

Licenciatura em Ciências Exatas

Macromoléculas

Revisão

Biologia IV

Slides doados pela Prof. Ilana Lopes Baratella da Cunha Camargo

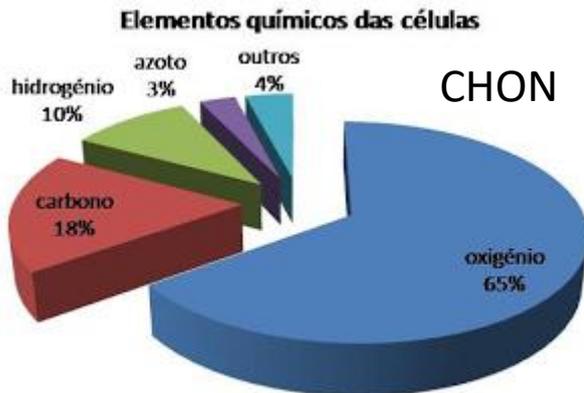
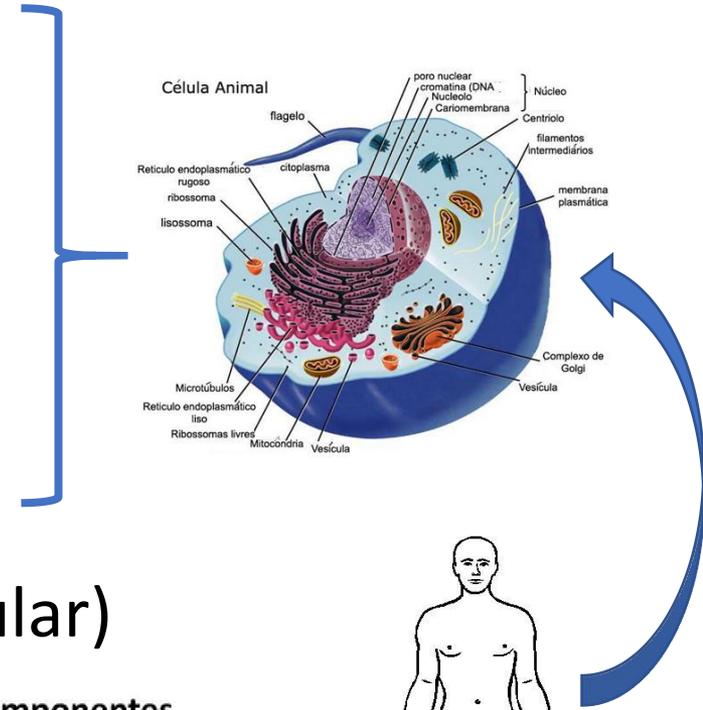
2020

Objetivo:

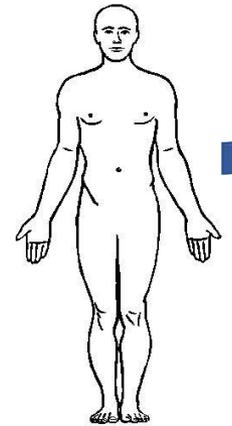
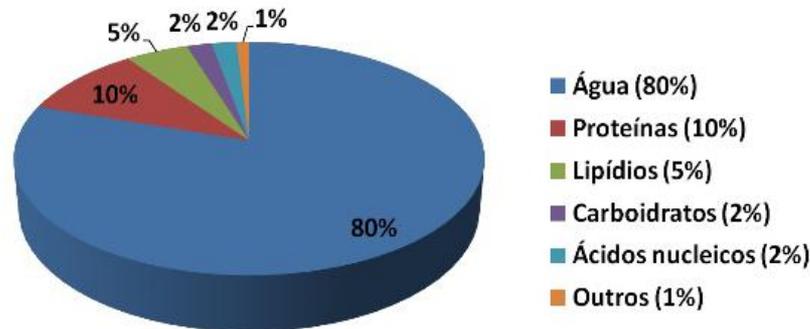
Recapitular características principais das macromoléculas biológicas

Macromoléculas

- Água
- Carboidratos
- Aminoácidos (proteínas/enzimas)
- Lipídeos
- Ácidos nucleicos (Biologia Molecular)



Proporção aproximada dos componentes químicos no corpo dos seres vivos



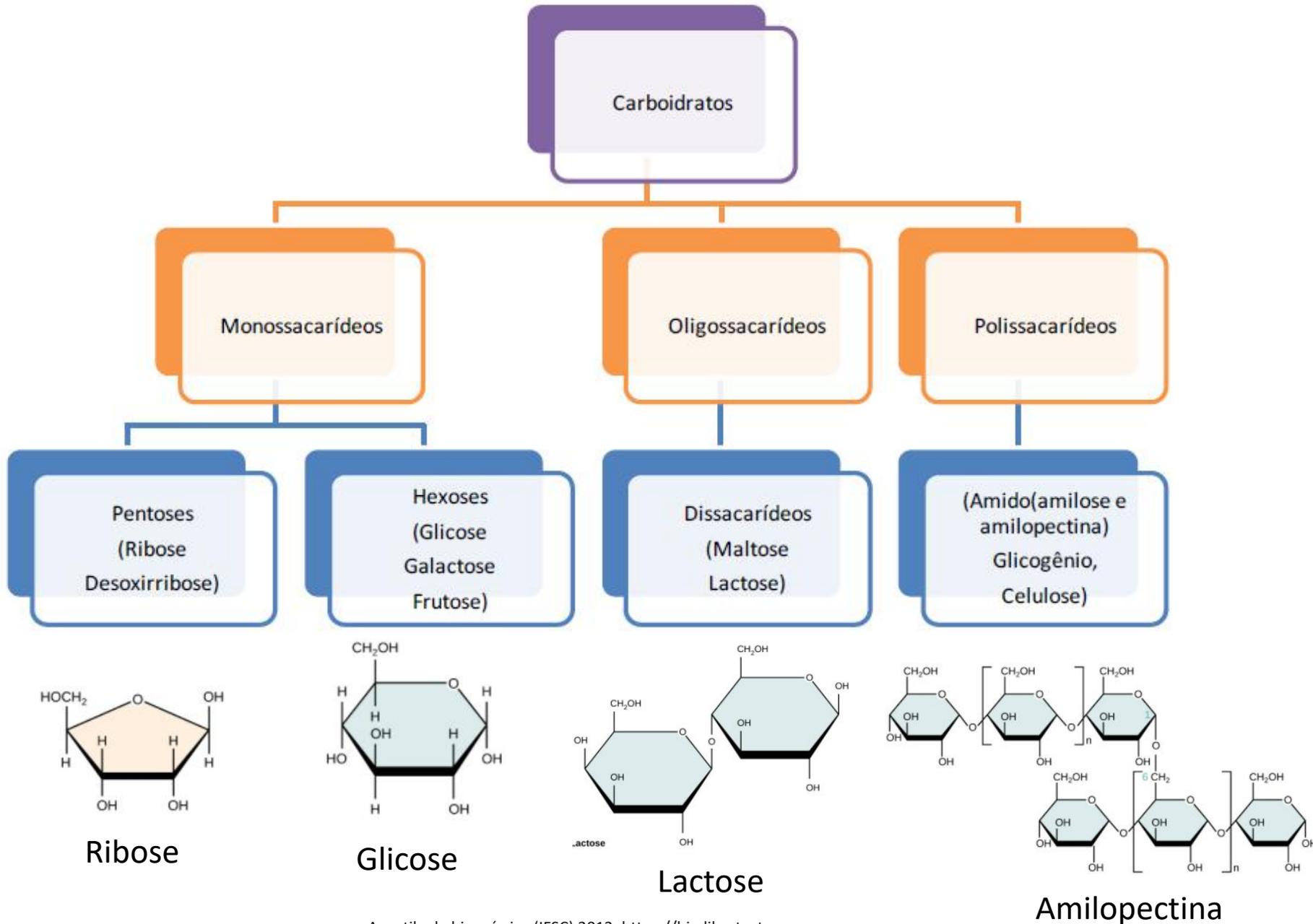
Carboidratos

compostos orgânicos que incluem amidos e açúcares

- Funções:
 - fonte de energia das células
 - Amido e glicogênio
 - elementos estruturais da parede celular e de proteção (exoesqueleto)
 - quitina
 - sinalizadores celulares
 - glicoproteínas e glicolipídeos
 - lubrificação de articulações
 - líquido sinovial, mucinas presentes na saliva responsáveis pela lubrificação e proteção da cavidade bucal
 - adesão celular
 - glicoproteínas e mucopolissacarídeos

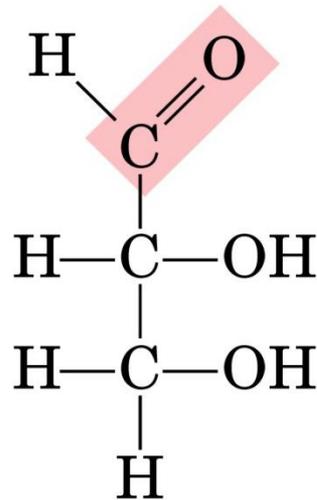
Açúcar desoxirribose é um bloco de construção do ácido desoxirribonucleico (DNA), a molécula que carrega informações hereditárias.

Carboidratos (CH₂O)_n

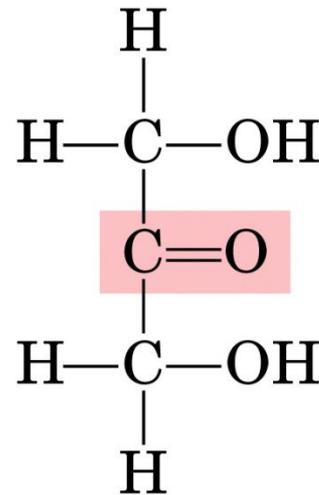


Monossacarídeos

- Unidade fundamental dos oligossacarídeos e polissacarídeos;
- São os mais simples dos açúcares, não sofrem hidrólise
- Possuem baixo peso molecular e são solúveis em água
- Trioses, tetroses, pentoses, hexoses, heptoses (3 a 7 átomos de carbono)
- Aldose ou cetose: posicionamento do grupo C=O



Gliceraldeído,
uma aldose



Diidroxiacetona,
uma cetose

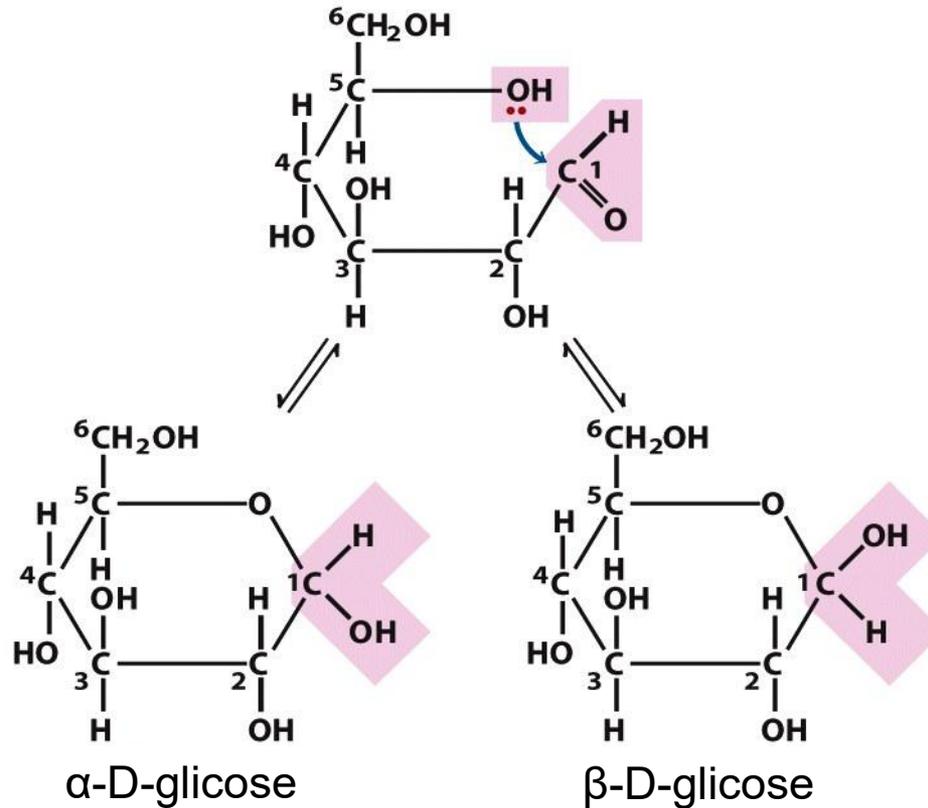
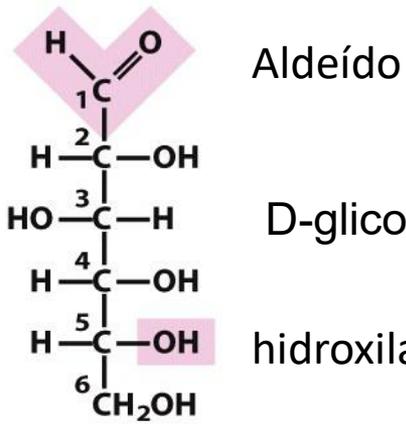
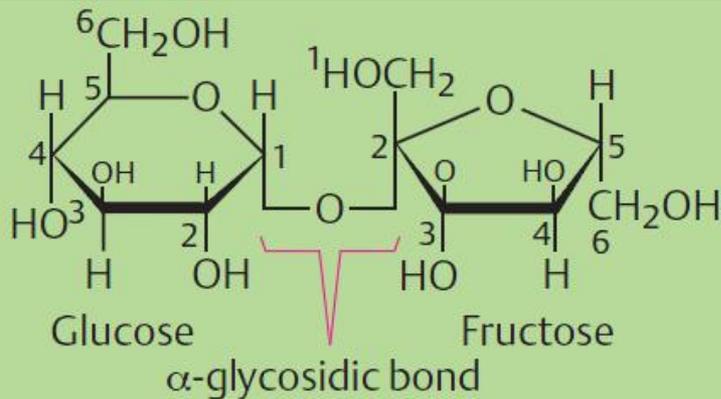


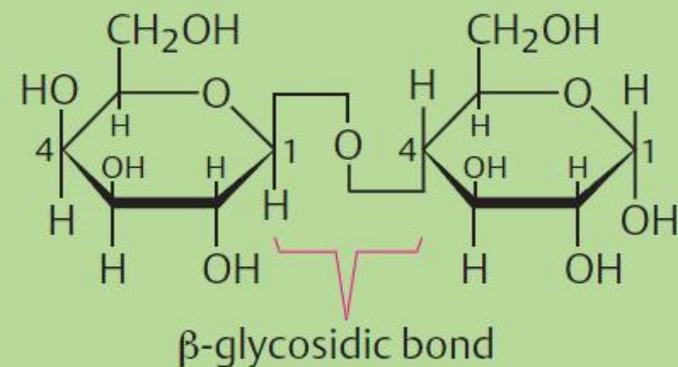
figure 1-6
 Lehninger Principles of Biochemistry, Fifth Edition
 © 2008 W.H. Freeman and Company

Oligossacarídeos

- Cadeias curtas de monossacarídeos
- **Dissacarídeos:** são os oligossacarídeos mais importantes (hidrossolúveis e adocicados)



Sucrose (Glucose- α -1, 2-fructose)



Lactose (Galactose- β -1.4-glucose)

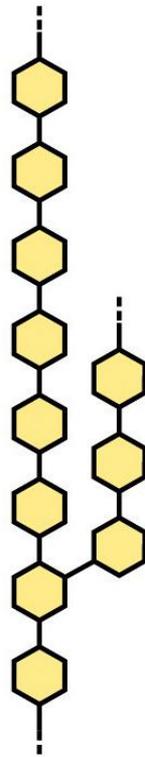
Polissacarídeos

Homopolissacarídeos

não ramificado



ramificado



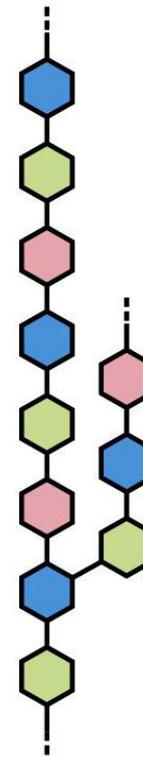
Combustível (Amido e glicogênio)
Estruturais (celulose)

Heteropolissacarídeos

Dois tipos de monômeros,
não ramificado



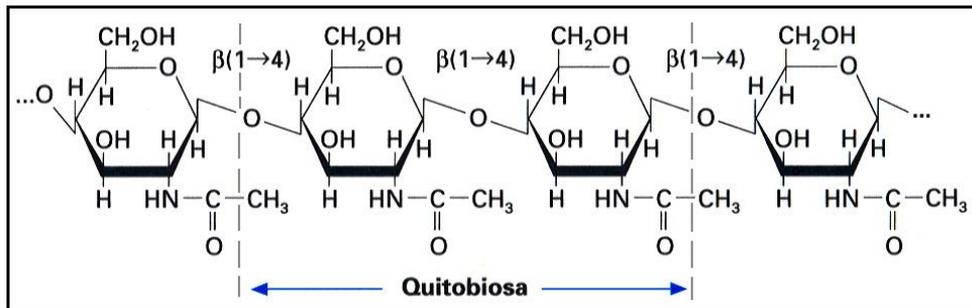
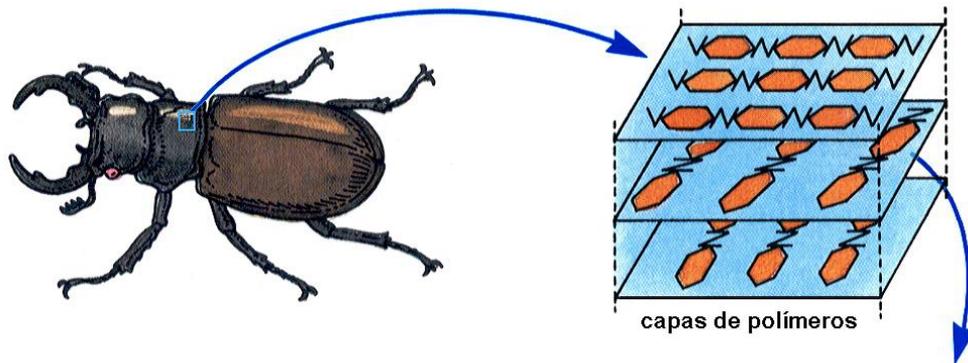
Múltiplos tipos de monômeros,
ramificado



Suporte celular: camada da parede bacteriana; ácido hialurônico (tendões)

Polissacarídeos

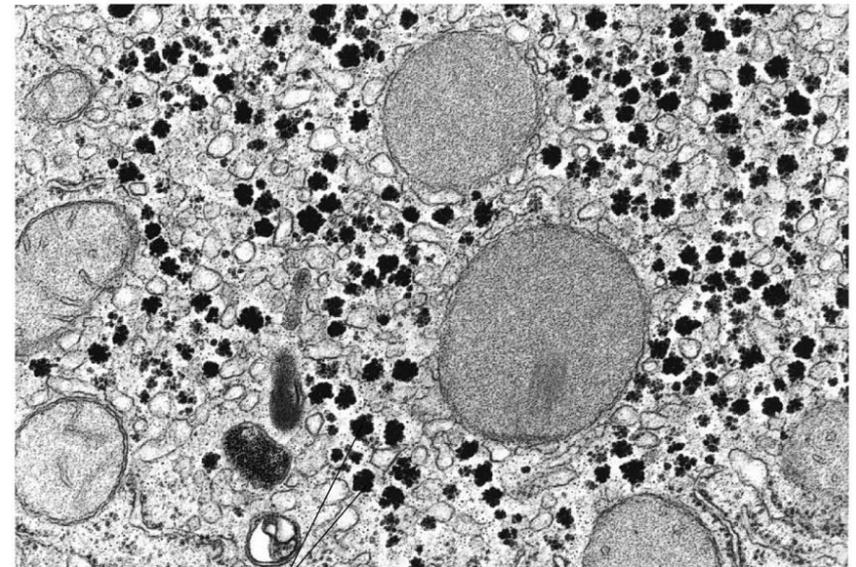
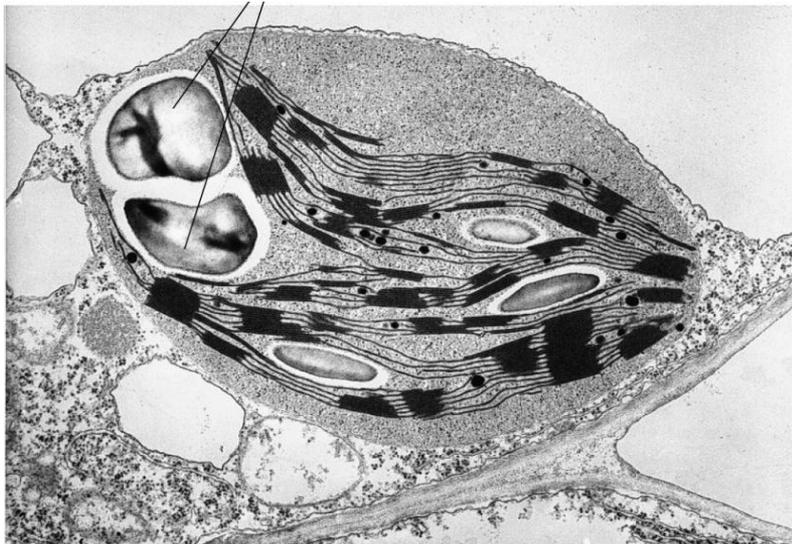
- função estrutural
- quitina (compõe a parede celular de fungos e o exoesqueleto de artrópodes)
- celulose (compõe a parede celular de células vegetais e algas)



Polissacarídeos

- Açúcares com mais de 20 unidades de monossacarídeos, forma predominante na natureza. Insolúveis e sem sabor adocicado
- Função de reserva: **Amido** (encontrado nas plantas e algas) e glicogênio (encontrado nos fungos e animais)
- São altamente hidratados (-OH), **quando extraídos com água quente formam soluções ou dispersões turvas**

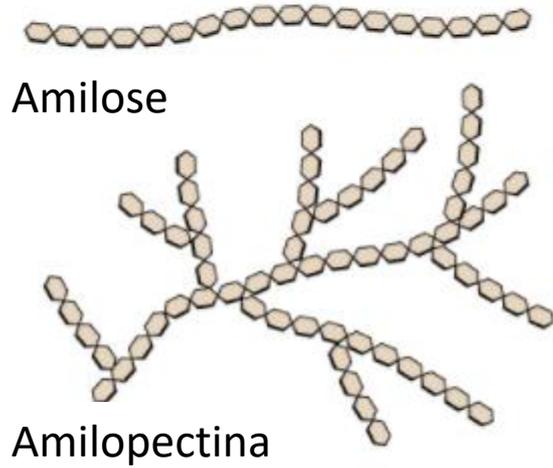
Grânulos de amido no cloroplasto



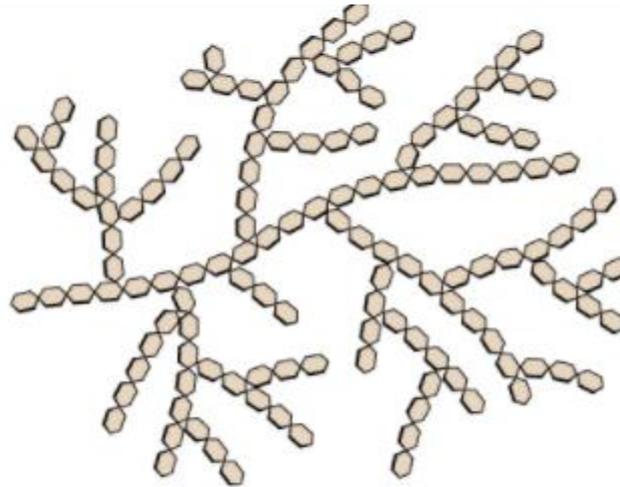
Grânulos de glicogênio no fígado

Polissacarídeos

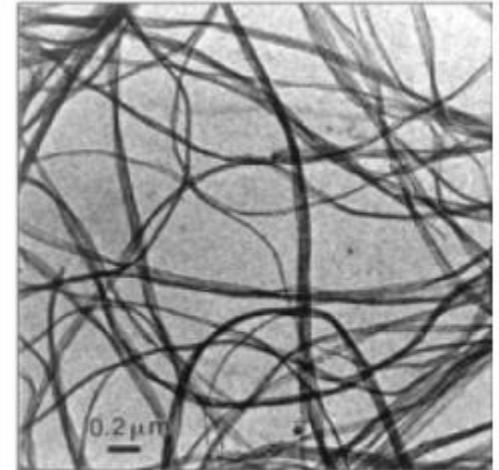
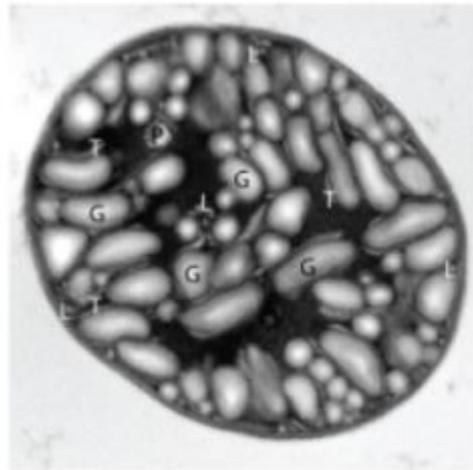
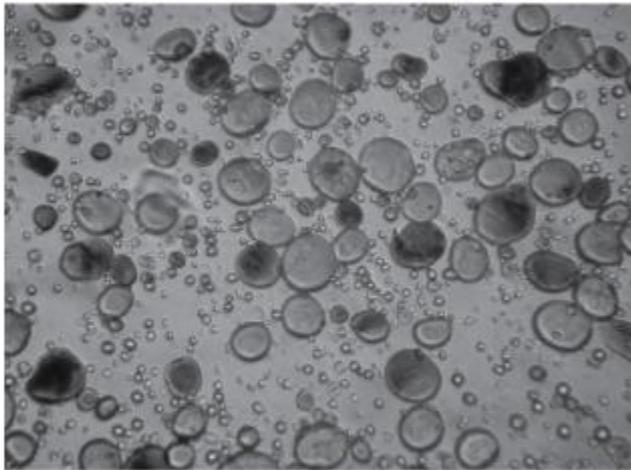
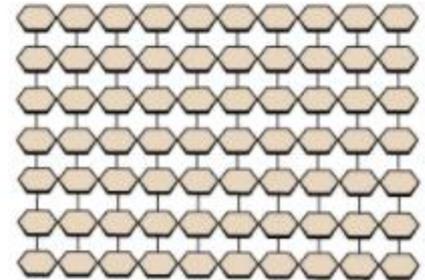
AMIDO



GLICOGÊNIO



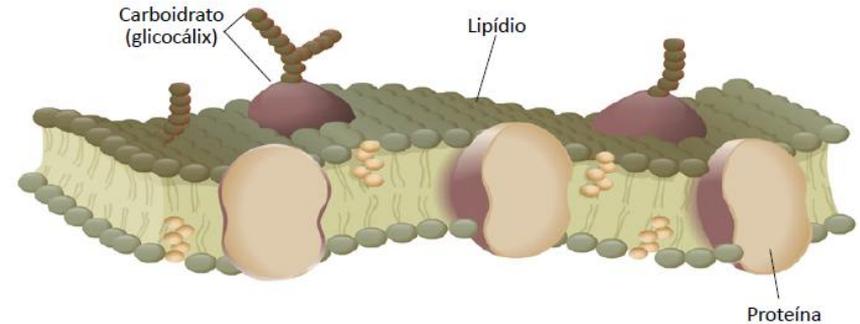
CELULOSE



Armazenamento de energia

Estrutural

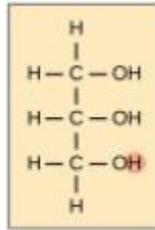
Lipídios



- Função energética e estrutural
 - Proteção e impermeabilização
 - Transporte de elétrons
 - Regulação do metabolismo
 - Componentes de moléculas complexas
 - Pigmentos absorvedores de luz
 - Hormônios, mensageiros intracelulares
- Apresentam maior quantidade de energia que os carboidratos
- São a 2º fonte de energia do organismo
- São insolúveis em água e solúveis em substâncias orgânicas apolares como éter e clorofórmio
- Não são poliméricos, mas se agregam

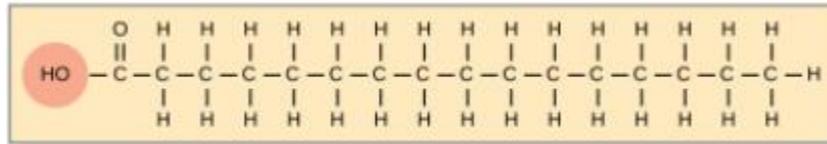
Lipídeos: glicerol + ácidos graxos

Glicerol



Ácido graxo (CH₃(CH₂)_nCOOH): hidrocarbonetos (12-24C)

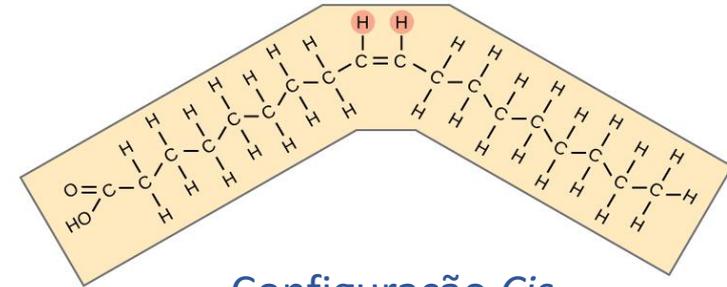
Comprimento e grau de saturação → solubilidade n' H₂O



Extremidade hidrofílica
(polar)

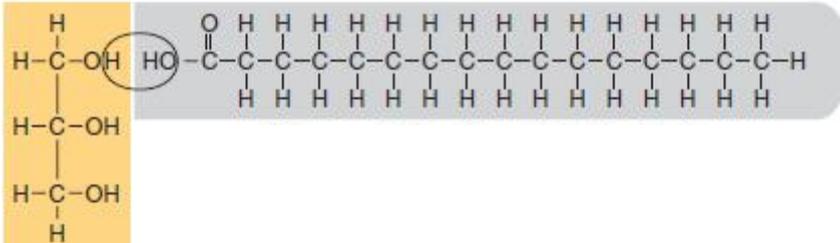
Extremidade hidrofóbica
(apolar)

Cadeia hidrocarbonada

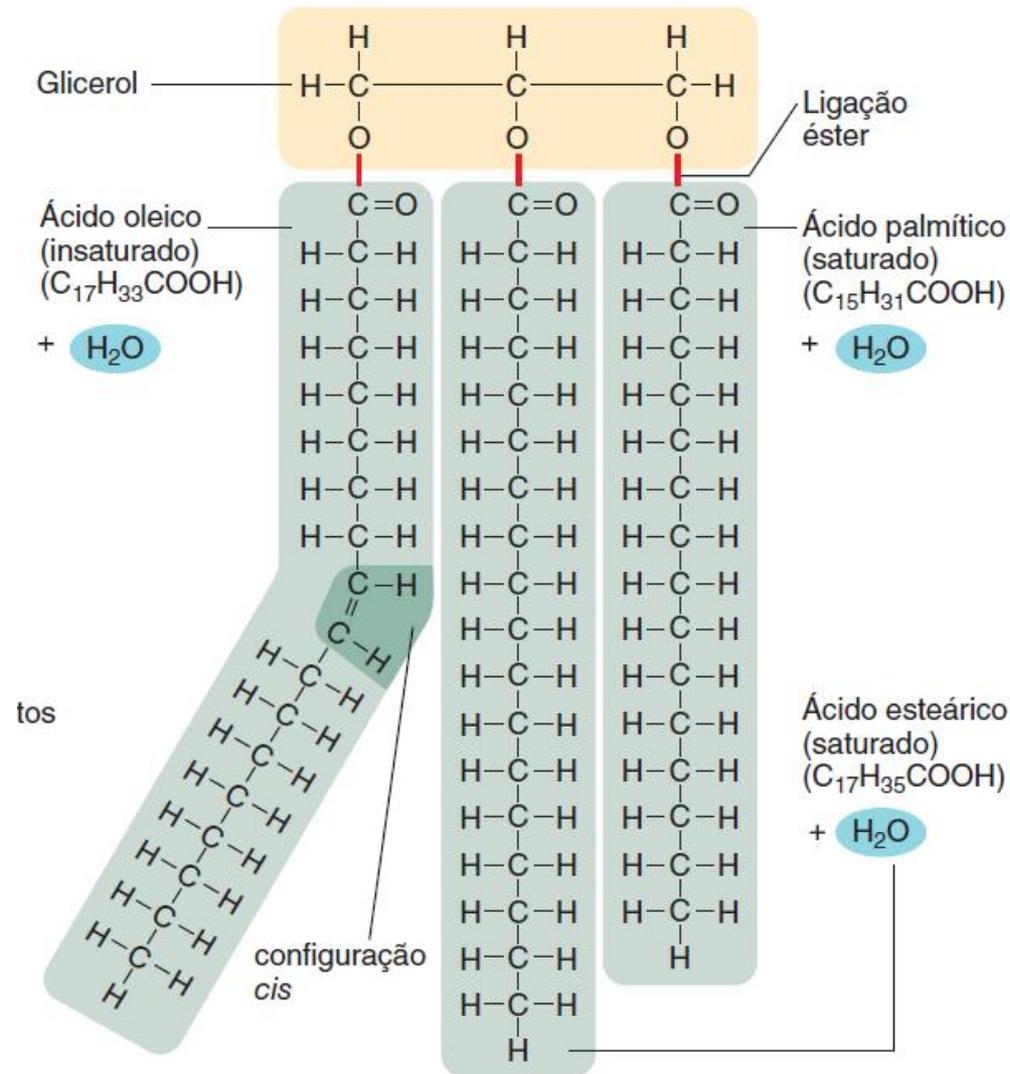


Configuração *Cis*

Lipídeo (Ácido palmítico) – ligação éster (esconde as OH polares)



Ác. graxos: saturação



(c) Molécula de gordura (triglicerídeo)

Ác. graxos: saturação

Manteiga



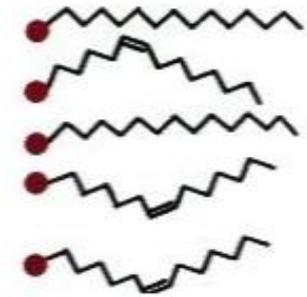
Saturado



Óleo



Insaturado

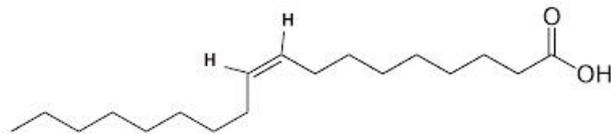


Manteiga tem origem animal

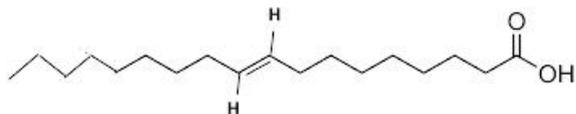
Margarina tem origem vegetal → provém de óleos (insaturados) → hidrogenação catalítica

Transformação de óleos de milho, soja e girassol em materiais pastosos → neste processo parte dos Ac. Graxos cis se transformam em trans que faz mal!!

Triglicerídeos saturados estão envolvidos com problemas circulatórios e cardíacos!!

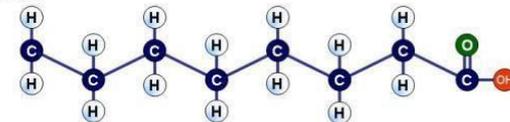


Conformação cis

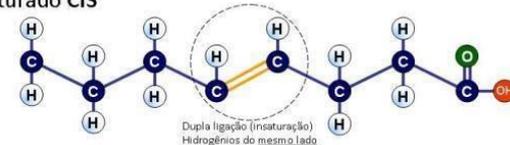


Conformação trans

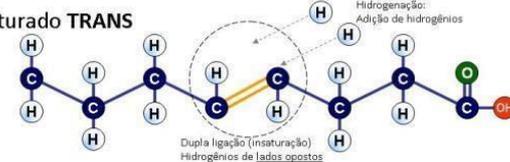
Ácido graxo saturado



Ácido graxo insaturado CIS

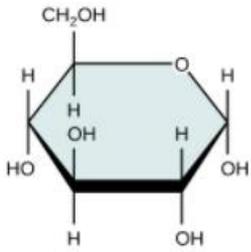


Ácido graxo insaturado TRANS

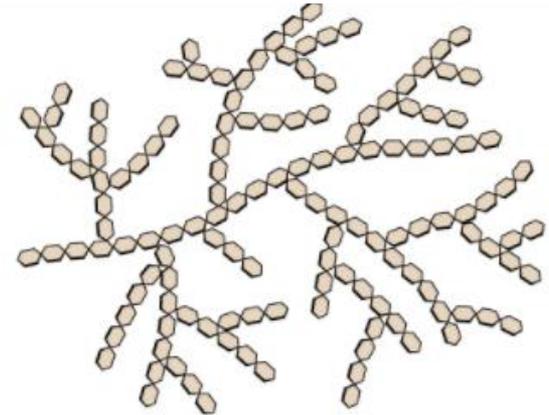
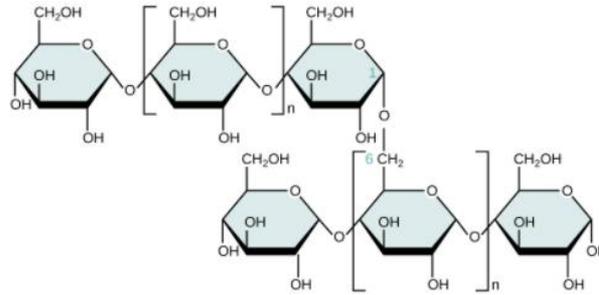


Biopolímeros

➤ Carboidratos



Glicose

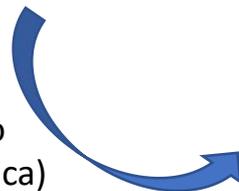


➤ Proteínas



Aminoácidos

Condensação
(ligação peptídica)

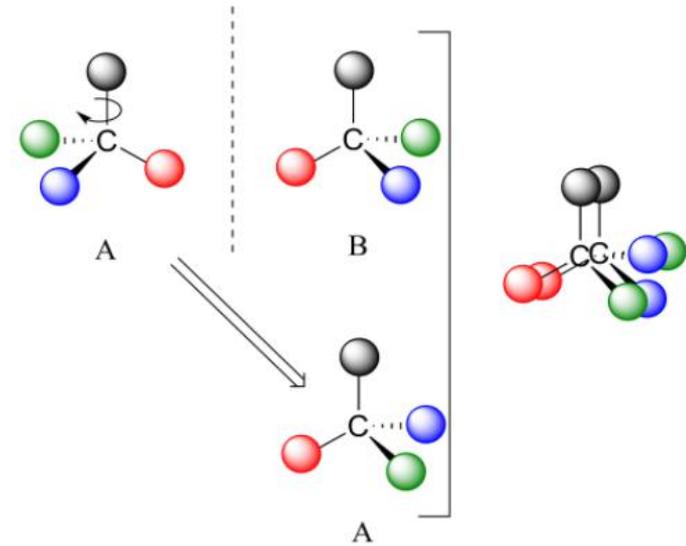
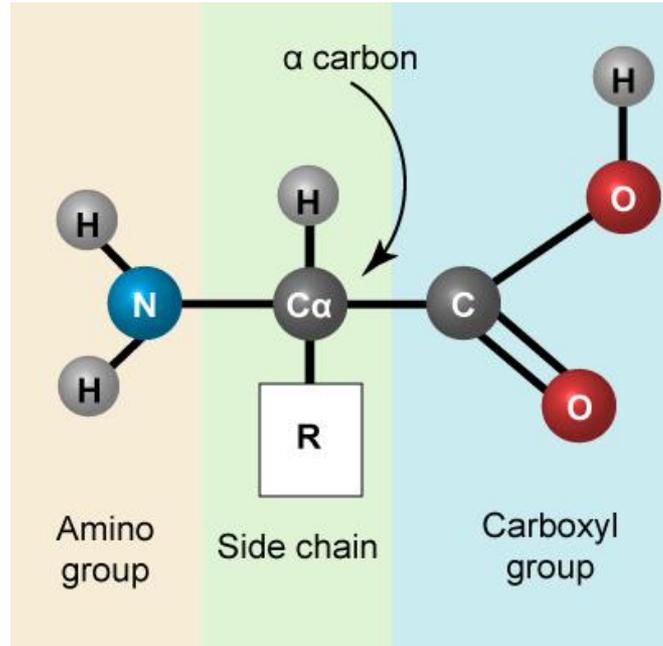


Proteínas

Funções das proteínas

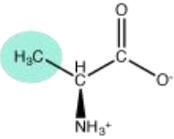
- Essenciais em todos os aspectos da estrutura e função celulares
- As *enzimas* são as proteínas que aceleram as reações químicas.
- As *proteínas transportadoras* auxiliam no transporte de certos compostos químicos para dentro e para fora das células.
- *Bacteriocinas*, produzidas por muitas bactérias, destroem outras bactérias.
- *Toxinas*, denominadas exotoxinas, produzidas por certos microrganismos causadores de doença;
- Algumas proteínas participam da *contração* das células musculares animais e do *movimento* de células microbianas ou de outros tipos.
- Outras proteínas são partes integrantes das *estruturas celulares*, como as paredes, as membranas e os componentes citoplasmáticos.
- *Hormônios* de certos organismos têm funções reguladoras.
- As proteínas chamadas de *anticorpos* desempenham um papel no sistema imune dos vertebrados.

Subunidade monomérica de proteínas = Aminoácidos (a.a.)

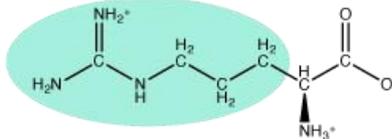


➤ Tamanho, estrutura, carga da proteína

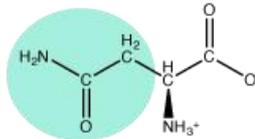
22 aminoácidos



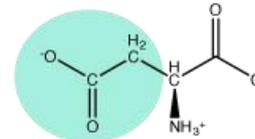
Alanine Ala (A)



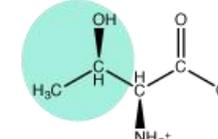
Arginine Arg (R)



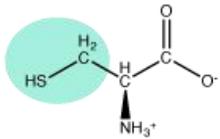
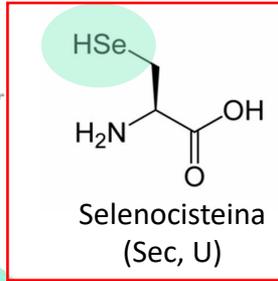
Asparagine Asn (N)



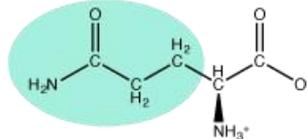
Aspartate Asp (D)



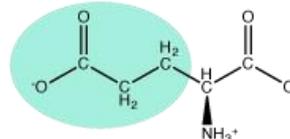
Threonine Thr (T)



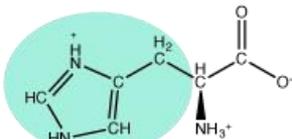
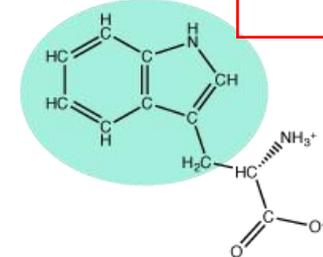
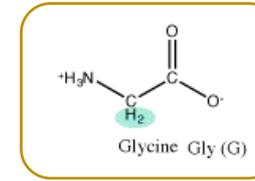
Cysteine Cys (C)



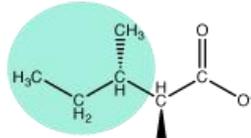
Glutamine Gln (Q)



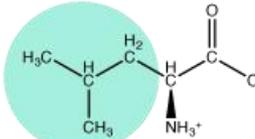
Glutamate Glu (E)



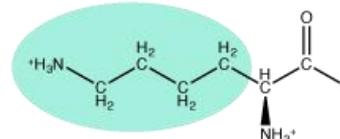
Histidine His (H)



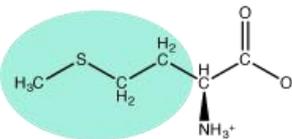
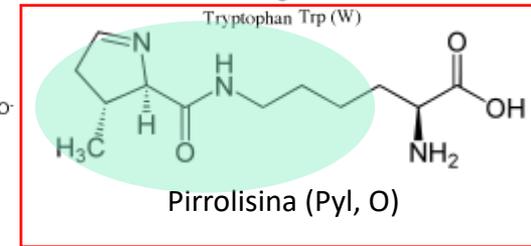
Isoleucine Ile (I)



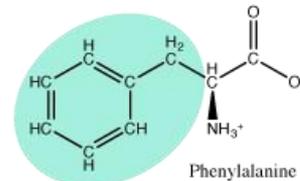
Leucine Leu (L)



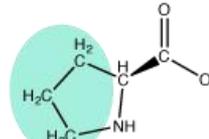
Lysine Lys (K)



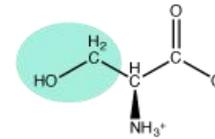
Methionine Met (M)



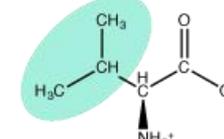
Phenylalanine Phe (F)



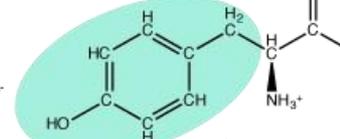
Proline Pro (P)



Serine Ser (S)



Valine Val (V)



Tyrosine Tyr (Y)

- Se há 22 a.a. e cada proteína tem em média 300 a.a. temos 22^{300} chances de produzir diferentes polipeptídios.
- Nas proteínas já foram encontrados mais de 100 a.a. diferentes (modificações dos canonicos).

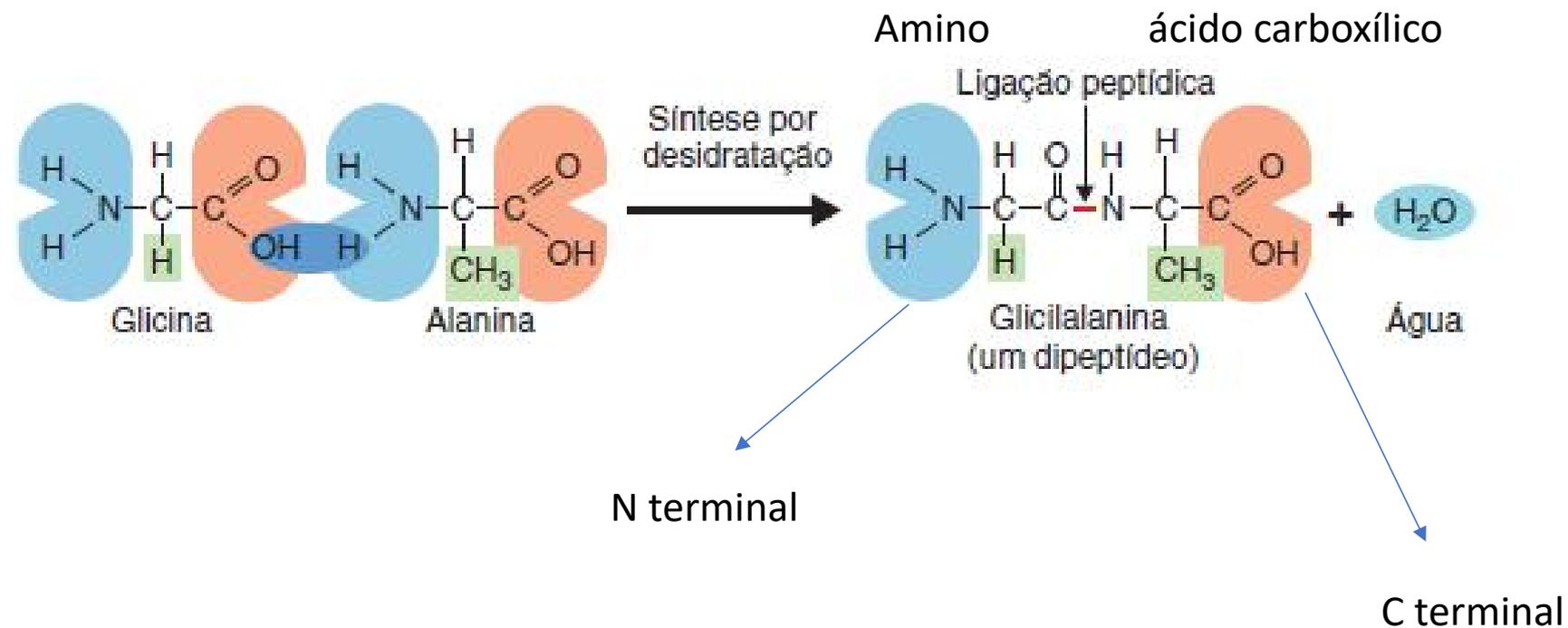


Figura 2.14 Formação da ligação peptídica por síntese por desidratação. Os aminoácidos glicina e alanina se combinam para formar um dipeptídeo. A nova ligação entre o átomo de carbono da glicina e o átomo de nitrogênio da alanina é chamada de ligação peptídica.

P Como os aminoácidos são relacionados com as proteínas?

Níveis hierárquicos de complexidade

Determina o *folding* das demais

Primária

Pro
Ala
Asp
Lys
Thr
Asn
Val
Lys
Ala
Ala
Trp
Gly
Lys
Val

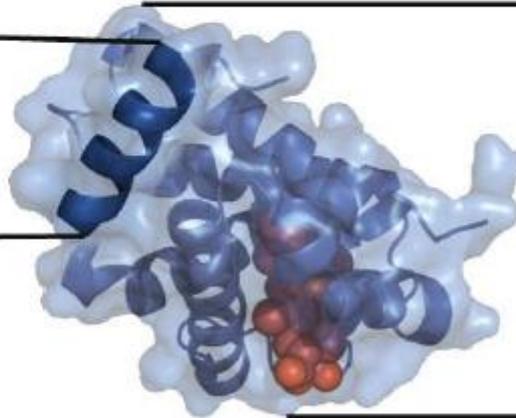
Resíduos de aminoácidos

Estrutura Secundária



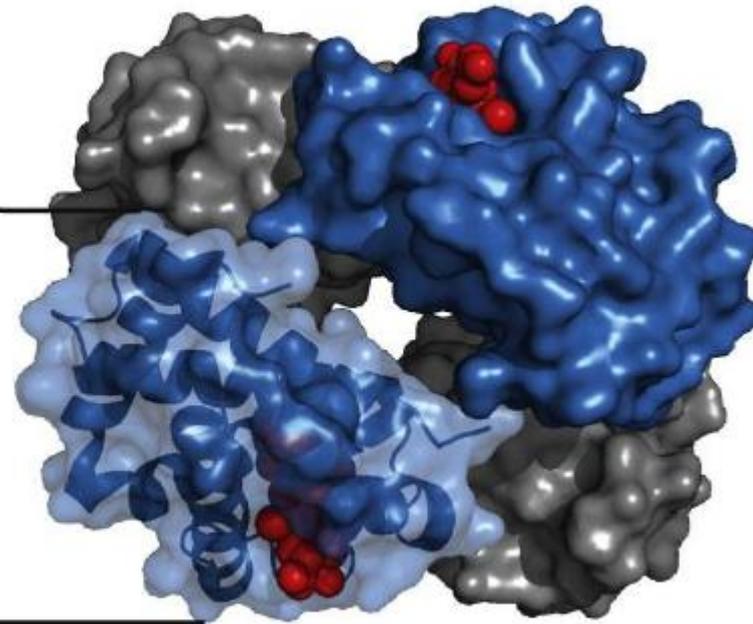
α -hélice

Estrutura Terciária

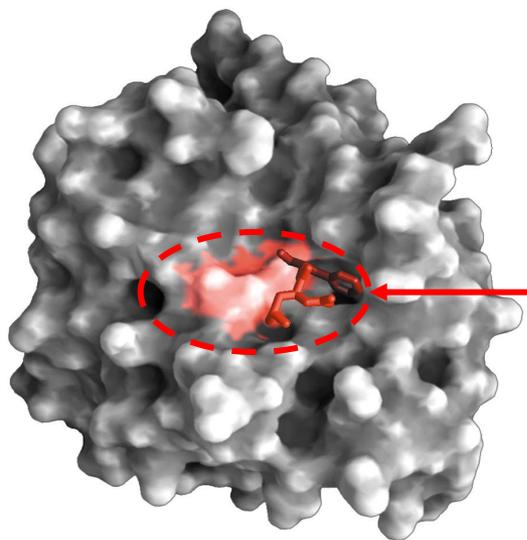


Cadeia polipeptídica

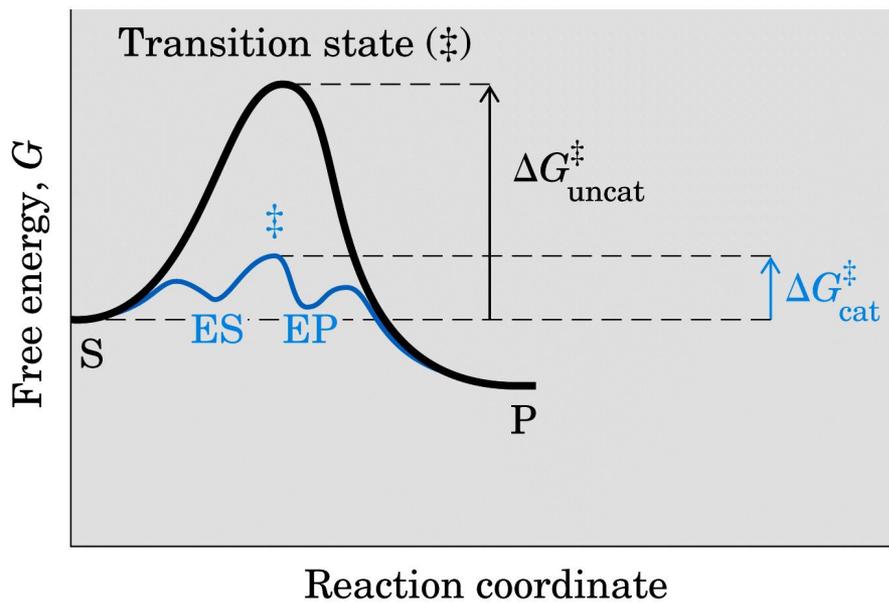
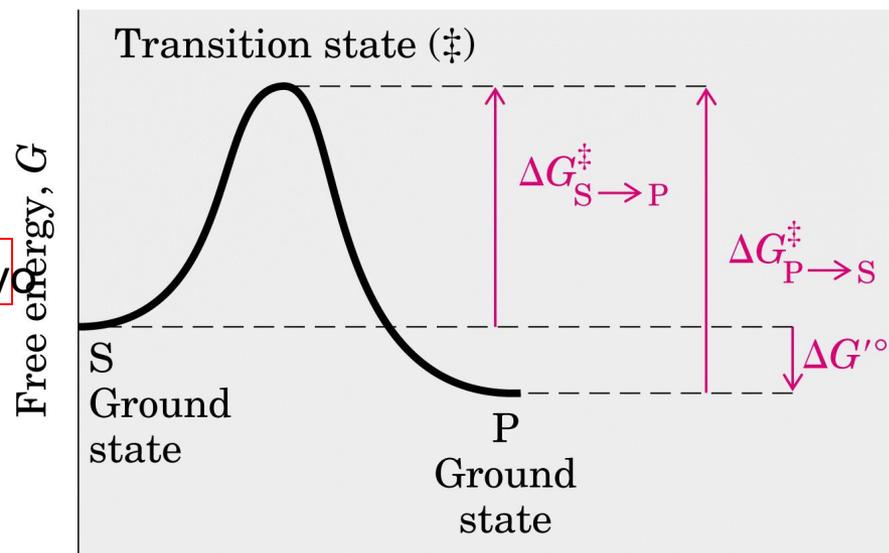
Estrutura Quaternária



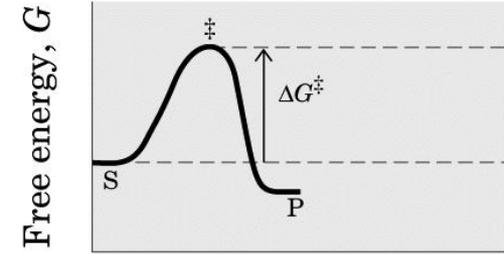
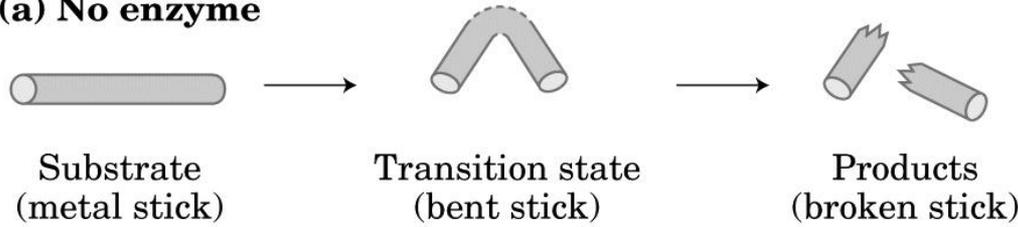
Subunidades protéicas



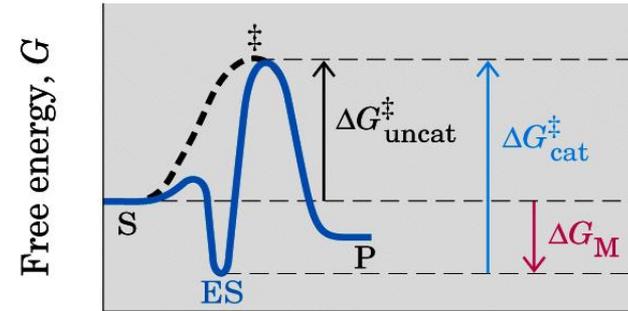
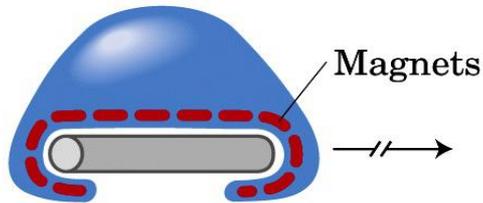
Sítio ativo



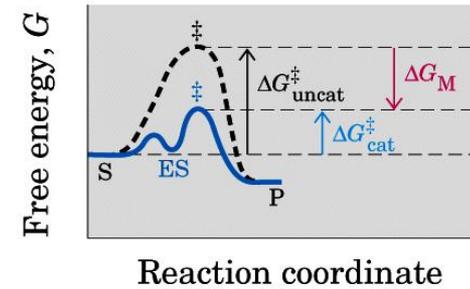
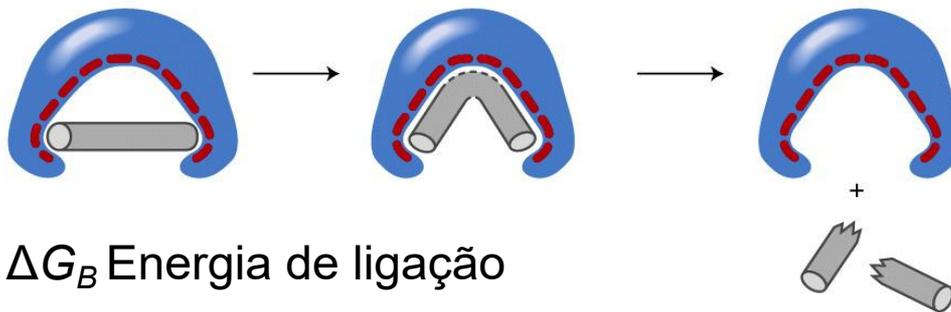
(a) No enzyme



(b) Enzyme complementary to substrate



(c) Enzyme complementary to transition state



- Redução de entropia
- Desolvatação
- “*Induced Fit*”

Nucleotídeos e Ácidos Nucléicos

DNA - Acido Desoxirribonucléico

Armazenamento da informação genética da célula

RNA - Acido Ribonucléico

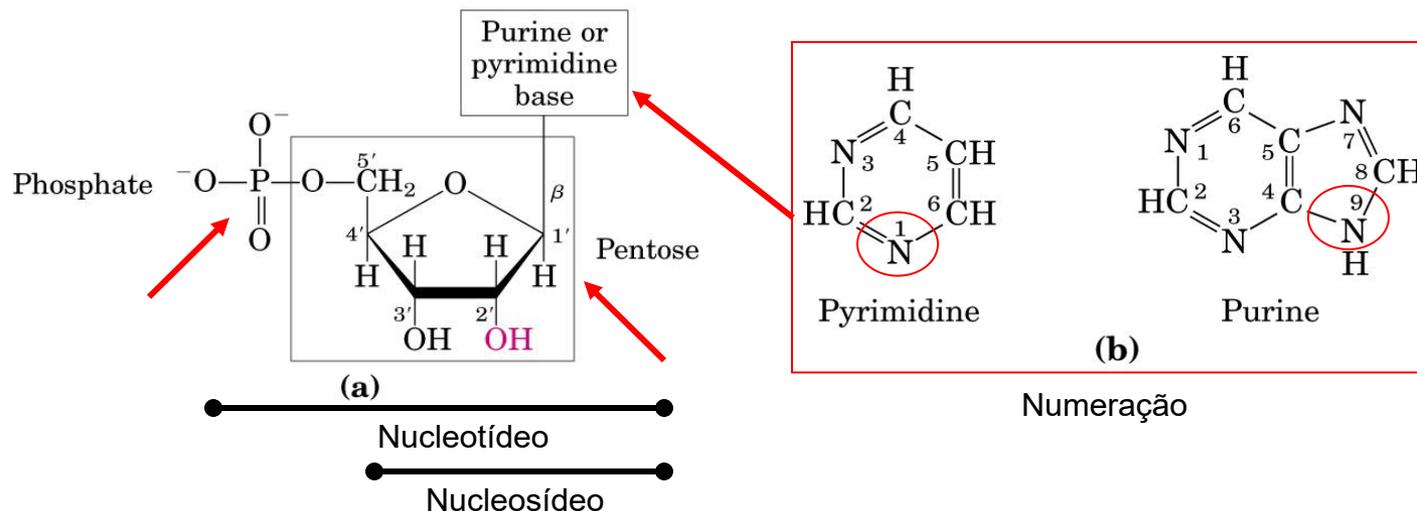
Funções variadas

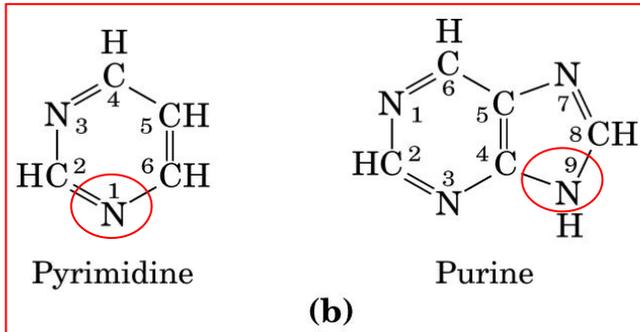
RNA ribossomal - rRNA - Componente estrutural do ribossomo

RNA transportador - tRNA - Adaptadores da síntese de proteínas

RNA mensageiro - mRNA - Intermediários na síntese de proteínas

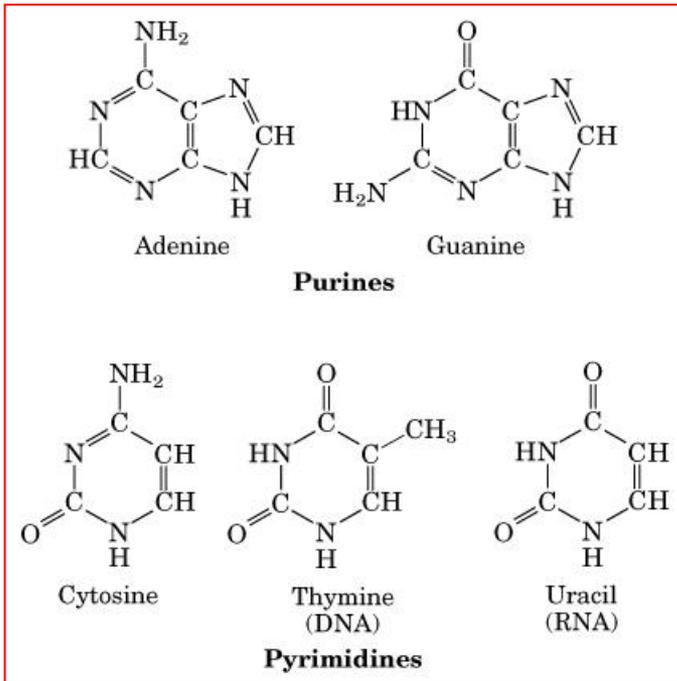
Unidade formadora: Nucleotídeos



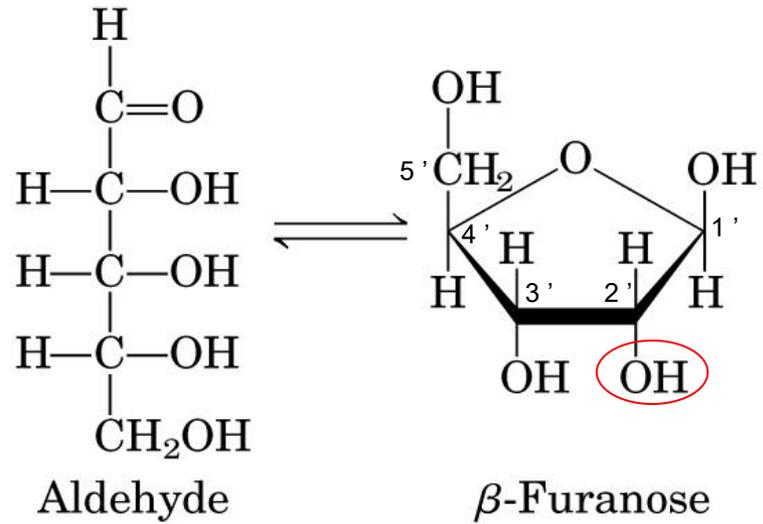


(b)

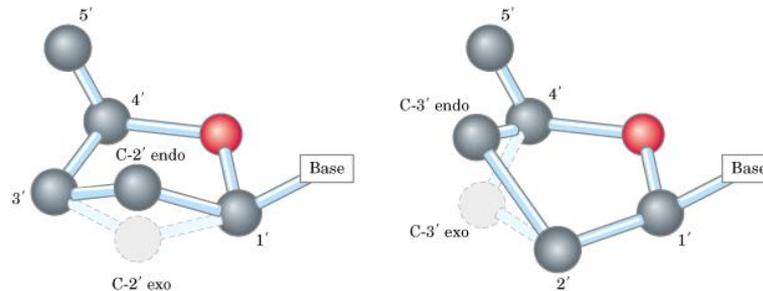
Numeração



Bases e ribose



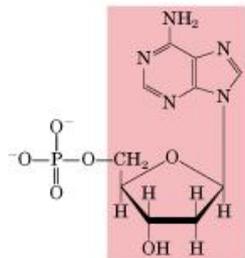
(a)



Nucleotide and Nucleic Acid Nomenclature

Base	Nucleoside*	Nucleotide*	Nucleic acid
Purines			
Adenine	Adenosine	Adenylate	RNA
	Deoxyadenosine	Deoxyadenylate	DNA
Guanine	Guanosine	Guanylate	RNA
	Deoxyguanosine	Deoxyguanylate	DNA
Pyrimidines			
Cytosine	Cytidine	Cytidylate	RNA
	Deoxycytidine	Deoxycytidylate	DNA
Thymine	Thymidine or deoxythymidine	Thymidylate or deoxythymidylate	DNA
Uracil	Uridine	Uridylate	RNA

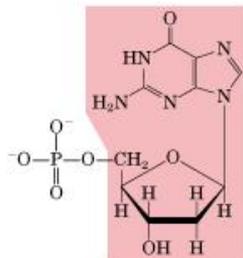
Nucleotídeos



Nucleotide: Deoxyadenylate (deoxyadenosine 5'-monophosphate)

Symbols: A, dA, dAMP

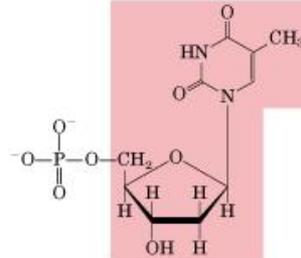
Nucleoside: Deoxyadenosine



Nucleotide: Deoxyguanylate (deoxyguanosine 5'-monophosphate)

Symbols: G, dG, dGMP

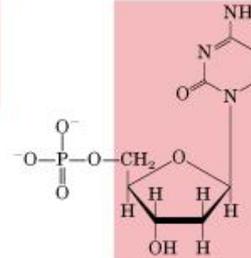
Nucleoside: Deoxyguanosine



Nucleotide: Deoxythymidylate (deoxythymidine 5'-monophosphate)

Symbols: T, dT, dTMP

Nucleoside: Deoxythymidine

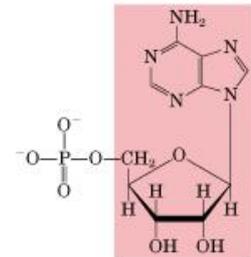


Nucleotide: Deoxycytidylate (deoxycytidine 5'-monophosphate)

Symbols: C, dC, dCMP

Nucleoside: Deoxycytidine

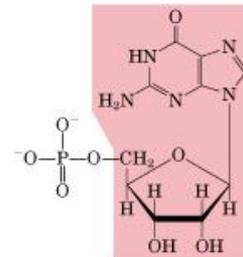
(a) Deoxyribonucleotides



Nucleotide: Adenylate (adenosine 5'-monophosphate)

Symbols: A, AMP

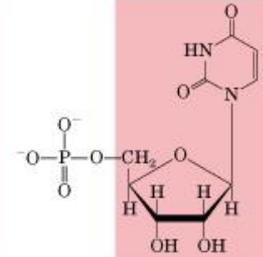
Nucleoside: Adenosine



Nucleotide: Guanylate (guanosine 5'-monophosphate)

Symbols: G, GMP

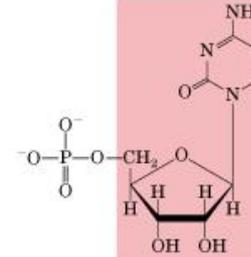
Nucleoside: Guanosine



Nucleotide: Uridylate (uridine 5'-monophosphate)

Symbols: U, UMP

Nucleoside: Uridine

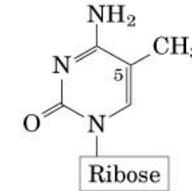


Nucleotide: Cytidylate (cytidine 5'-monophosphate)

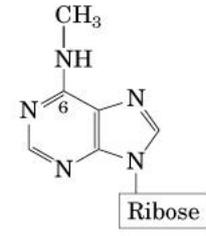
Symbols: C, CMP

Nucleoside: Cytidine

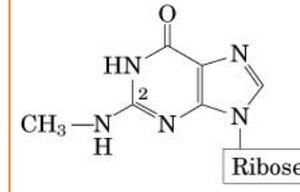
(b) Ribonucleotides



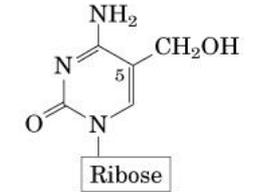
5-Methylcytidine



N⁶-Methyladenosine



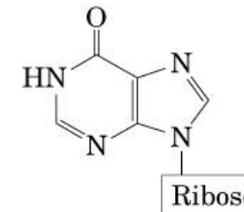
N²-Methylguanosine



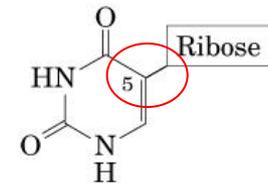
5-Hydroxymethylcytidine

(a)

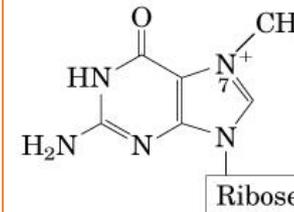
tRNA



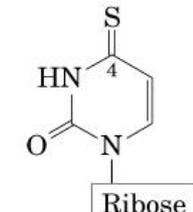
Inosine



Pseudouridine

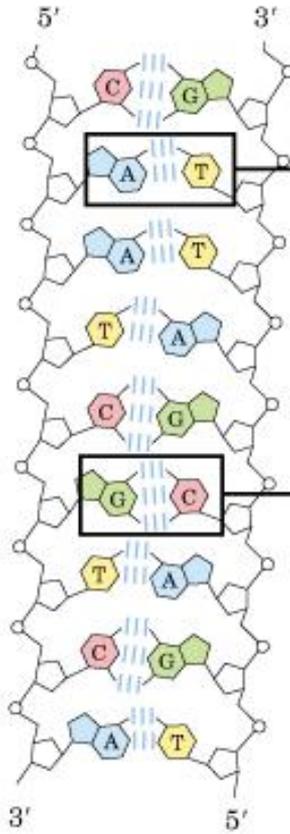


7-Methylguanosine

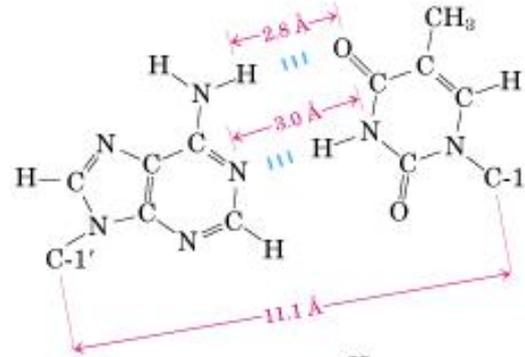


4-Thiouridine

(b)

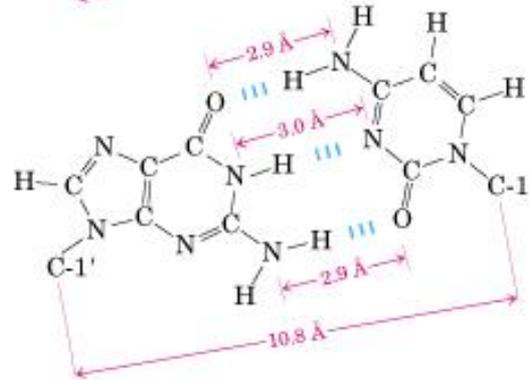


Adenine

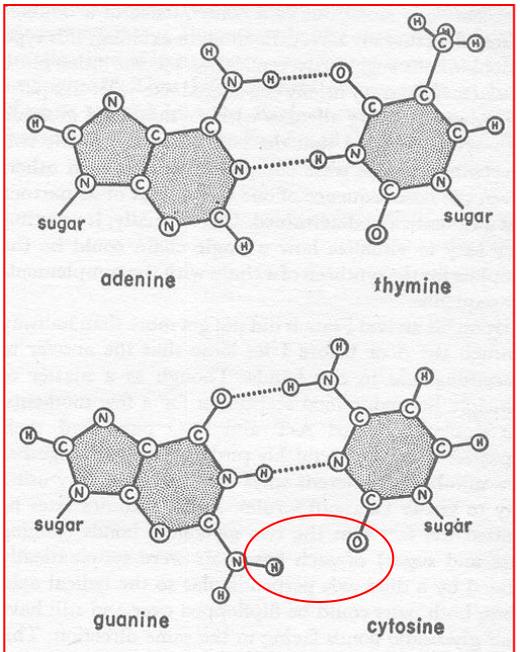
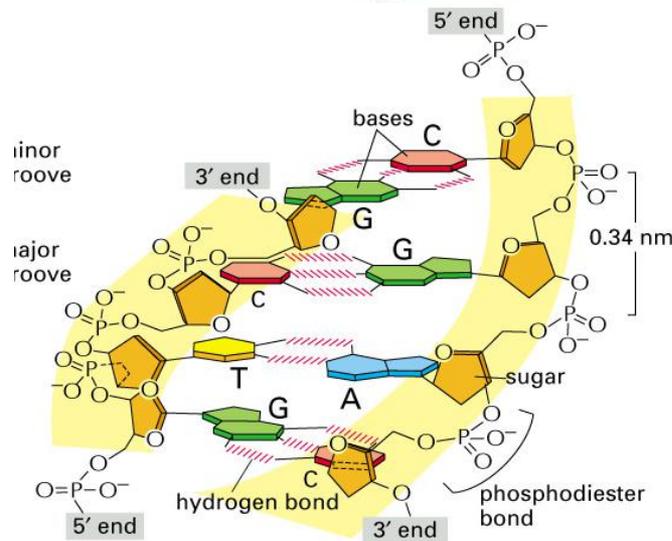


Thymine

Guanine

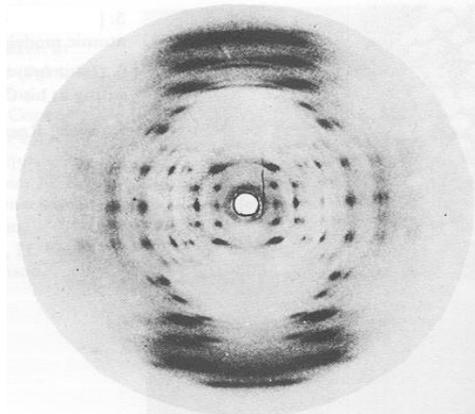


Cytosine

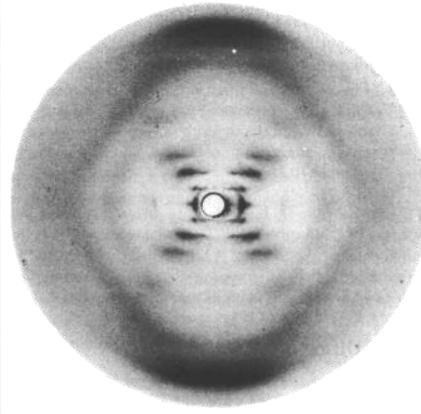


Difração de Raios-X por Fibra de DNA

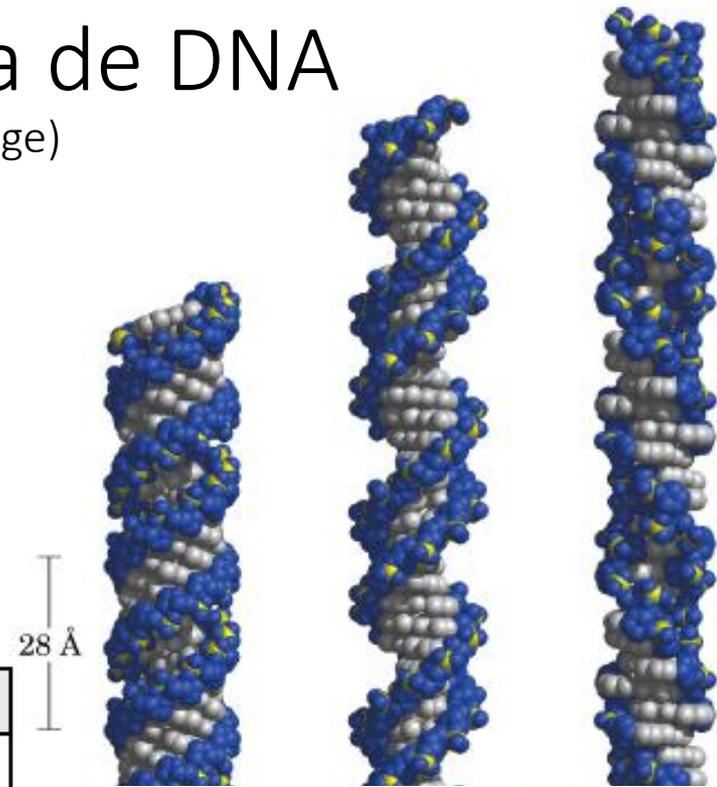
(fotos obtidas por Wilkins, Gosling e Stokes – King's College)



DNA tipo "A"



DNA tipo "B"



	A form	B form	Z form
Helical sense	Right handed	Right handed	Left handed
Diameter	~26 Å	~20 Å	~18 Å
Base pairs per helical turn	11	10.5	12
Helix rise per base pair	2.6 Å	3.4 Å	3.7 Å
Base tilt normal to the helix axis	20°	6°	7°
Sugar pucker conformation	C-3' endo	C-2' endo	C-2' endo for pyrimidines; C-3' endo for purines
Glycosyl bond conformation	Anti	Anti	Anti for pyrimidines; syn for purines

