

Introduzione alla Biochimica

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Biochimica: Chimica della vita

Argomenti di interesse della biochimica:

- Struttura e funzione delle macromolecole biologiche
- Interazioni tra le macromolecole biologiche
- Meccanismi molecolari che determinano l'attività delle macromolecole biologiche
- L'energia nelle cellule
- Conservazione e trasmissione dell'informazione genetica

Strumenti e tecniche per lo studio della biochimica:

- Metodi di separazione (es. cromatografia a scambio ionico, gel-permeazione)
- Elettroforesi
- Centrifugazione
- Tecnologie del DNA ricombinante (es. clonaggio e amplificazione)
- Tecniche spettroscopiche (es. UV-Vis, Dicroismo circolare, Raggi X)
- Bioinformatica

Gruppi funzionali di interesse in Biochimica

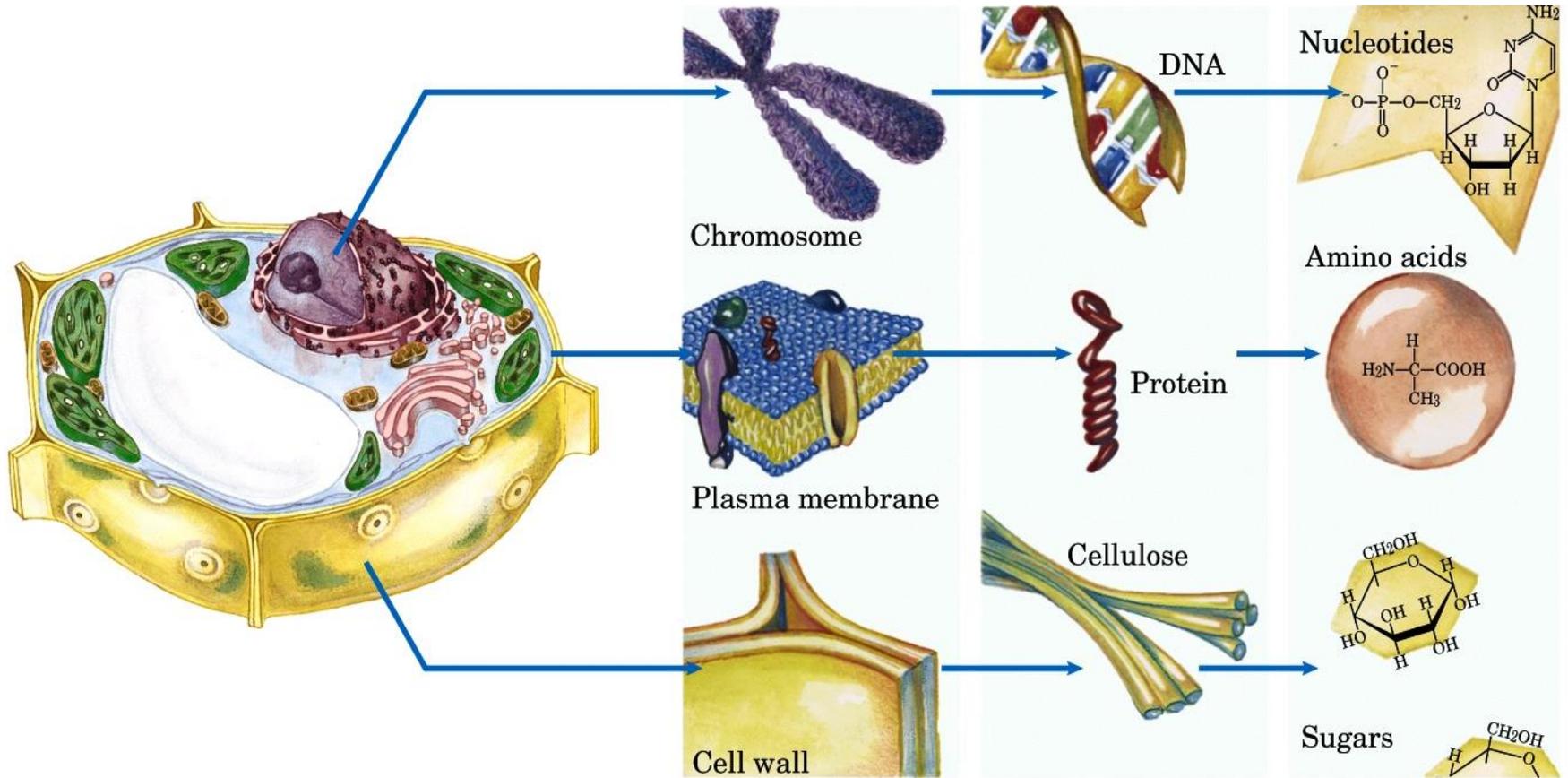
Compound Name	Structure ^a	Functional Group or Linkage	Compound Name	Structure ^a	Functional Group or Linkage
Amine ^b	RNH ₂ or $\overset{+}{\text{R}}\text{NH}_3$ R ₂ NH or $\overset{+}{\text{R}}_2\text{NH}_2$ R ₃ N or $\overset{+}{\text{R}}_3\text{NH}$	>N< or $\overset{+}{\text{N}}$ (amino group)	Amide	$\begin{array}{c} \text{O} \\ \parallel \\ \text{R}-\text{C}-\text{NH}_2 \end{array}$ $\begin{array}{c} \text{O} \\ \parallel \\ \text{R}-\text{C}-\text{NHR} \end{array}$ $\begin{array}{c} \text{O} \\ \parallel \\ \text{R}-\text{C}-\text{NR}_2 \end{array}$	>C=O (amido group) $\text{R}-\overset{\text{O}}{\parallel}{\text{C}}-$ (acyl group) ^c
Alcohol	ROH	-OH (hydroxyl group)	Imine (Schiff base) ^b	$\text{R}=\text{NH}$ or $\text{R}=\overset{+}{\text{N}}\text{H}_2$ $\text{R}=\text{NR}$ or $\text{R}=\overset{+}{\text{N}}\text{HR}$	>C=N< or $\text{>C}=\overset{+}{\text{N}}\text{<}$ (imino group)
Thiol	RSH	-SH (sulfhydryl group)	Disulfide	$\text{R}-\text{S}-\text{S}-\text{R}$	$-\text{S}-\text{S}-$ (disulfide linkage)
Ether	ROR	-O- (ether linkage)	Phosphate ester ^b	$\begin{array}{c} \text{O} \\ \parallel \\ \text{R}-\text{O}-\text{P}-\text{O}^- \\ \\ \text{OH} \end{array}$	$\begin{array}{c} \text{O} \\ \parallel \\ -\text{P}-\text{O}^- \\ \\ \text{OH} \end{array}$ (phosphoryl group)
Aldehyde	$\begin{array}{c} \text{O} \\ \parallel \\ \text{R}-\text{C}-\text{H} \end{array}$	$\begin{array}{c} \text{O} \\ \parallel \\ -\text{C}- \end{array}$ (carbonyl group)	Diphosphate ester ^b	$\begin{array}{c} \text{O} \quad \text{O} \\ \parallel \quad \parallel \\ \text{R}-\text{O}-\text{P}-\text{O}-\text{P}-\text{O}^- \\ \quad \\ \text{O}^- \quad \text{OH} \end{array}$	$\begin{array}{c} \text{O} \quad \text{O} \\ \parallel \quad \parallel \\ -\text{P}-\text{O}-\text{P}-\text{O}^- \\ \quad \\ \text{O}^- \quad \text{OH} \end{array}$ (phosphoanhydride group)
Ketone	$\begin{array}{c} \text{O} \\ \parallel \\ \text{R}-\text{C}-\text{R} \end{array}$	$\begin{array}{c} \text{O} \\ \parallel \\ -\text{C}- \end{array}$ (carbonyl group)	Phosphate diester ^b	$\begin{array}{c} \text{O} \\ \parallel \\ \text{R}-\text{O}-\text{P}-\text{O}-\text{R} \\ \\ \text{O}^- \end{array}$	$\begin{array}{c} \text{O} \\ \parallel \\ -\text{O}-\text{P}-\text{O}- \\ \\ \text{O}^- \end{array}$ (phosphodiester linkage)
Carboxylic acid ^b	$\begin{array}{c} \text{O} \quad \text{O} \\ \parallel \quad \parallel \\ \text{R}-\text{C}-\text{OH} \text{ or } \text{R}-\text{C}-\text{O}^- \end{array}$	$\begin{array}{c} \text{O} \\ \parallel \\ -\text{C}-\text{OH} \end{array}$ (carboxyl group) or $\begin{array}{c} \text{O} \\ \parallel \\ -\text{C}-\text{O}^- \end{array}$ (carboxylate group)	Ester	$\begin{array}{c} \text{O} \\ \parallel \\ \text{R}-\text{C}-\text{OR} \end{array}$	$\begin{array}{c} \text{O} \\ \parallel \\ -\text{C}-\text{O}- \end{array}$ (ester linkage) $\text{R}-\overset{\text{O}}{\parallel}{\text{C}}-$ (acyl group) ^c
Thioester	$\begin{array}{c} \text{O} \\ \parallel \\ \text{R}-\text{C}-\text{SR} \end{array}$	$\begin{array}{c} \text{O} \\ \parallel \\ -\text{C}-\text{S}- \end{array}$ (thioester linkage) $\text{R}-\overset{\text{O}}{\parallel}{\text{C}}-$ (acyl group) ^c			

^aR represents any carbon-containing group. In a molecule with more than one R group, the groups may be the same or different.

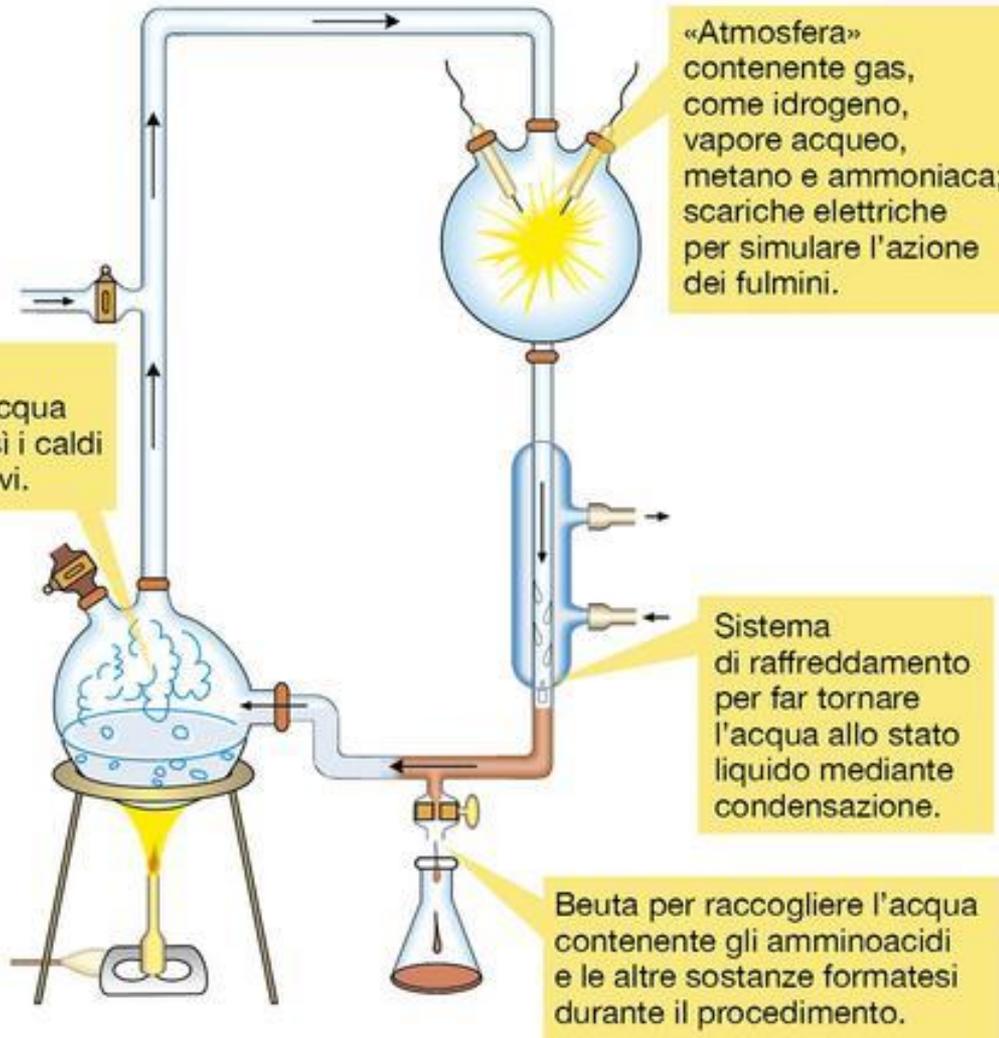
^bUnder physiological conditions, these groups are ionized and hence bear a positive or negative charge.

^cIf attached to an atom other than carbon.

Le funzioni vitali sono basate su precisi meccanismi molecolari che seguono le leggi della fisica e della chimica



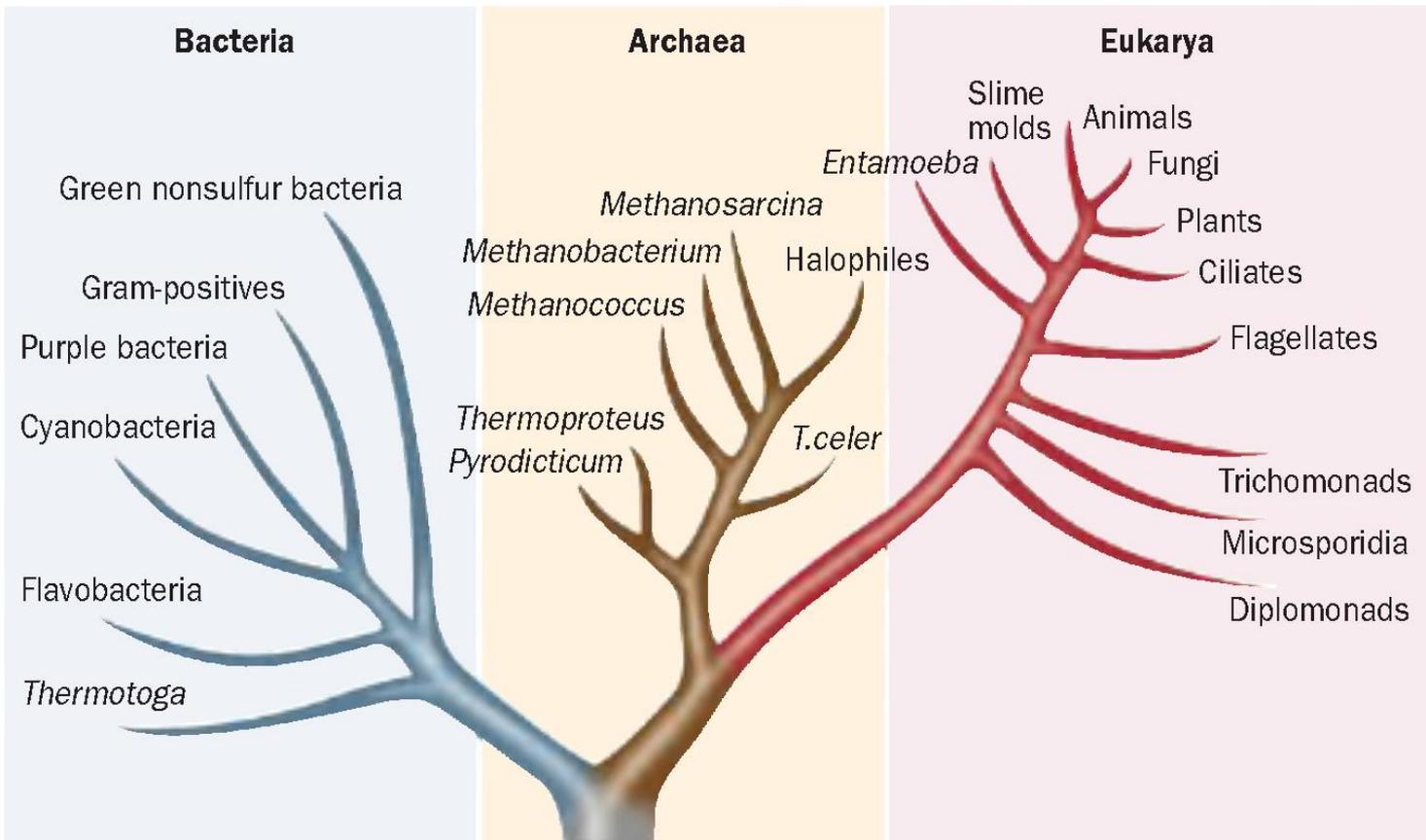
L'esperimento di Miller per simulare le reazioni pre-biotiche



Compound	Yield (%)
Glycine*	2.1
Glycolic acid	1.9
Sarcosine	0.25
Alanine*	1.7
Lactic acid	1.6
<i>N</i> -Methylalanine	0.07
α -Amino- α -butyric acid	0.34
α -Aminoisobutyric acid	0.007
α -Hydroxybutyric acid	0.34
β -Alanine	0.76
Succinic acid	0.27
Aspartic acid*	0.024
Glutamic acid*	0.051
Imnodiacetic acid	0.37
Iminoisopropionic acid	0.13
Formic acid	4.0
Acetic acid	0.51
Propionic acid	0.66
Urea	0.034
<i>N</i> -Methylurea	0.051

* Amino acid constituent of proteins.

L'assemblaggio e l'interazione delle macromolecole biologiche determina la biodiversità



- L'evoluzione non è finalistica
- I processi biologici sono legati a precisi meccanismi molecolari
- Nell'ambito di regole precise, è comunque possibile una certa variabilità tra individui
- L'evoluzione è sempre in corso