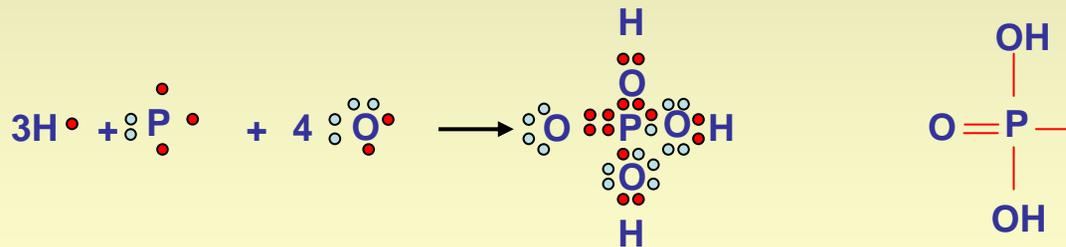
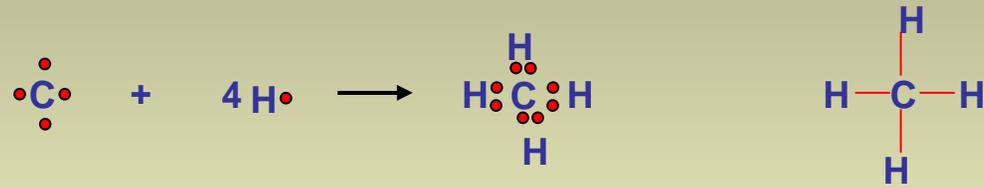
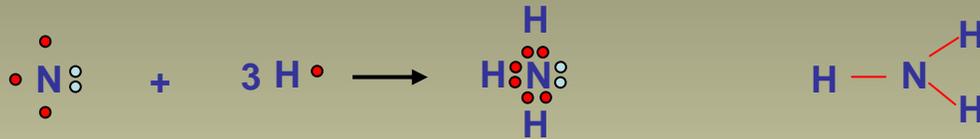
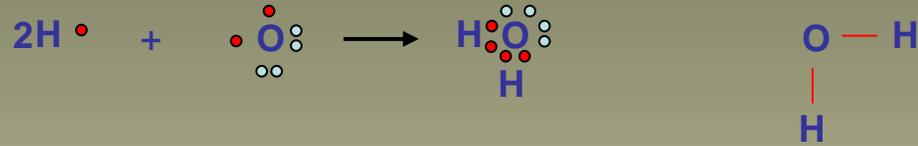




Átomo	Número de electrones no apareados (en rojo)	Número de electrones en la capa externa
 H	1	2
 O	2	8
 N	3	8
 C	4	8
 S	2	8
 P	3	8



**Abundancia de elementos en el agua de mar, en el cuerpo humano y en la corteza terrestre**

Agua de mar	(%)	Cuerpo humano	(%)	corteza terrestre	(%)
H	66	H	63	O	47
O	33	O	25.5	Si	28
Cl	0.33	C	9.5	Al	7.9
Na	0.28	N	1.4	Fe	4.5
Mg	0.033	Ca	0.31	Ca	3.5
S	0.017	P	0.22	Na	2.5
Ca	0.0062	Cl	0.08	K	2.5
K	0.0060	K	0.06	Mg	2.2
C	0.0014				

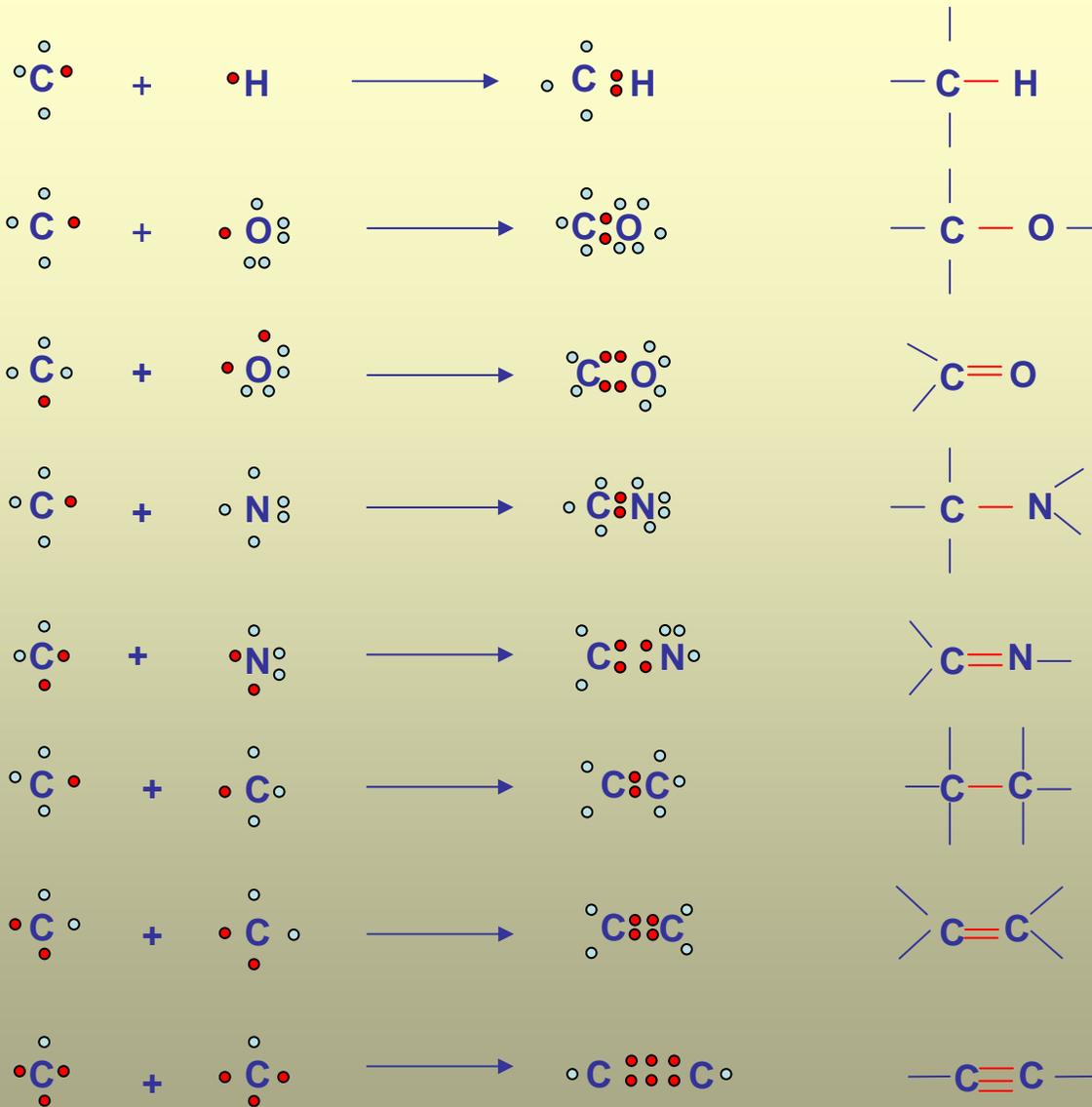
Los valores se dan como porcentaje del número total de átomos

## Función biológica de algunos elementos traza

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Elemento	Ejemplo de función biológica
Fe	Transportador de electrones en reacciones de óxido-reducción
Cu	Componente de oxidasa mitocondrial
Mn	Cofactor de la enzima arginasa y de otras enzimas
Zn	Cofactor de dehidrogenasas
Co	Componente de la vitamina B12
Mo	Componente de enzima fijadora de N <sub>2</sub>
Se	Componente de la enzima glutatión peroxidasa
V	Cofactor de la enzima nitrato reductasa
Ni	Cofactor de la enzima ureasa
I	Componente de la hormona tiroídea
Mg	Cofactor en la fotosíntesis

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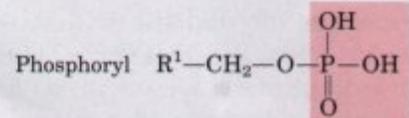
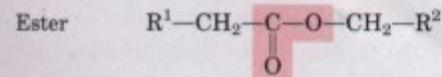
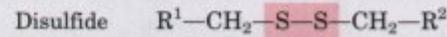
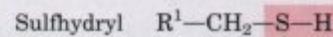
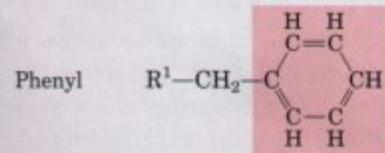
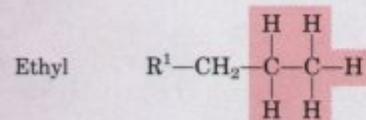
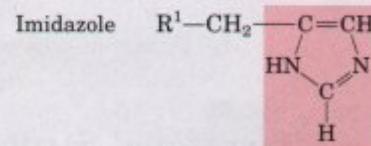
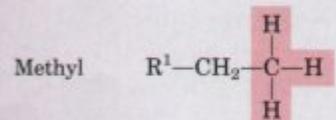
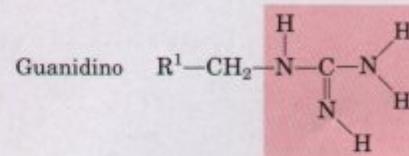
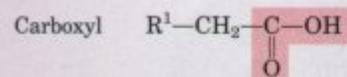
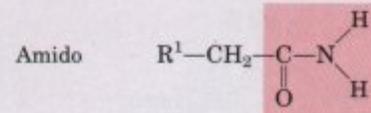
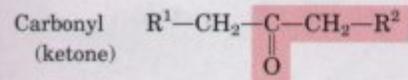
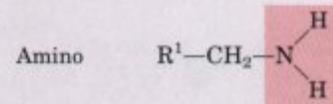
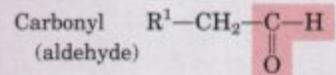
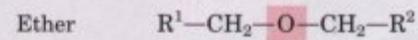
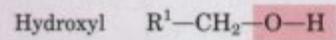
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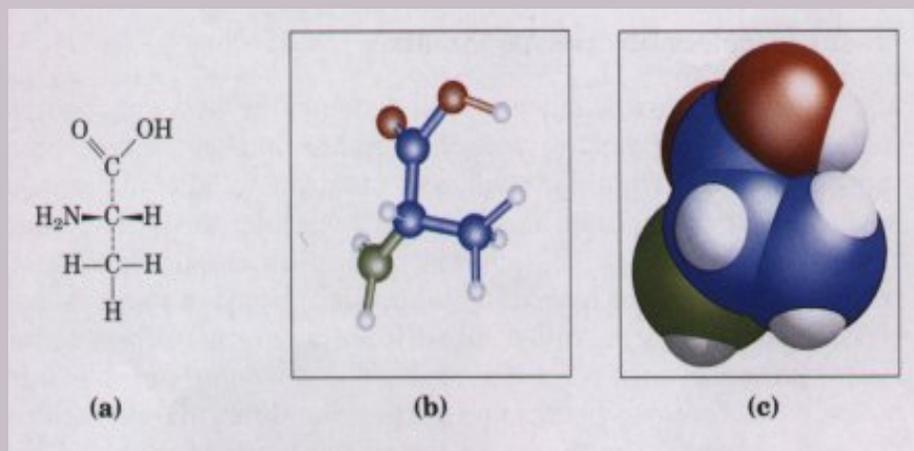
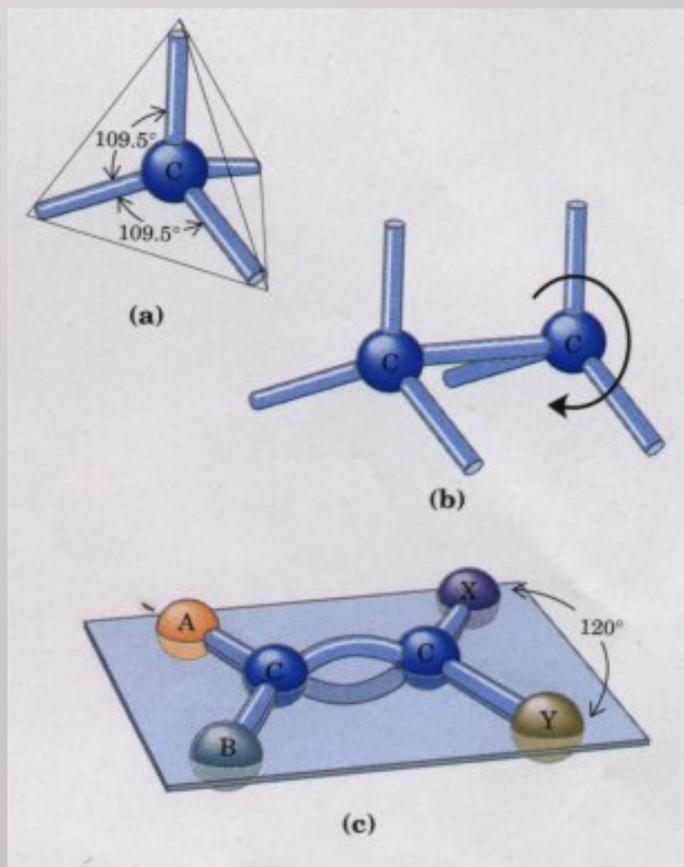
## Componentes químicos de las células

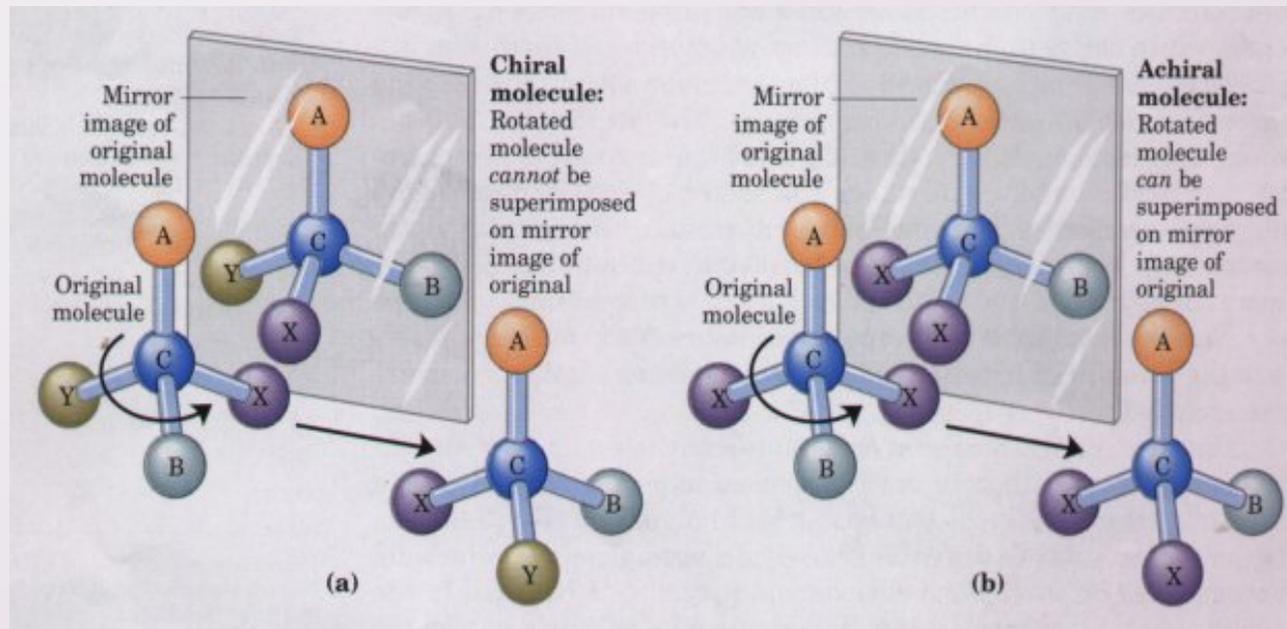
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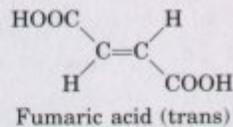
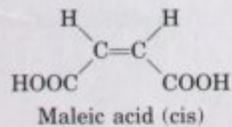
Componente	Rango de peso molecular
H <sub>2</sub> O	18
Iones inorgánicos: Na <sup>+</sup> , K <sup>+</sup> , Cl <sup>-</sup> , SO <sub>4</sub> <sup>2-</sup> , HCO <sub>3</sub> <sup>-</sup> , Ca <sup>2+</sup> , Mg <sup>2+</sup> , etc	23-100
Moléculas orgánicas pequeñas: Carbohidratos, aminoácidos, lípidos, nucleótidos, péptidos	100-1200
Macromoléculas: Proteínas, Polisacáridos, ácidos nucleicos	50.000 — 1x10 <sup>9</sup>

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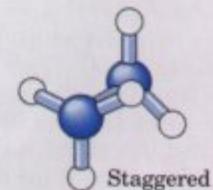
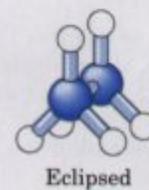
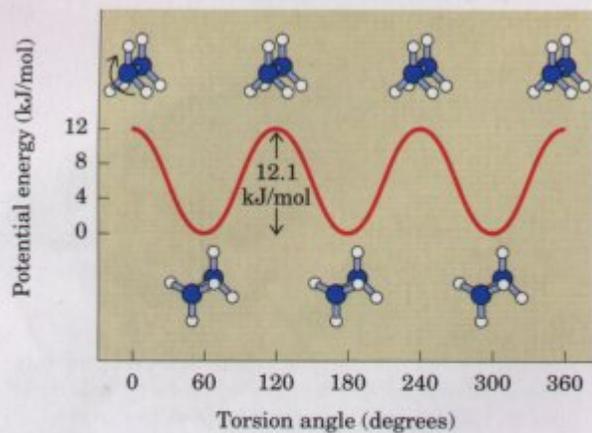
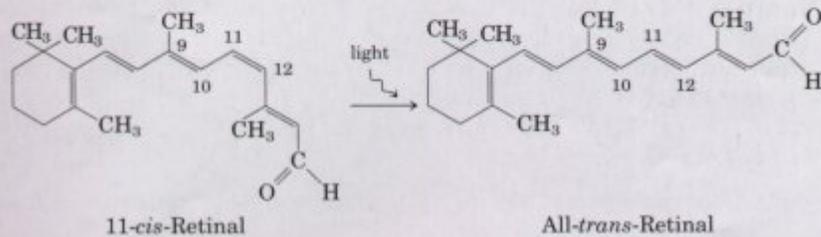
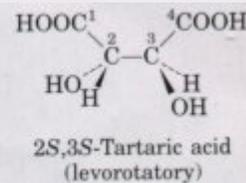
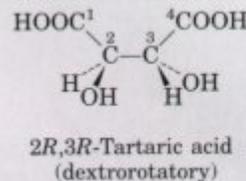








(a)



**Table 3-5 Strengths of bonds common in biomolecules**

Type of bond	Bond dissociation energy (kJ/mol)	Type of bond	Bond dissociation energy (kJ/mol)
<i>Single bonds</i>		<i>Double bonds</i>	
O—H	461	C=O	712
H—H	435	C=N	615
P—O	419	C=C	611
C—H	414	P=O	502
N—H	389		
C—O	352	<i>Triple bonds</i>	
C—C	348	C≡C	816
S—H	339	N≡N	930
C—N	293		
C—S	260	<i>Noncovalent bonds or interactions</i>	
N—O	222	Hydrogen bonds	} 4–20
S—S	214	van der Waals interactions	
		Hydrophobic interactions	
		Ionic interactions	

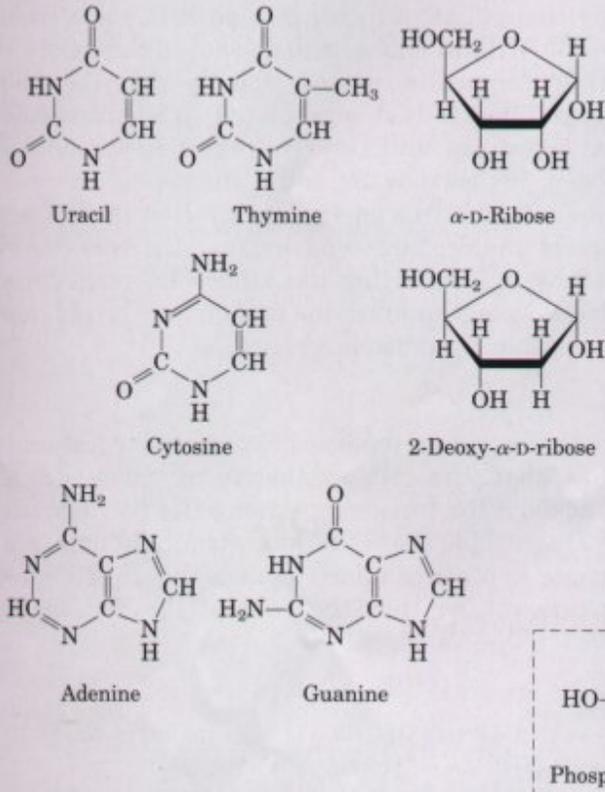
**Table 3-3** Radios de Van der Waals y covalente (enlace simple), radio de algunos elementos\*

Element	Radio de van der Waals (nm)	Radio Covalente para enlace simple(nm)
H	0.1	0.030
O	0.14	0.074
F	0.14	0.071
N	0.15	0.073
C	0.17	0.077
S	0.18	0.103
Cl	0.18	0.099
P	0.19	0.110
Br	0.20	0.114
I	0.22	0.133

El radio de van der Waals para cada elemento es  $\pm$  dos veces el radio el covalente. La distanciam entre núcleos en una Interacción de van der Waals o un enlace covalente es approx. igual a la suma de los valores para los dos átomos. Así,

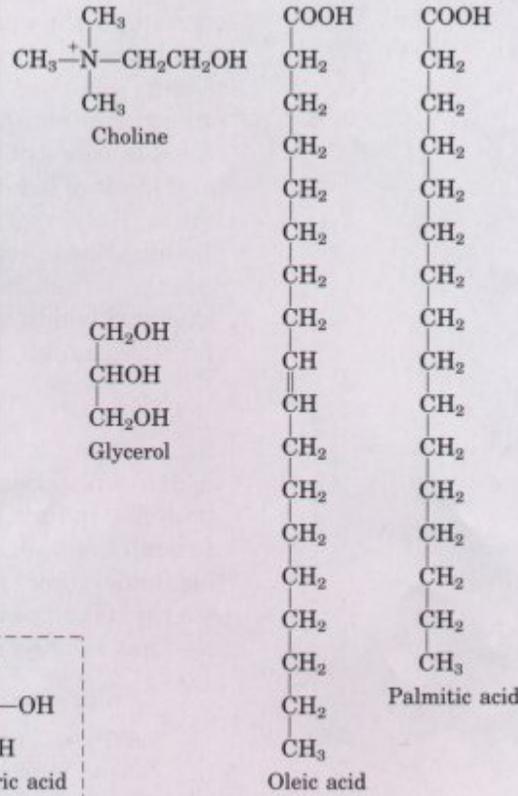
La longitud de un enlace simple C-C es  $\pm 0.077 + 0.077 = 0.154$  nm

**The components of nucleic acids**



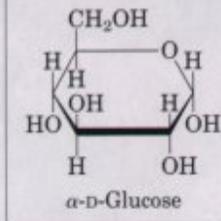
(b)

**Some components of lipids**

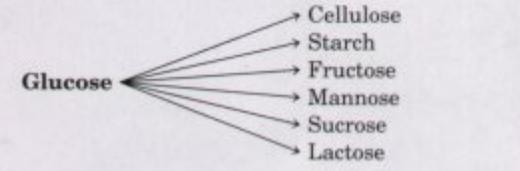
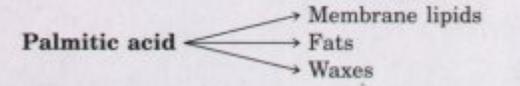
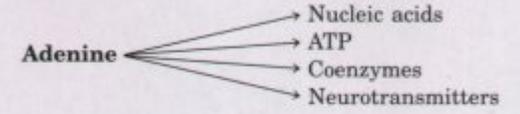
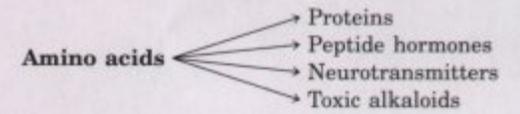


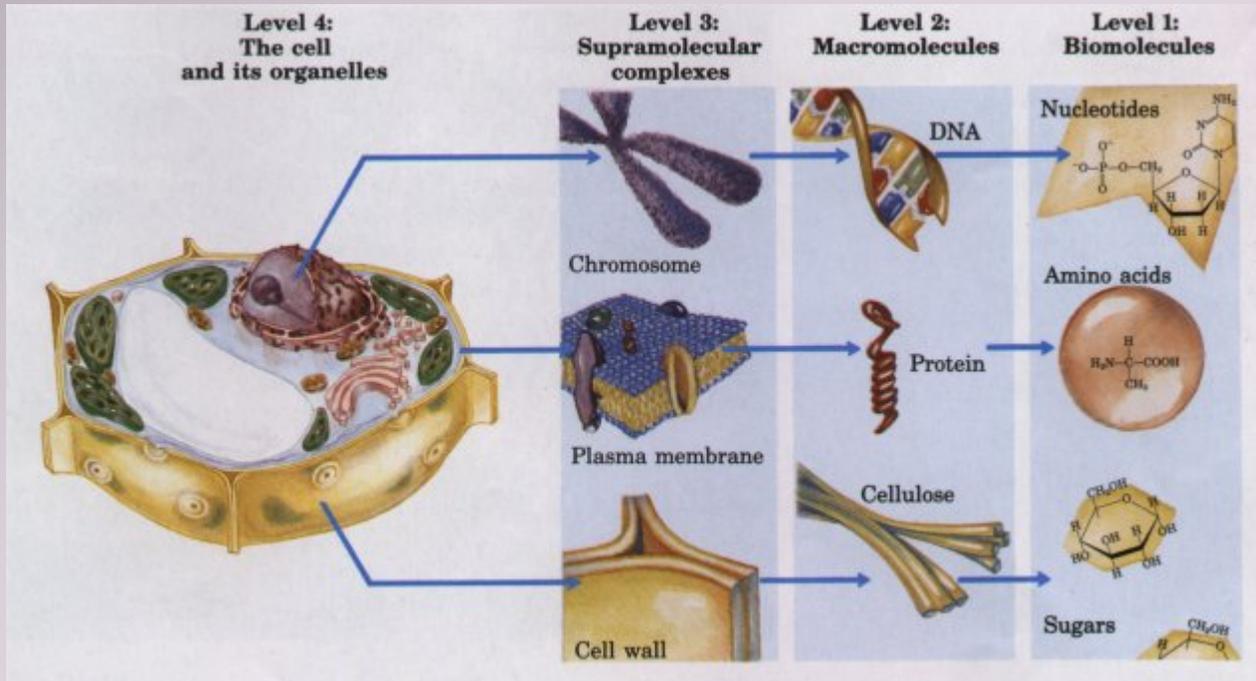
(c)

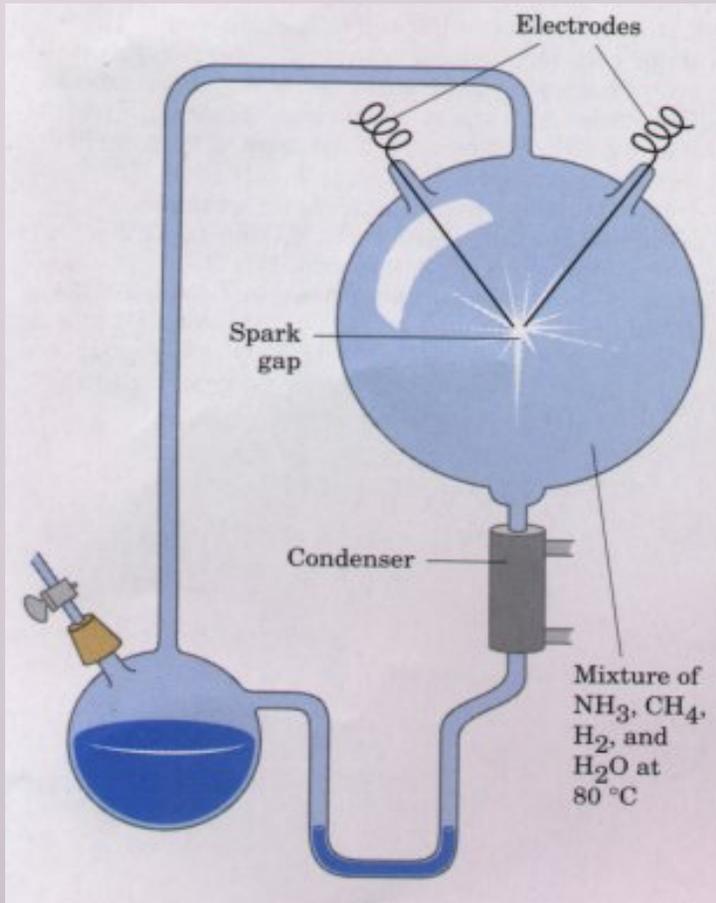
**The parent sugar**



(d)







El bioquímico ruso Alexander Oparin y el fisiólogo escocés John Haldane propusieron en forma Independiente la hipótesis de que la vida celular fue precedida por un período de evolución química. Durante ésta etapa se produjo la formación espontánea de moléculas orgánicas simples a partir de compuestos químicos simples. 1920s

Esta proposición fue probada experimentalmente en el laboratorio de Harold Urey por Stanley Miller. 1950s

- Cuatro factores facilitaron la evolución química:
- 1- Ausencia de oxígeno libre.
  - 2- Energía
  - 3- Materia química (agua, iones minerales, y gases de la atmósfera inicial)
  4. Tiempo.

## Algunos productos formados en condiciones prebióticas

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### Aminoácidos:

Glicina

Alanina

Ac.  $\alpha$ -aminobutírico

Valina

Leucina

Isoleucina

Prolina

Ac. Aspártico

Ac. Glutámico

Serina

Treonina

Azúcares

Pentosas y hexosas

lineales y ramificadas

### Acidos carboxílicos:

Ácido fórmico

Ac. Acético

Ac. Propiónico

Ac. Grasos rectos

y ramificados (C4-C10)

Ac. Glicólico

Ac. Láctico

Ac. Succínico

### Bases de ac. Nucleicos

Adenina

Guanina

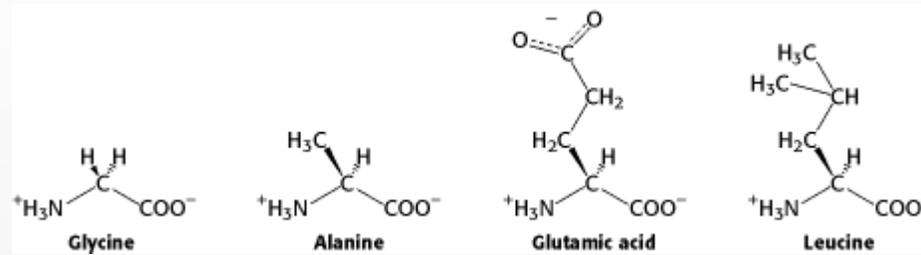
Xantina

Hipoxantina

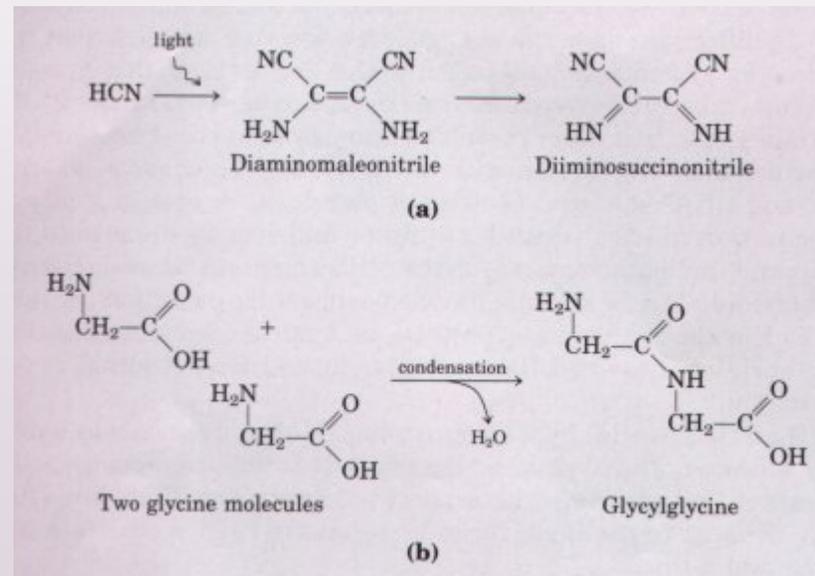
Citosina

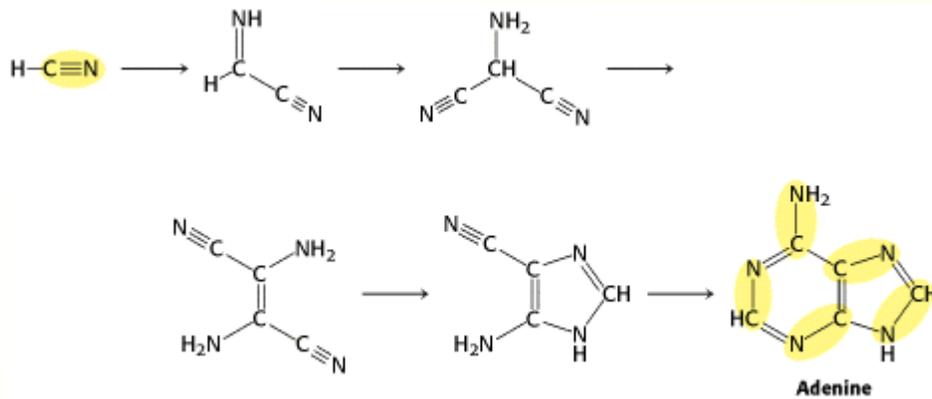
uracilo

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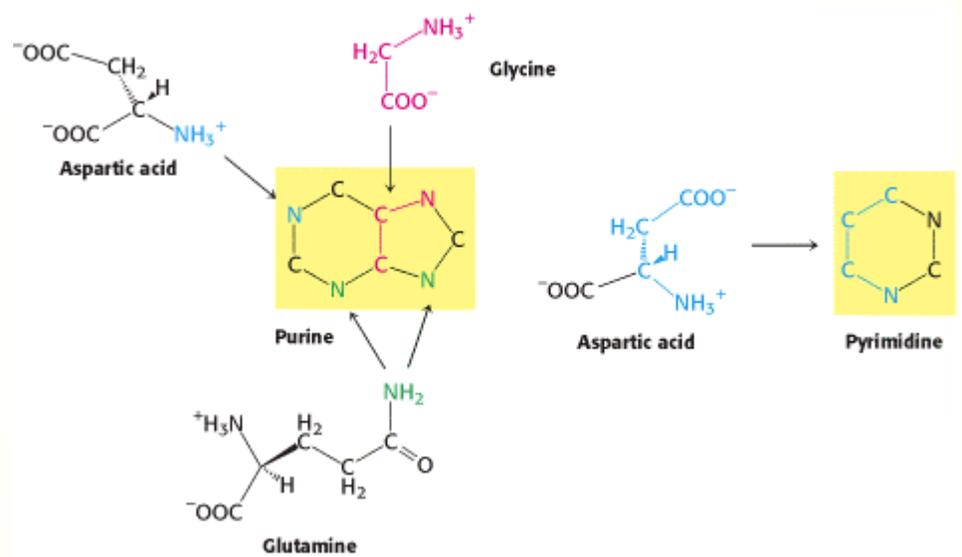


## Productos de síntesis prebiótica, aminoácidos producidos en experimento de Urey-Miller

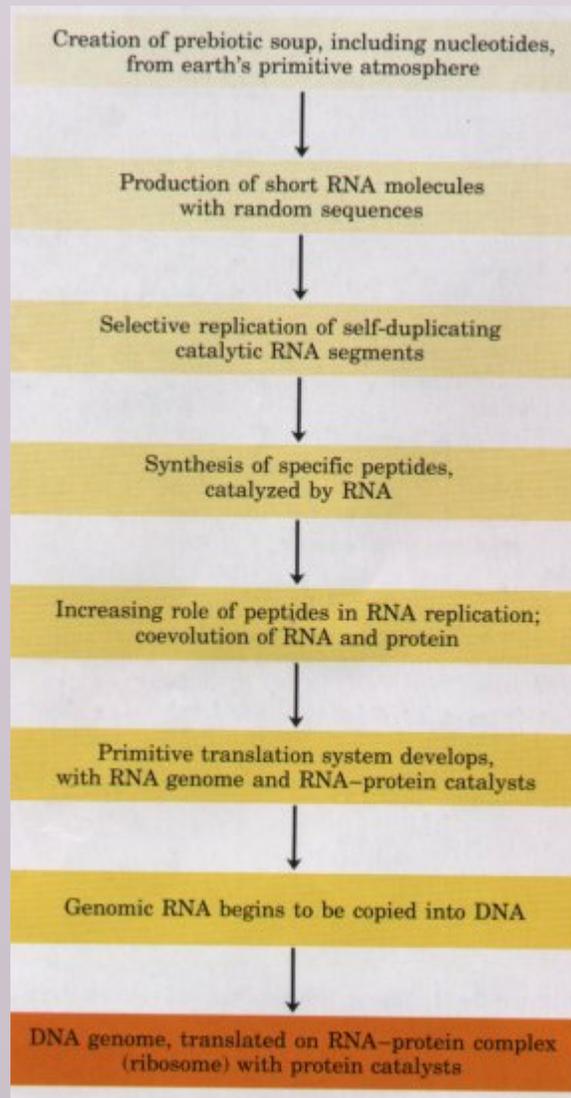




## Productos producidos por reacciones del ácido cianhídrico



## Aminoácidos como precursores de bases



# Evolución de vía metabólica

