BIOQUÍMICA: Rama del conocimiento que estudia el fenómeno de la vida desde un punto de vista químico, buscando explicar y describir las estructuras y funciones biológicas en términos moleculares.

El bioquímico se plantea preguntas del tipo…

¿Cuáles son las estructuras químicas de los componentes de la materia viva?

¿Cómo interactúan estos componentes para formar estructuras supramoleculares, células, tejidos, órganos y organismos?

¿Cómo puede la materia viva extraer energía de su entorno para mantenerse viva?

¿Cómo almacena y transmite un organismo la información necesaria para crecer y reproducirse?

¿Cuáles son las transformaciones químicas responsables de la reproducción, el envejecimiento o la muerte?

¿Cómo se controlan éstas y otras transformaciones químicas en el interior de las células vivas?

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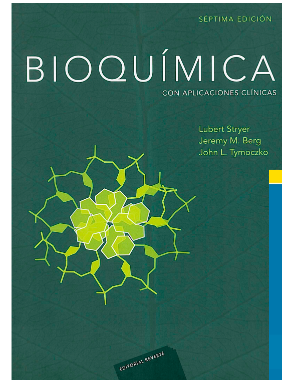
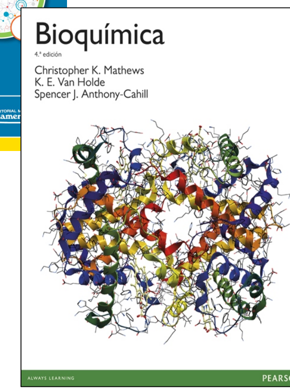
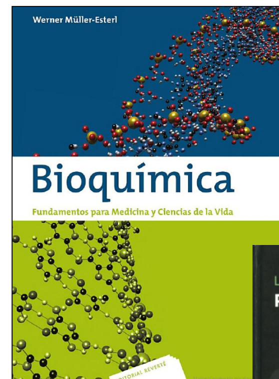


1200 pp.

456 pp.

1376 pp.





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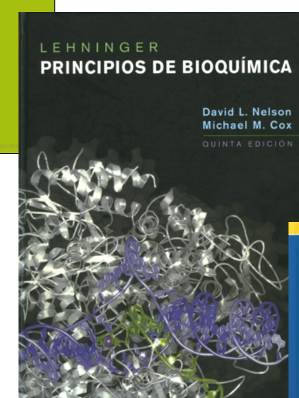


1300 pp.

1276 pp.

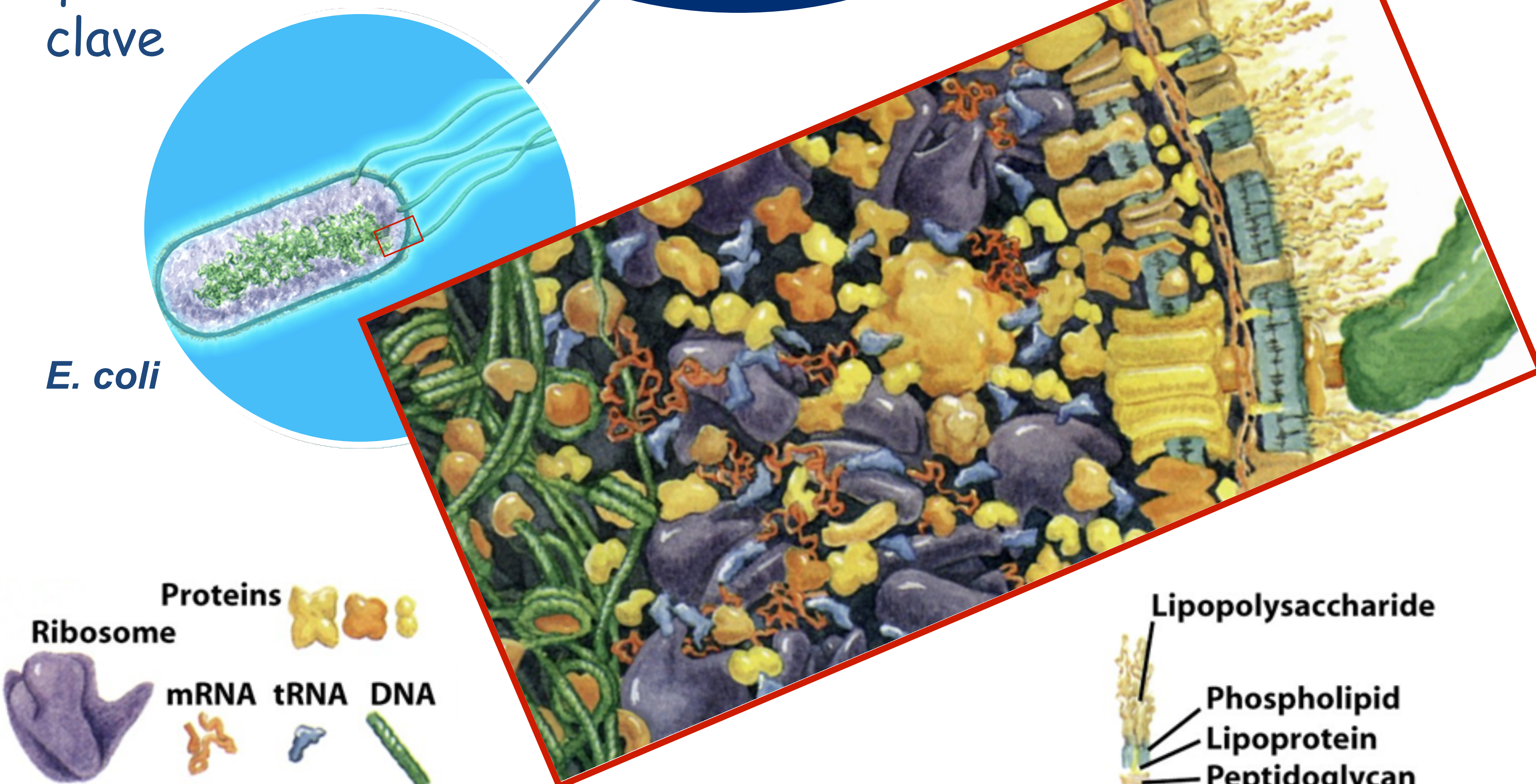
La mayor parte de las moléculas biológicas son grandes y complejas

MACROMOLÉCULAS

La Vida

conceptos químico-físicos clave

Complejidad y Orden



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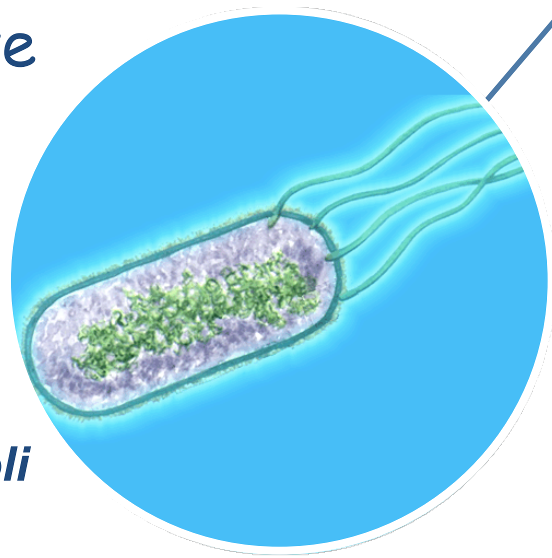


E. coli

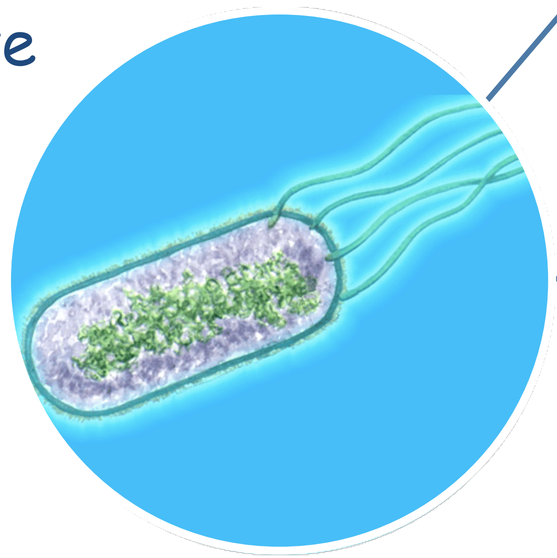
MACROMOLÉCULAS

Compuestos de C, capaz de formar enlaces covalentes y una amplia diversidad de grupos funcionales

TABLE 1–1	Molecular Components of an *E. coli* Cell	
	Percentage of total weight of +1cell	Approximate number of different
Water	70	1
Proteins	15	3,000
Nucleic acids		
DNA	1	1
RNA	6	>3,000
Polysaccharides	3	5
Lipids	2	20
Monomeric subunits and intermediates	2	500
Inorganic ions	1	20

Table 1-1
Lehninger Principles of Biochemistry, Fifth Edition

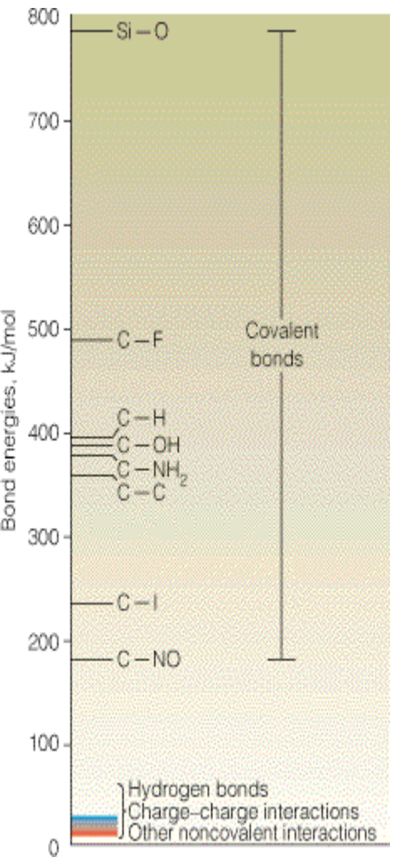
La Vida
conceptos químico-físicos clave

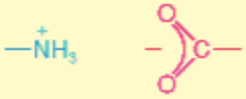
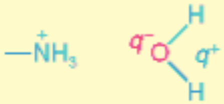
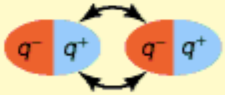
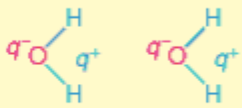
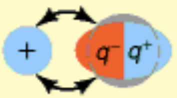
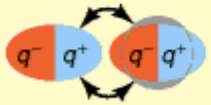
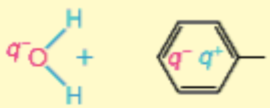
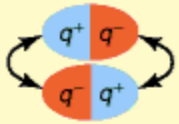
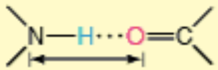


Complejidad y Orden

Interacciones Dinámicas entre moléculas

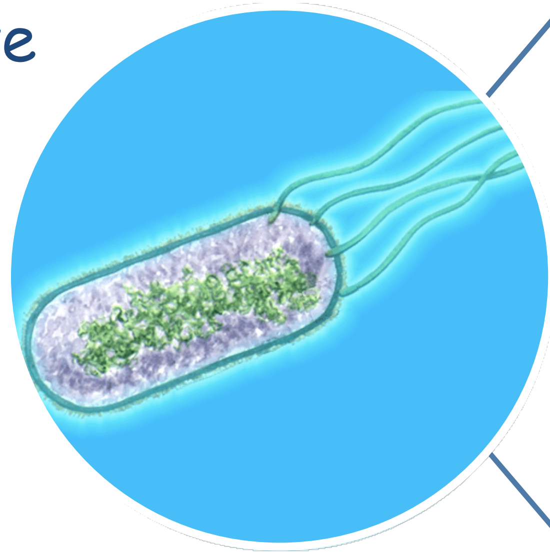
Las moléculas biológicas se reconocen e interaccionan mediante **enlaces débiles** que se están rompiendo y formando continuamente



Type of Interaction	Model	Example	Dependence of Energy on Distance
(a) Charge–charge Longest-range force; nondirectional			$1/r$
(b) Charge–dipole Depends on orientation of dipole			$1/r^2$
(c) Dipole–dipole Depends on mutual orientation of dipoles			$1/r^3$
(d) Charge–induced dipole Depends on polarizability of molecule in which dipole is induced			$1/r^4$
(e) Dipole–induced dipole Depends on polarizability of molecule in which dipole is induced			$1/r^5$
(f) Dispersion Involves mutual synchronization of fluctuating charges			$1/r^6$
(g) van der Waals repulsion Occurs when outer electron orbitals overlap			$1/r^{12}$
(h) Hydrogen bond Charge attraction + partial covalent bond	 Donor Acceptor	 Hydrogen bond length	**Fixed Bond Length**

Bioquímica *3rd ed.*; Mathews, van Holde, Ahern

La Vida
conceptos químico-físicos clave



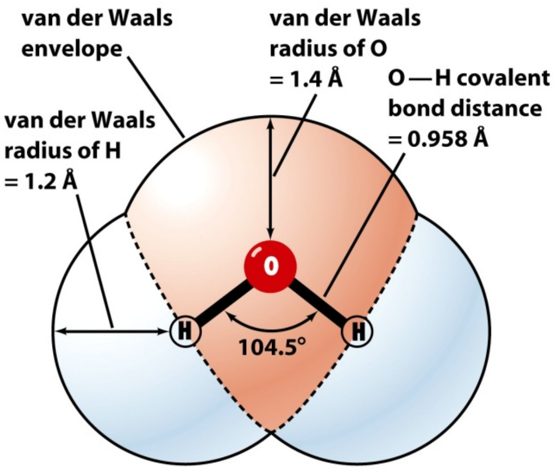
Complejidad y Orden

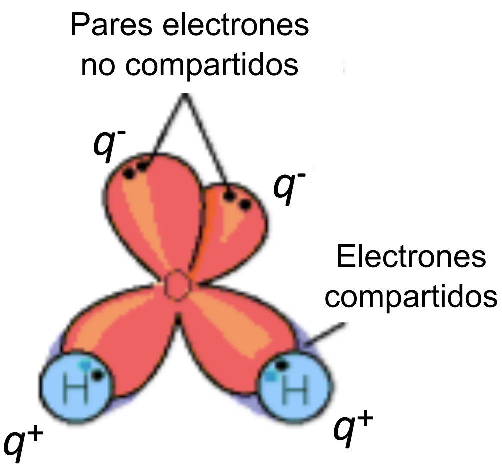
Interacciones Dinámicas entre moléculas

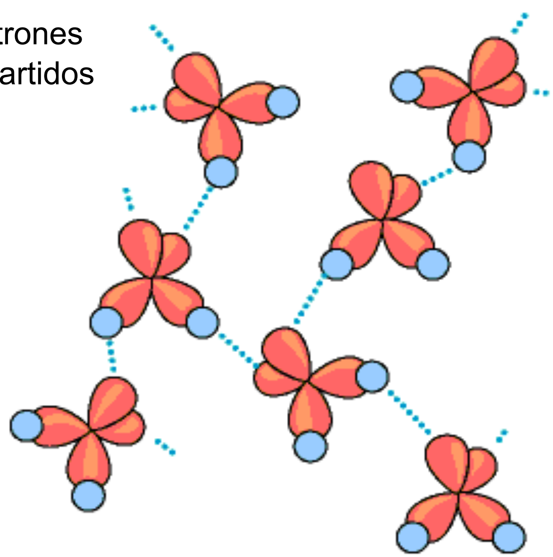
H_2O
El medio vital

¿Cómo afecta el medio acuoso a las estructuras de las macromoléculas y a las interacciones débiles?

H_2O: Un disolvente muy especial





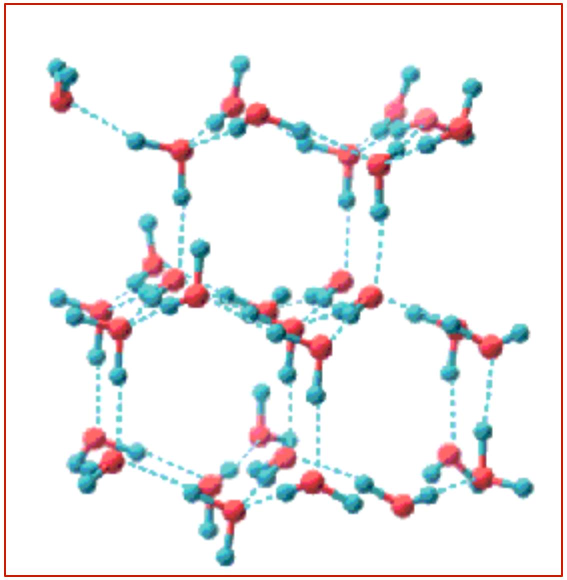


El agua comparada con compuestos de bajo peso molecular

Compound	Molecular Weight	Melting Point (°C)	Boiling Point (°C)	Heat of Vaporization (kJ/mol)
CH_4	16.04	−182	−164	8.16
NH_3	17.03	−78	−33	23.26
H_2O	18.02	0	+100	40.71
H_2S	34.08	−86	−61	18.66

TABLE 2–1 Melting Point, Boiling Point, and Heat of Vaporization of Some Common Solvents

	Melting point (°C)	Boiling point (°C)	Heat of vaporization (J/g)*
Water	0	100	2,260
Methanol (CH_3OH)	−98	65	1,100
Ethanol (CH_3CH_2OH)	−117	78	854
Propanol ($CH_3CH_2CH_2OH$)	−127	97	687
Butanol ($CH_3(CH_2)_2CH_2OH$)	−90	117	590
Acetone (CH_3COCH_3)	−95	56	523
Hexane ($CH_3(CH_2)_4CH_3$)	−98	69	423
Benzene (C_6H_6)	6	80	394
Butane ($CH_3(CH_2)_2CH_3$)	−135	−0.5	381
Chloroform ($CHCl_3$)	−63	61	247



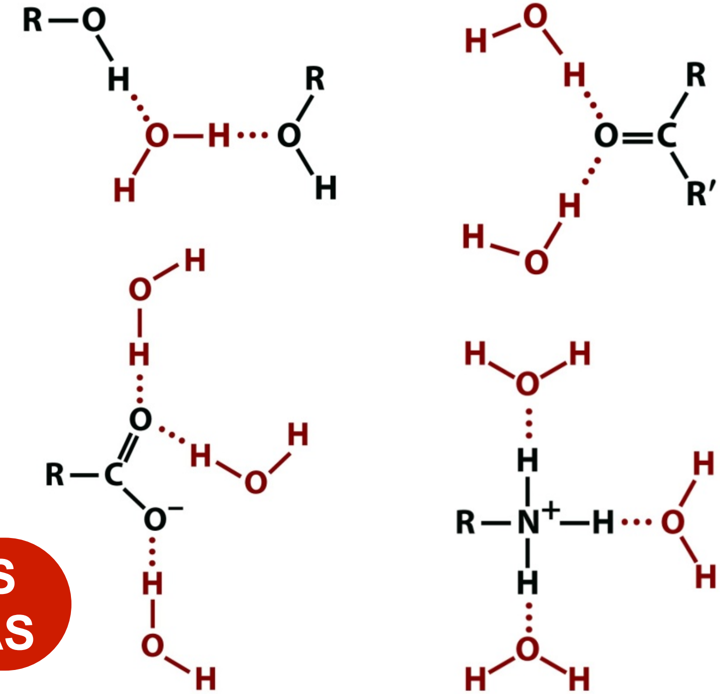
Estructura del hielo

El H_2O como disolvente

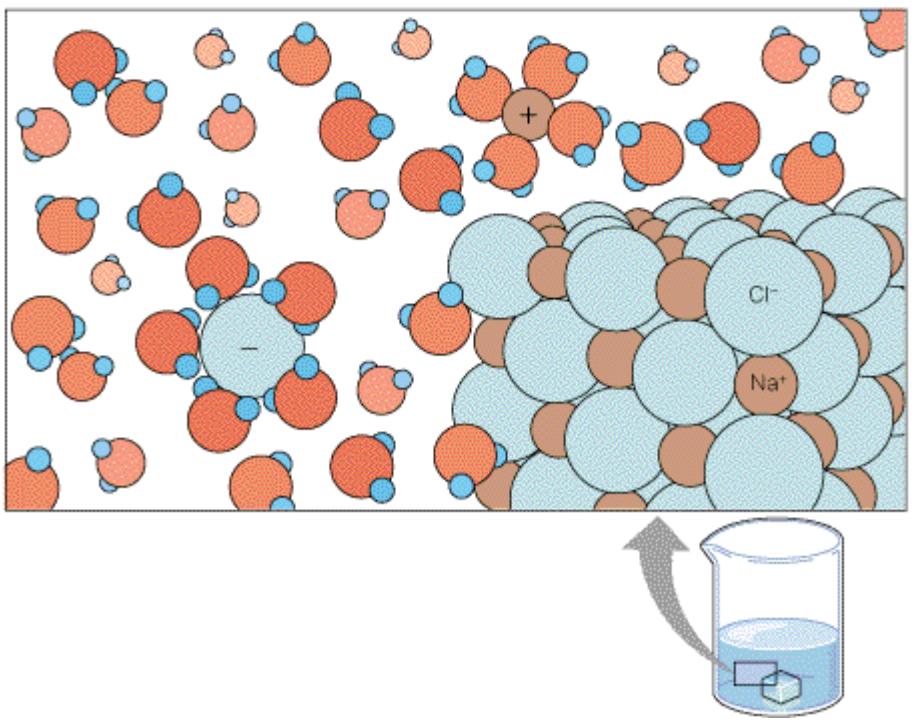
- Carácter Prótico
- Carácter Polar

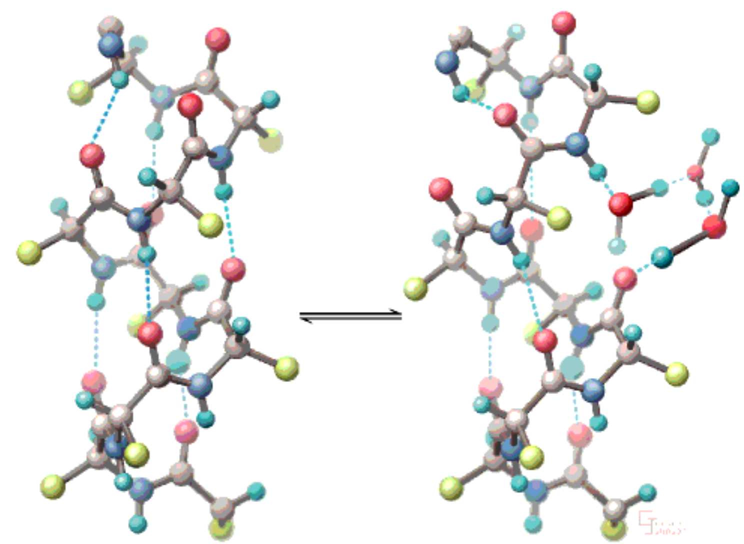
H_2O en comparación con *n*-Pentano (no polar y aprótico)

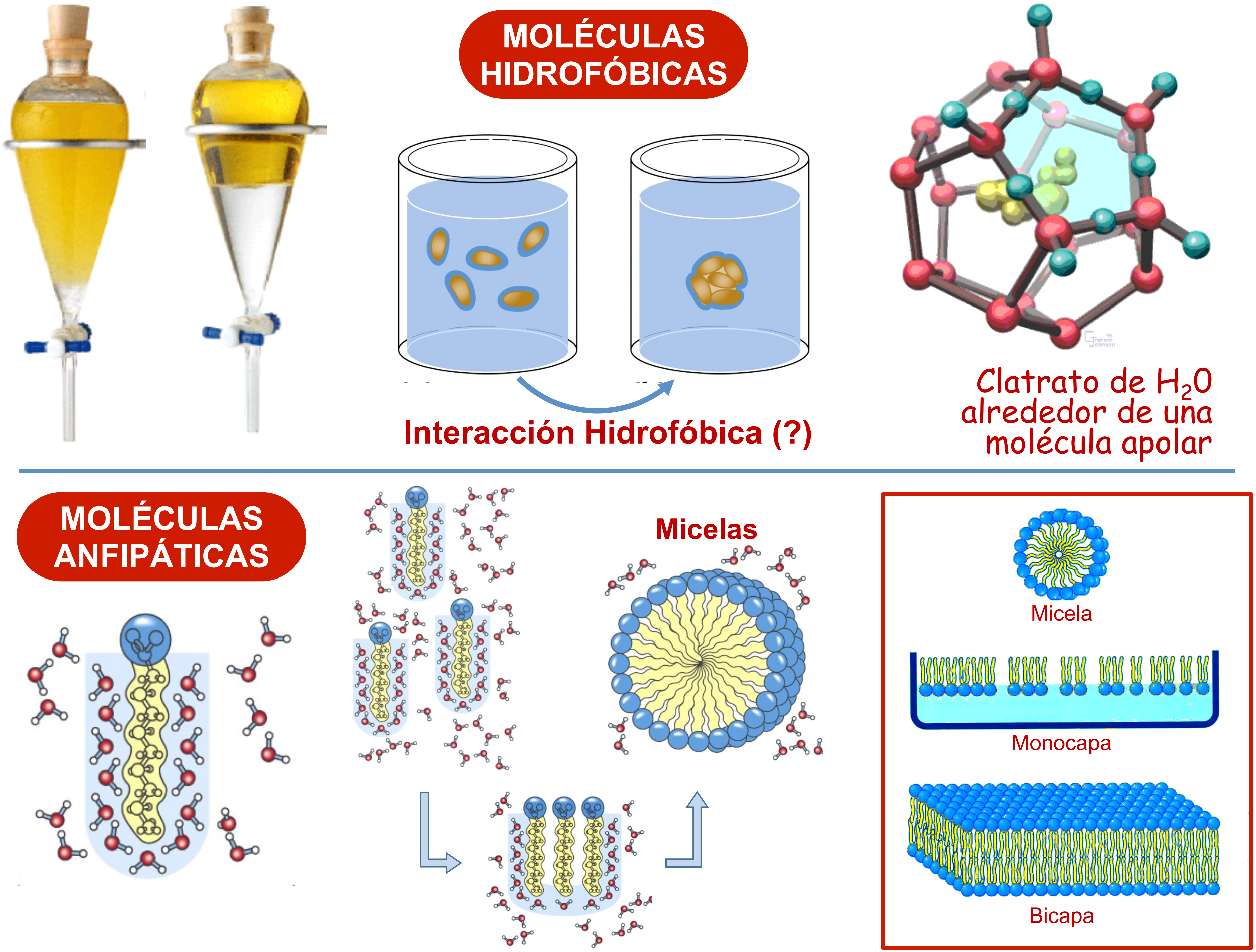
Property	Water	*n*-Pentane
Molecular weight (g/mol)	18.02	72.15
Density (g/cm^3)	0.997	0.626
Boiling point (°C)	100	36.1
Dielectric constant	78.54	1.84
Viscosity (g/cm·s)	0.890×10^{-2}	0.228×10^{-2}
Surface tension (dyne/cm)	71.97	17



MOLÉCULAS HIDROFÍLICAS



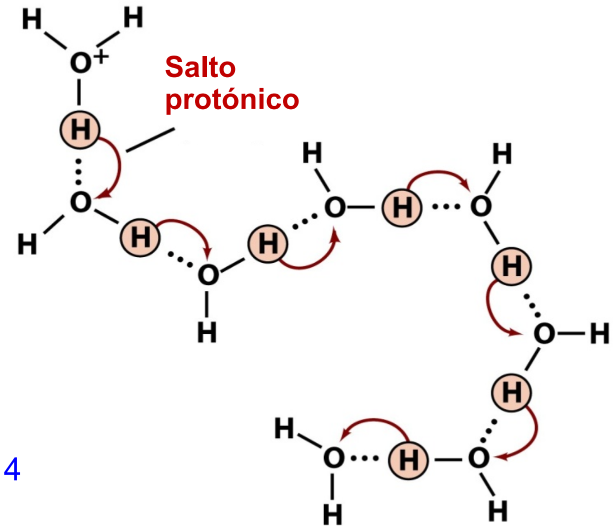



MOLÉCULAS HIDROFÓBICAS
Interacción Hidrofóbica (?)
Clatrato de H_2O alrededor de una molécula apolar
MOLÉCULAS ANFIPÁTICAS
Micelas
Micela
Monocapa
Bicapa

Ionización del H_2O

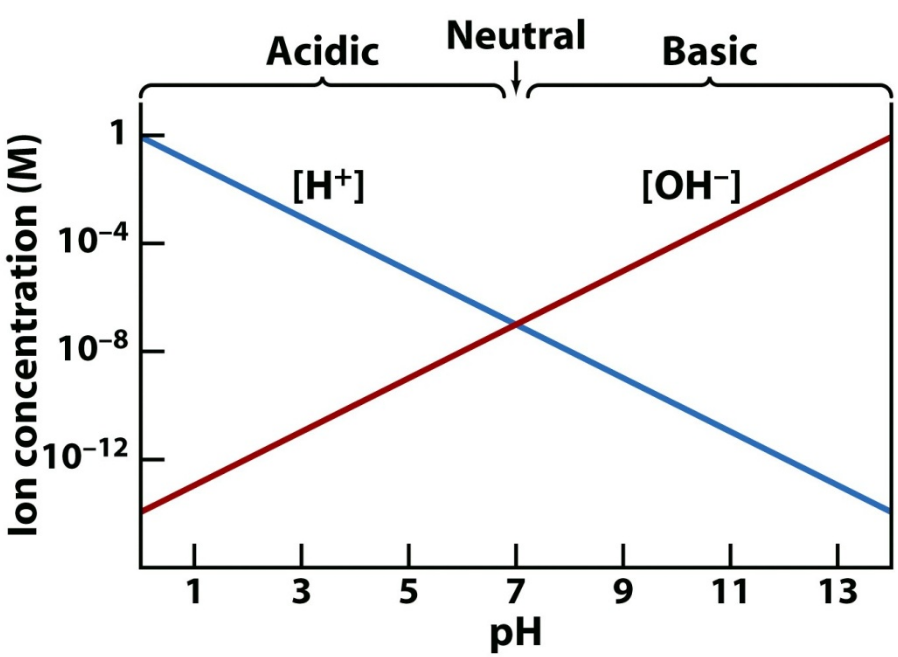
$$H_2O \rightleftharpoons H^+ + OH^-$$

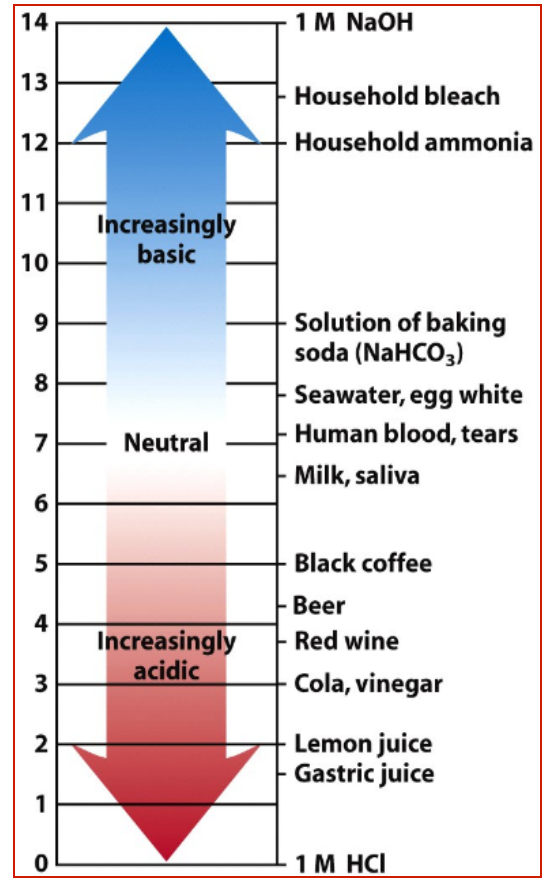
$$H^+ + H_2O \rightleftharpoons H_3O^+$$



Producto iónico $K_w = [H^+][OH^-] = 10^{-14}$

Agua pura neutra $[H^+] = [OH^-] = 10^{-7} \Rightarrow pH = -\log[H^+] = 7.0$





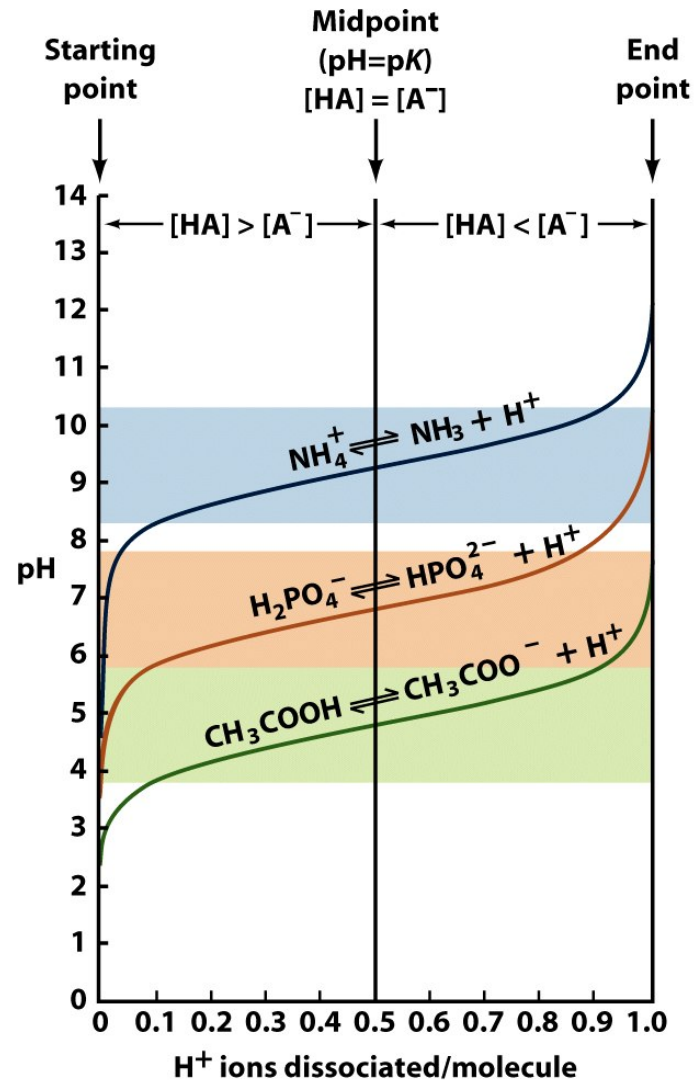
Equilibrio Ácido-Base

Ec. de Henderson-Hasselbalch

$$HA \rightleftharpoons H^+ + A^-$$

$$K_a = \frac{[H^+][A^-]}{[HA]} \Rightarrow \boxed{pH = pK_a + \log\frac{[A^-]}{[HA]}}$$

Acid	K	pK
Oxalic acid	5.37×10^{-2}	1.27 (pK_1)
H_3PO_4	7.08×10^{-3}	2.15 (pK_1)
Formic acid	1.78×10^{-4}	3.75
Succinic acid	6.17×10^{-5}	4.21 (pK_1)
Oxalate$^-$	5.37×10^{-5}	4.27 (pK_2)
Acetic acid	1.74×10^{-5}	4.76
Succinate$^-$	2.29×10^{-6}	5.64 (pK_2)
2-(*N*-Morpholino)ethanesulfonic acid (MES)	8.13×10^{-7}	6.09
H_2CO_3	4.47×10^{-7}	6.35 (pK_1)[a]
Piperazine-*N*,*N*′-bis(2-ethanesulfonic acid) (PIPES)	1.74×10^{-7}	6.76
$H_2PO_4^-$	1.51×10^{-7}	6.82 (pK_2)
3-(*N*-Morpholino)propanesulfonic acid (MOPS)	7.08×10^{-8}	7.15
N-2-Hydroxyethylpiperazine-*N*′-2-ethanesulfonic acid (HEPES)	3.39×10^{-8}	7.47
Tris(hydroxymethyl)aminomethane (Tris)	8.32×10^{-9}	8.08
NH_4^+	5.62×10^{-10}	9.25
Glycine (amino group)	1.66×10^{-10}	9.78
HCO_3^-	4.68×10^{-11}	10.33 (pK_2)
Piperidine	7.58×10^{-12}	11.12
HPO_4^{2-}	4.17×10^{-13}	12.38 (pK_3)



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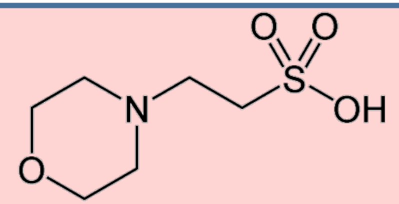
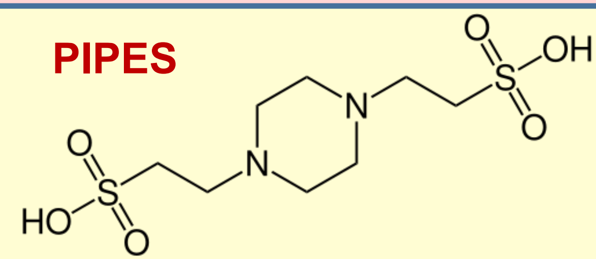
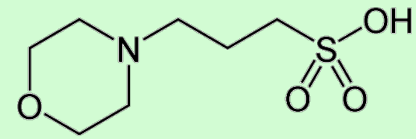
MES



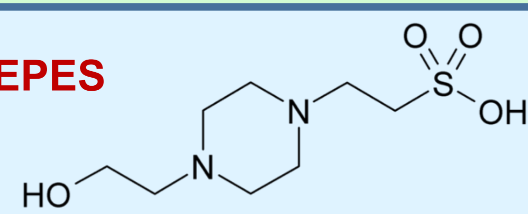
PIPES



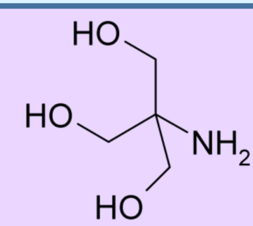
MOPS



HEPES



Tris



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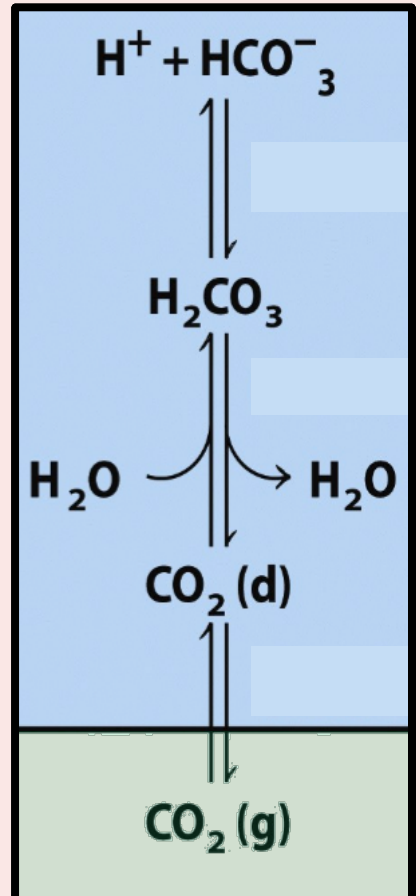
Tampón Bicarbonato

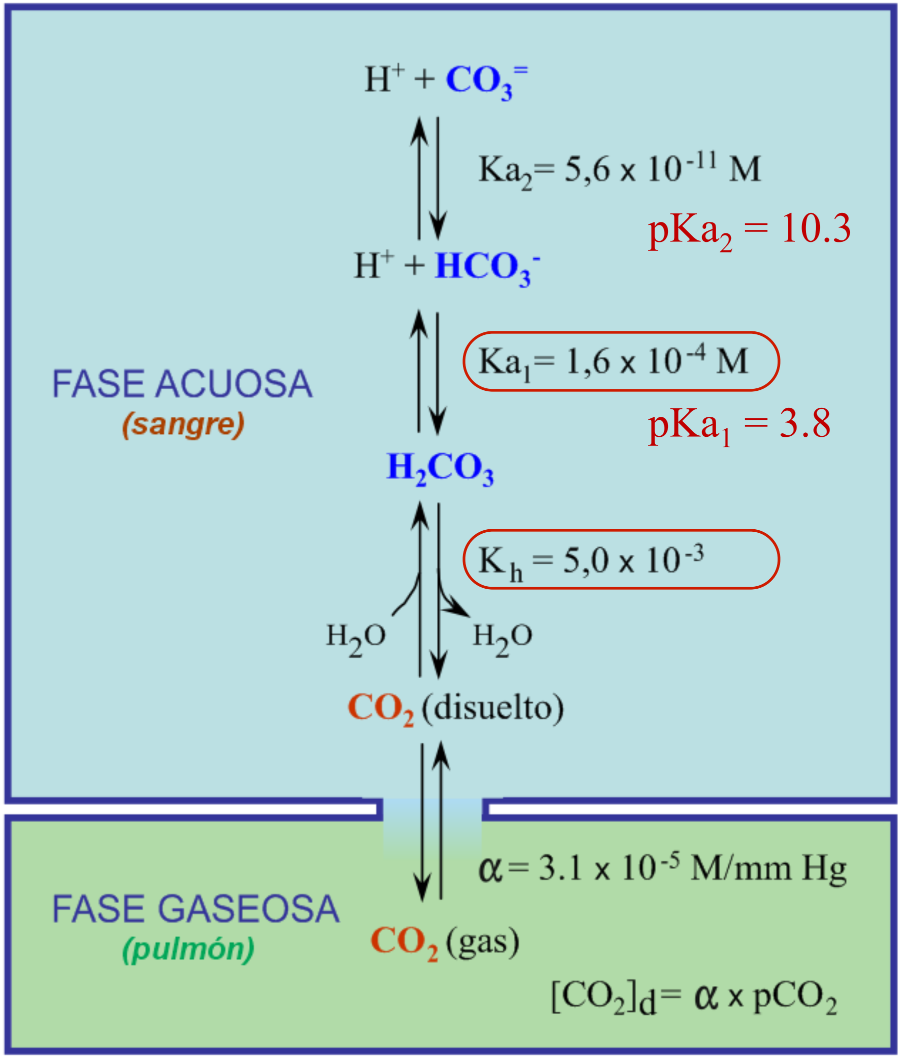
Amortiguador del pH sanguíneo



Fase Acuosa *(Sangre)*

Fase Gaseosa *(Pulmón)*

Tampón Bicarbonato de la Sangre



pH

Acidosis [7.35 --- **7.4** --- 7.45] Alcalosis

$$Ka_1 = \frac{[HCO_3^-] \times [H^+]}{[H_2CO_3]} = 1,6 \times 10^{-4} \text{ M}$$

$$K_h = \frac{[H_2CO_3]}{[CO_2]d} = 5,0 \times 10^{-3} \text{ M} \Rightarrow [H_2CO_3] = K_h \times [CO_2]d$$

$$Ka_1 = \frac{[HCO_3^-] \times [H^+]}{K_h \times [CO_2]d}$$

$$Ka_1 \times K_h = \frac{[HCO_3^-] \times [H^+]}{[CO_2]d} =$$

$$= (1,6 \times 10^{-4}) \times (5,0 \times 10^{-3}) = 8 \times 10^{-7} \text{ M} = Ka'$$

$$pKa' = 6,1$$

$$pH = 6,1 + \log \frac{[HCO_3^-]}{[CO_2]d}$$

↓ Acidosis metabólica

↑ Alcalosis metabólica

↑ Acidosis respiratoria

↓ Alcalosis respiratoria