosphate and a carboxyl group, or two or more phosphate groups, gives an acid anhydride.



# POLÍMEROS: MACROMOLÉCULAS DE CADENA LARGA FORMADAS POR SUBUNIDADES O MONÓMEROS



# **POLÍMEROS: MACROMOLÉCULAS DE CADENA LARGA FORMADAS POR SUBUNIDADES O MONÓMEROS**

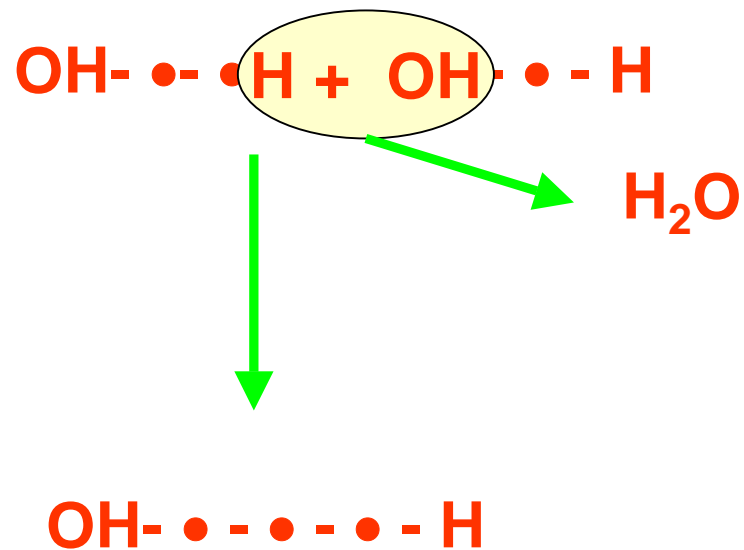
<b>Macromolécula</b>	<b>Subunidad</b>	<b>G.Funcional</b>	<b>Función</b>
<b>CARBOHIDRATOS</b>	<b>AZÚCAR SIMPLE</b>	<b>C=O</b>	<b>ALMACENA E ESTRUCTURAL</b>
<b>LÍPIDOS</b>	<b>ACIDO GRASO</b>	<b>COOH</b>	<b>ALMACENA E ESTRUCTURAL</b>
<b>PROTEÍNAS</b>	<b>AMINOÁCIDOS</b>	<b>COOH NH<sub>2</sub></b>	<b>CATÁLISIS TRANSPORTE</b>
<b>ÁCIDOS NUCLEICOS</b>	<b>NUCLEOTIDOS</b>	<b>PO<sub>4</sub><sup>-3</sup></b>	<b>EXPRESIÓN GÉNICA</b>



# FORMACIÓN DE POLÍMEROS Y RUPTURA DE UN ENLACE COVALENTE ENTRE SUBUNIDADES

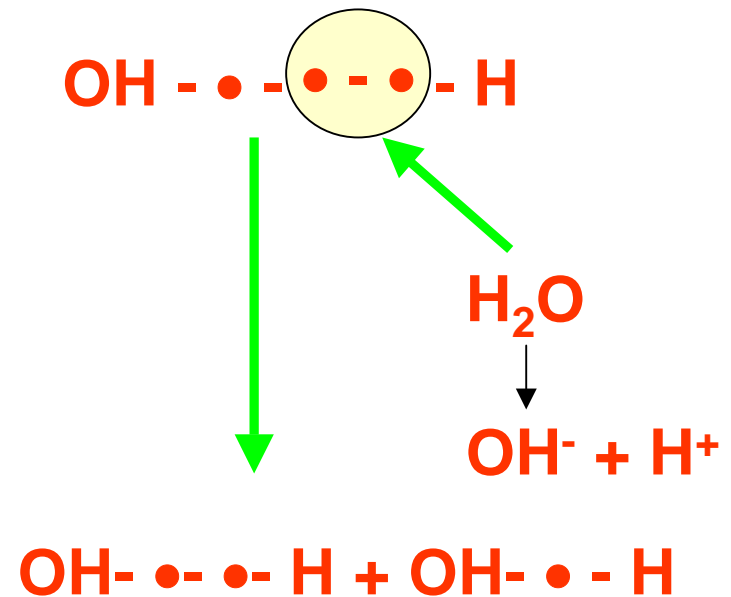
## FORMACIÓN

### DESHIDRATACIÓN



## RUPTURA

### HIDRÓLISIS



# **HIDRATOS DE CARBONO O CARBOHIDRATOS**

**CONTIENEN C,H,O (1:2:1)**

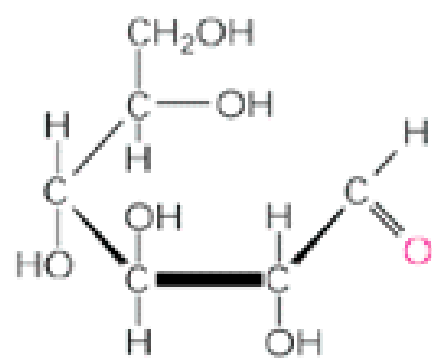
**FÓRMULA EMPÍRICA:  $(CH_2O)_n$**

**FUNCIÓN: ALMACENAN ENERGÍA: ENLACES C-H**

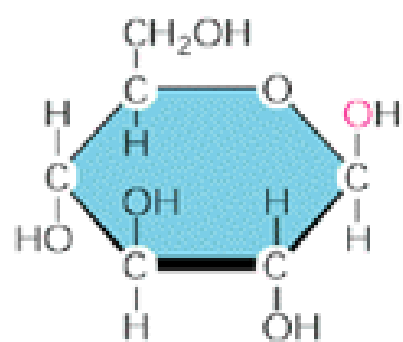
**CARBOHIDRATOS MÁS SIMPLES: MONOSACÁRIDOS O AZÚCARES SIMPLES**

**EL AZÚCAR MÁS SIMPLE: 3 ÁTOMOS DE C**

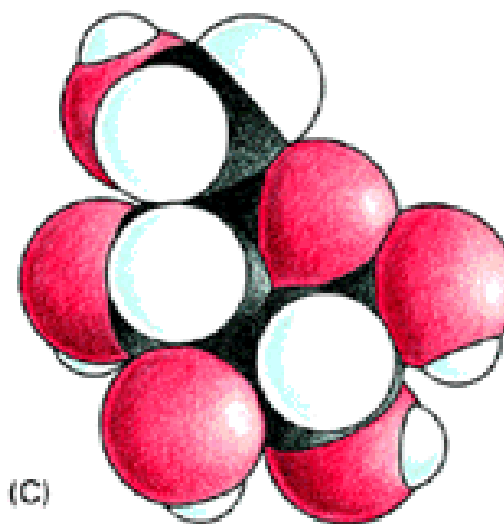
**LOS QUE TIENEN UN ROL ENERGÉTICO: 6 ÁTOMOS DE C**



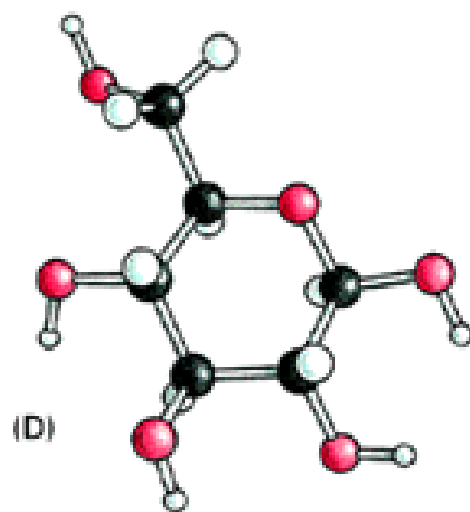
(A)



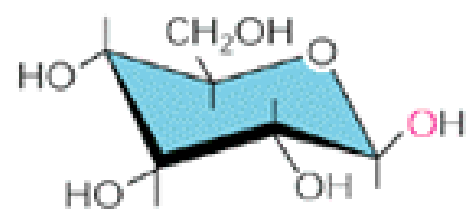
(B)



(C)

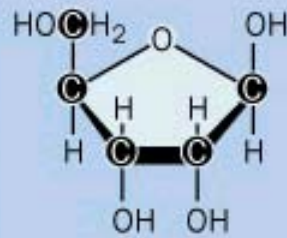


(D)

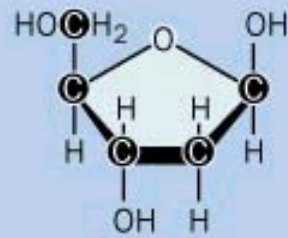


(E)

### Monosaccharides with 5 carbons

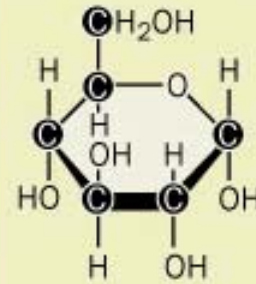


Ribose

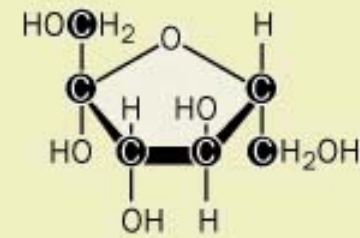


Deoxyribose

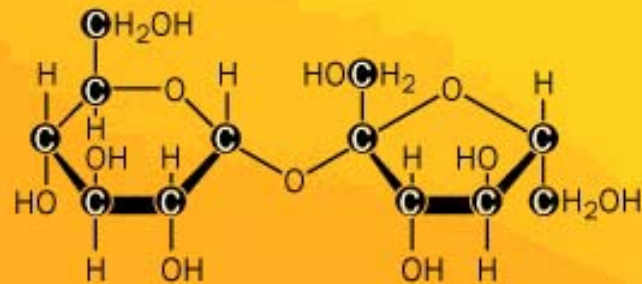
### Monosaccharides with 6 carbons



Glucose



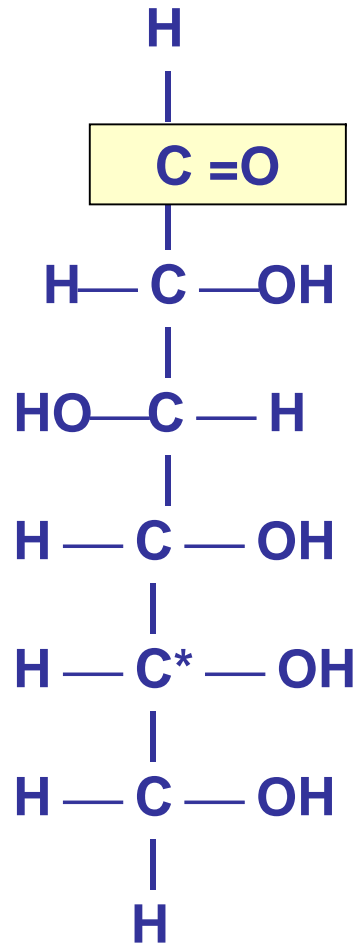
Fructose



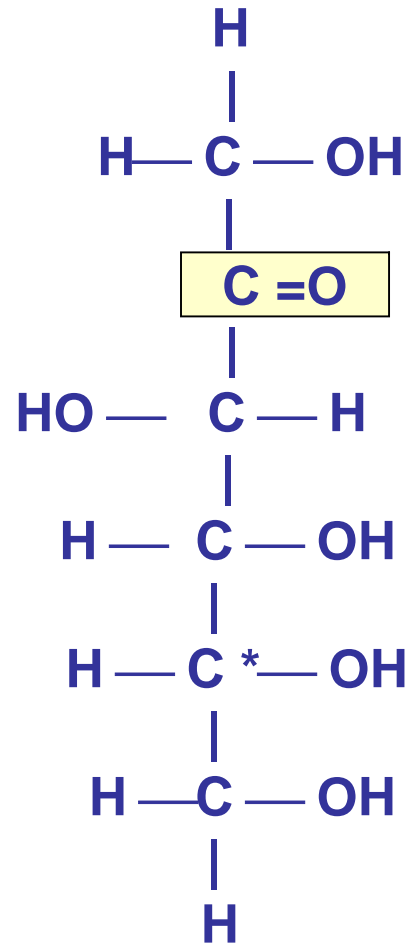
Sucrose (a disaccharide)

## Sugars

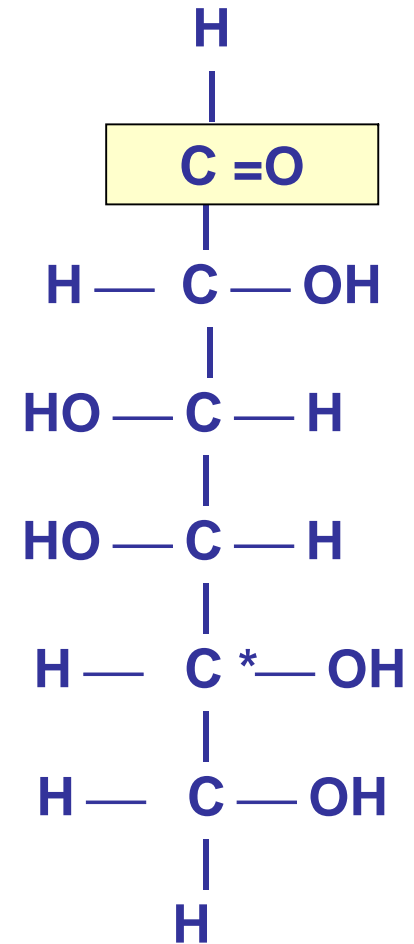
## GLUCOSA



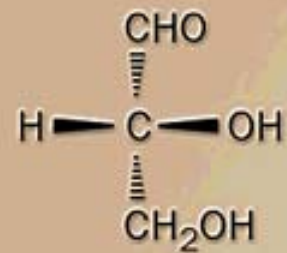
## FRUCTOSA



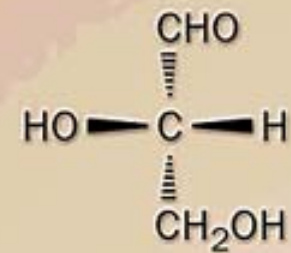
## GALACTOSA



**GLUCOSA-FRUCTOSA: ISÓMEROS ESTRUCTURALES**  
**GLUCOSA-GALACTOSA: ISÓMEROS ESPACIALES**



**D-Glyceraldehyde**

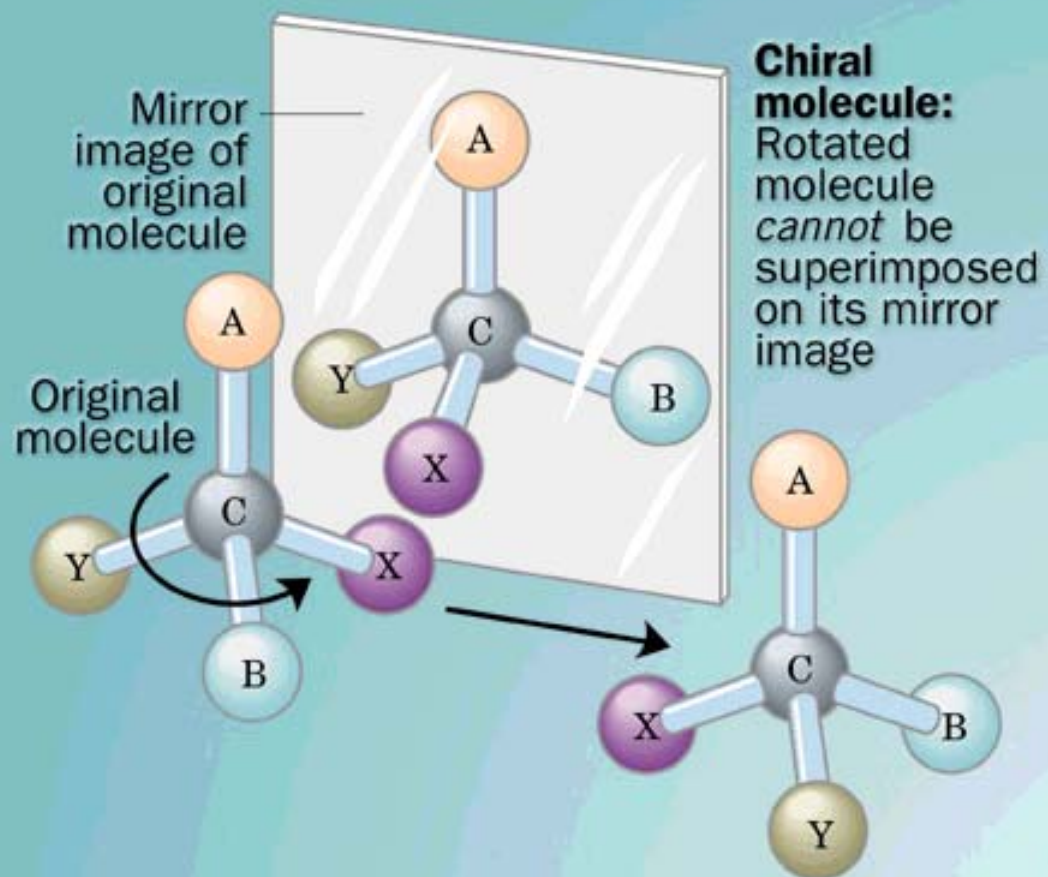


**L-Glyceraldehyde**





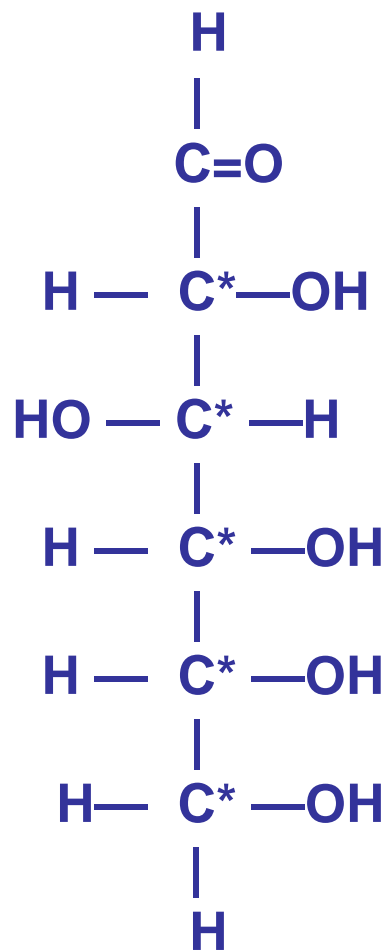
**ENANTIOMERS**



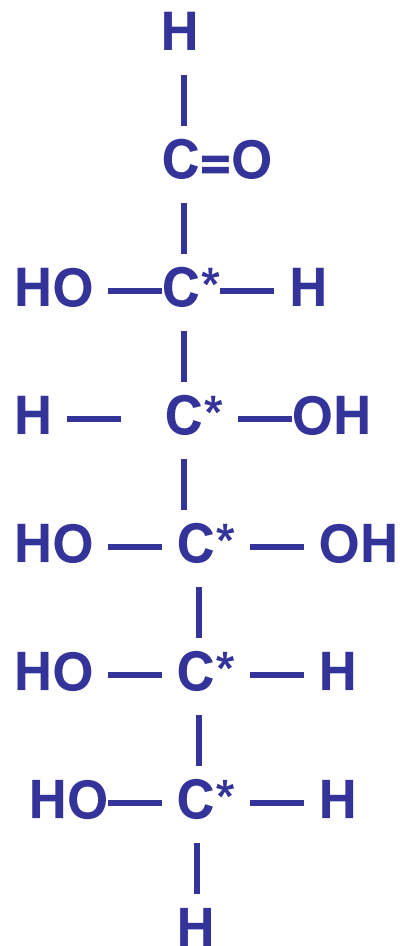
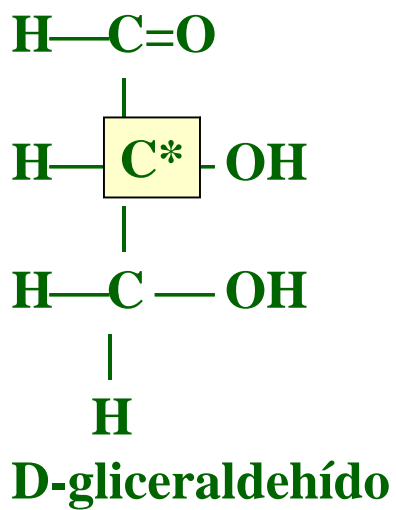


# ESTEREOISÓMEROS

## ENANTIÓMEROS - ISÓMEROS ÓPTICOS: IMAGEN ESPECULAR



D-Glucosa



L-Glucosa

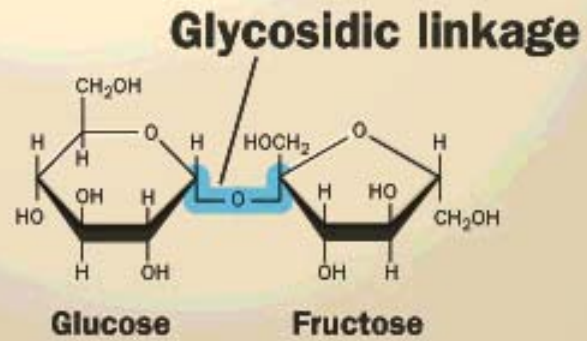
C\*: centro quiral

**Organismos vivos sólo metabolizan D-azúcares**

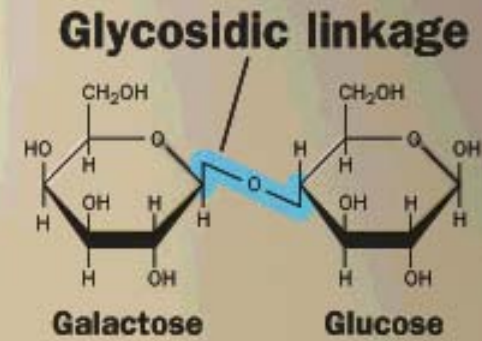


**Productos Dietéticos**

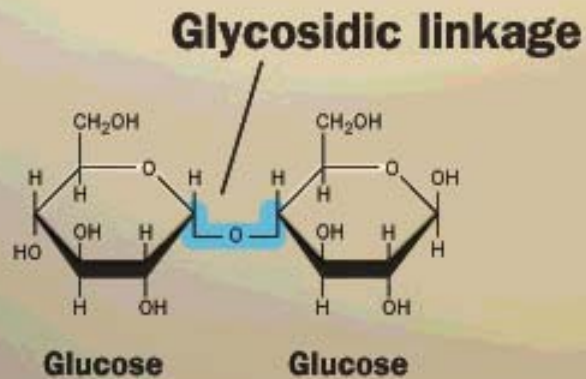
**L-azúcares**



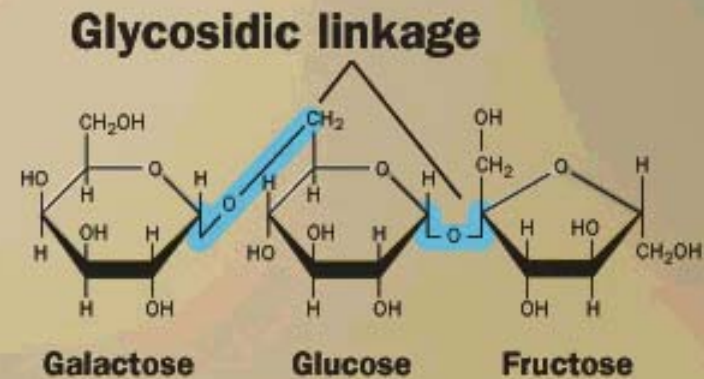
**Sucrose**



**Lactose**

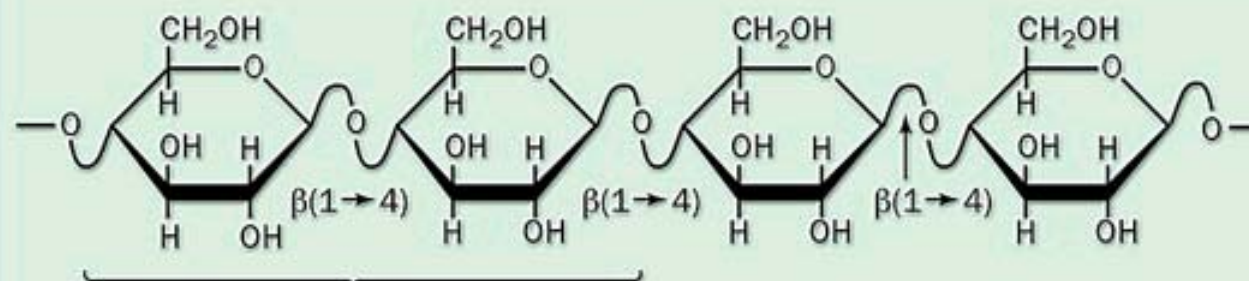


**Maltose**



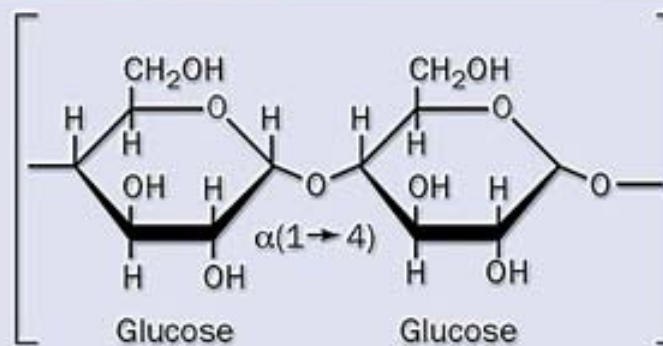
**Raffinose**

# **OLIGOSACCHARIDE**



Repeating disaccharide  
in cellulose ( $\beta$ -cellobiose)

**Cellulose**



Glucose

Glucose

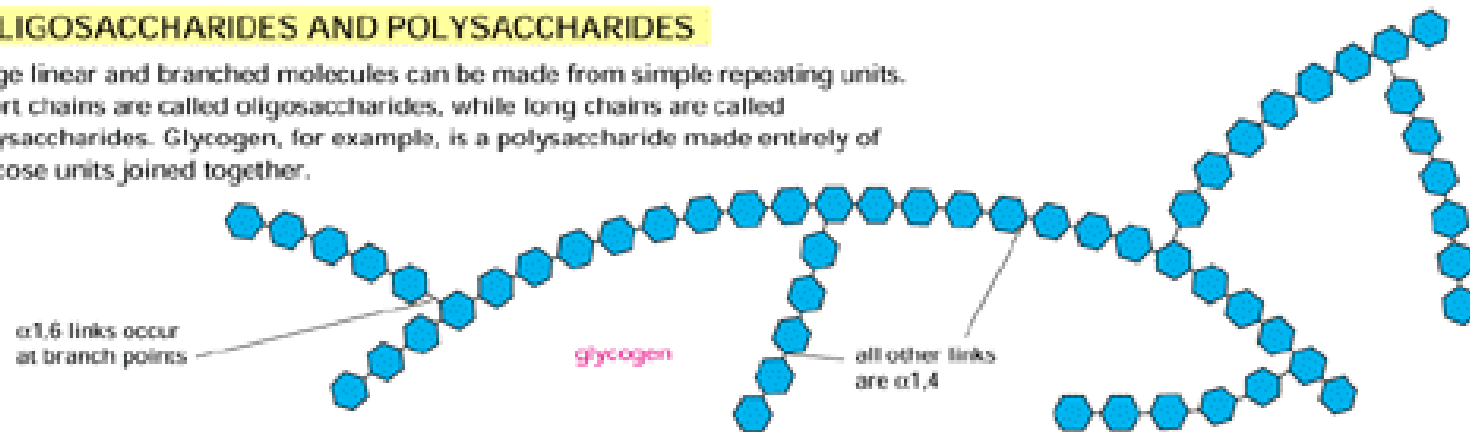
**Starch**

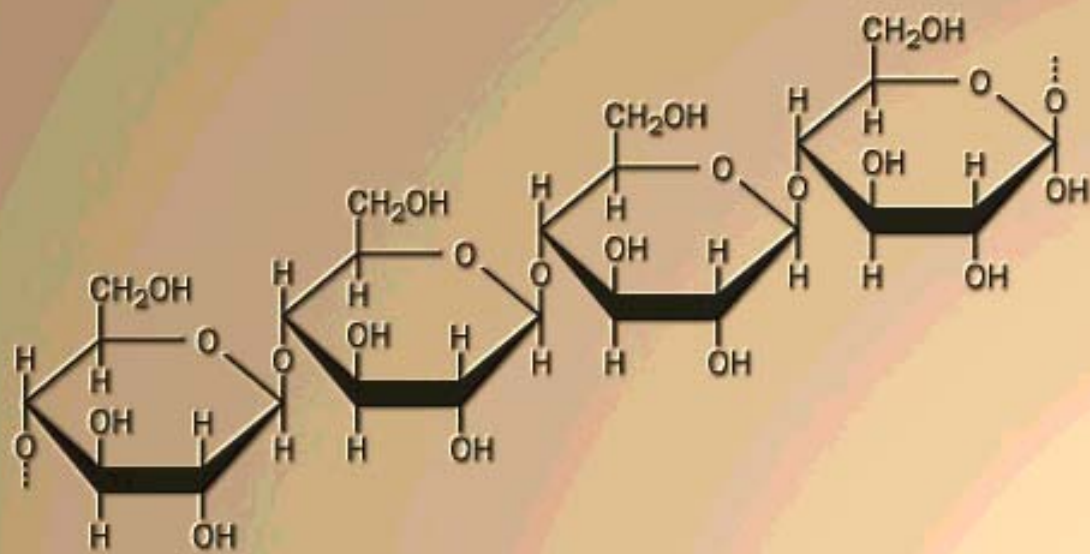
# Glicógeno

## Azúcar de almacenamiento en animales

### OLIGOSACCHARIDES AND POLYSACCHARIDES

Large linear and branched molecules can be made from simple repeating units. Short chains are called oligosaccharides, while long chains are called polysaccharides. Glycogen, for example, is a polysaccharide made entirely of glucose units joined together.

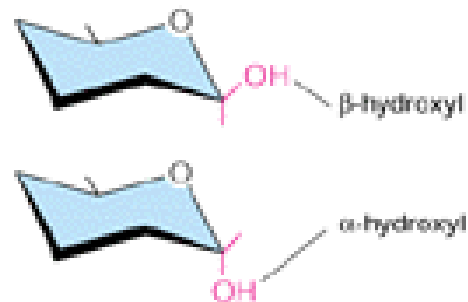




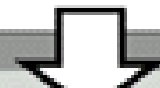
**Cellulose**

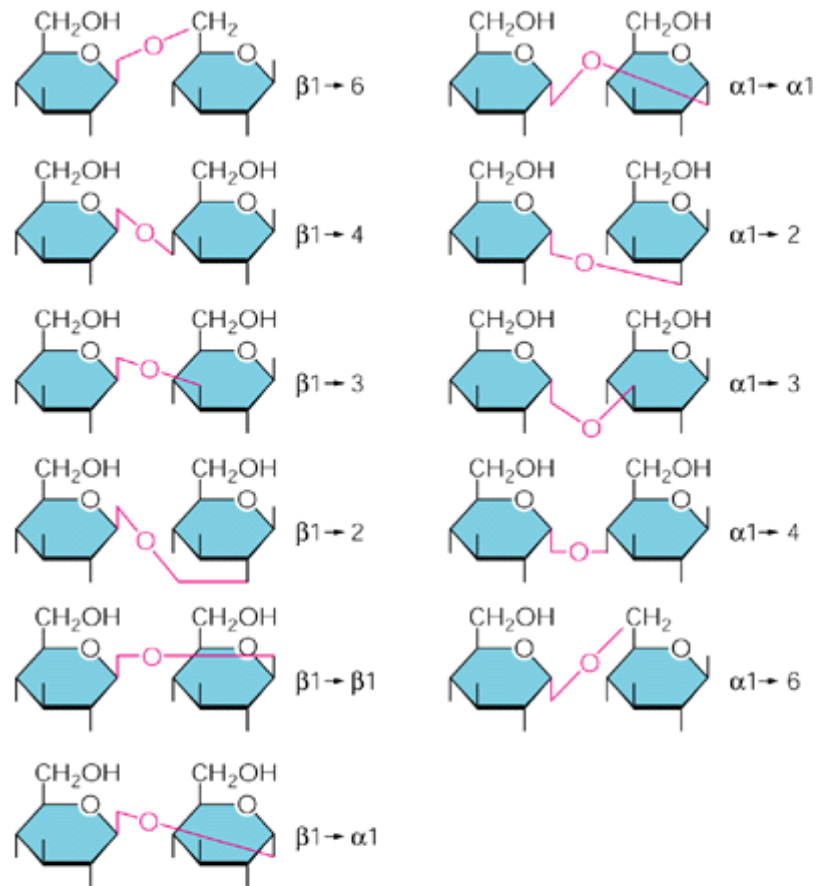
### $\alpha$ - AND $\beta$ -LINKS

The hydroxyl group on the carbon that carries the aldehyde or ketone can rapidly change from one position to another. These two positions are called  $\alpha$ - and  $\beta$ -.



As soon as one sugar is linked to another, the  $\alpha$ - or  $\beta$ -form is frozen.





**11 disacáridos formados por 2 residuos de D-glucosas**