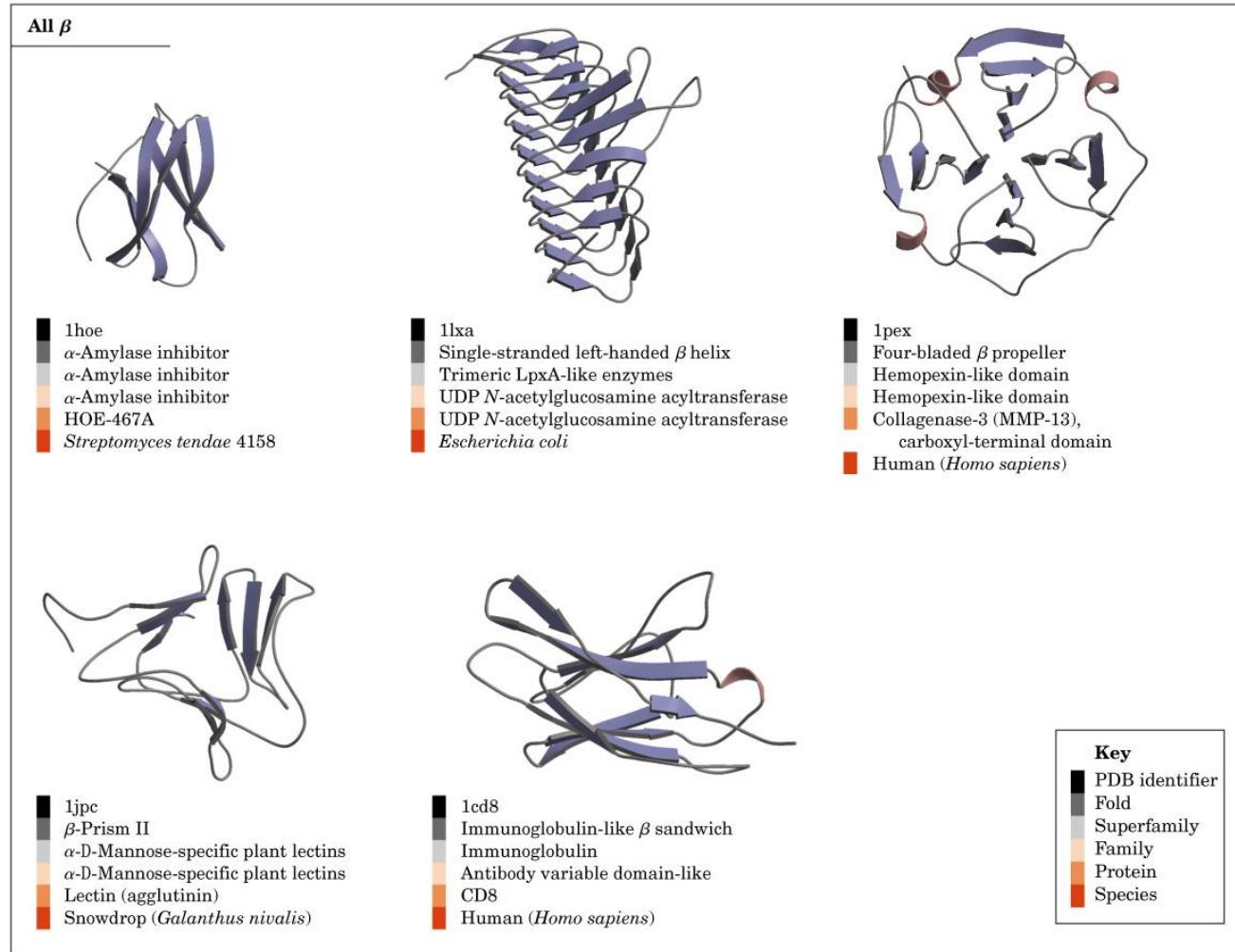
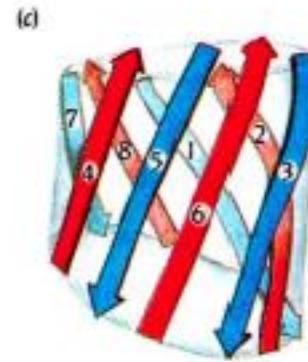
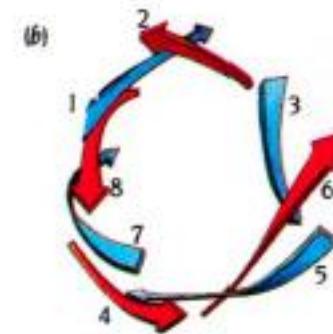
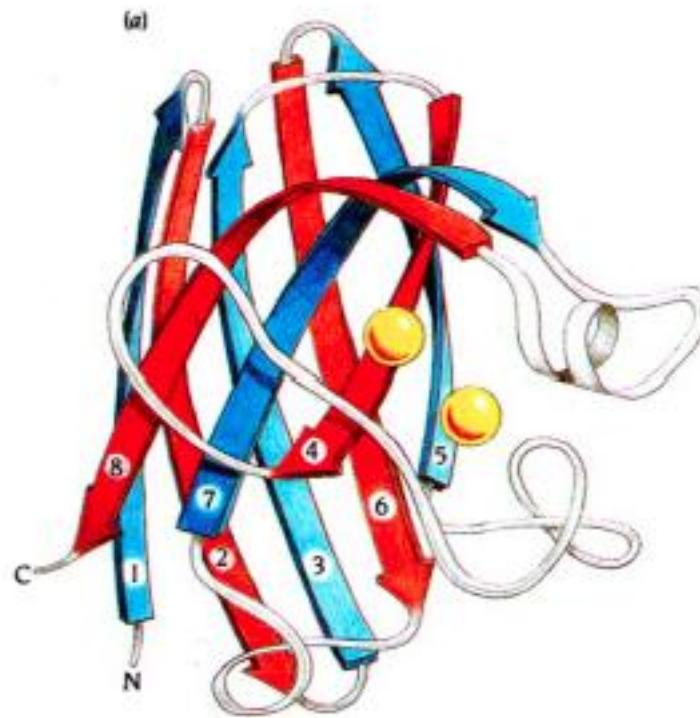


Proteine a motivi tutto β

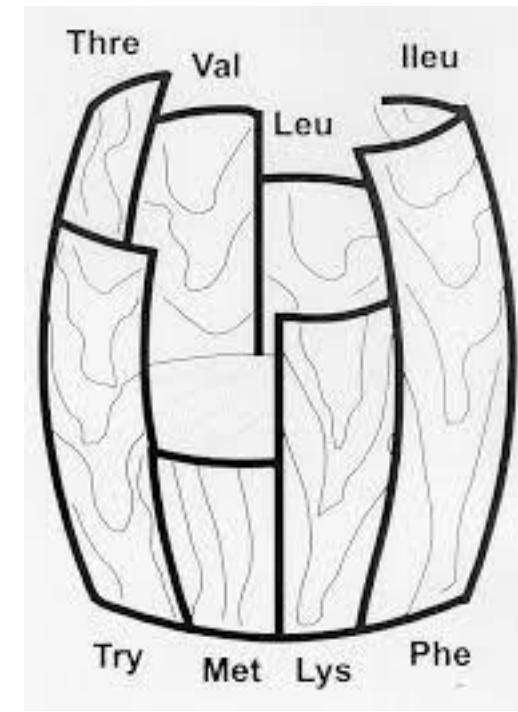


Proteine a motivi tutto β

Superossido dismutasi : un esempio di struttura a forma di botte

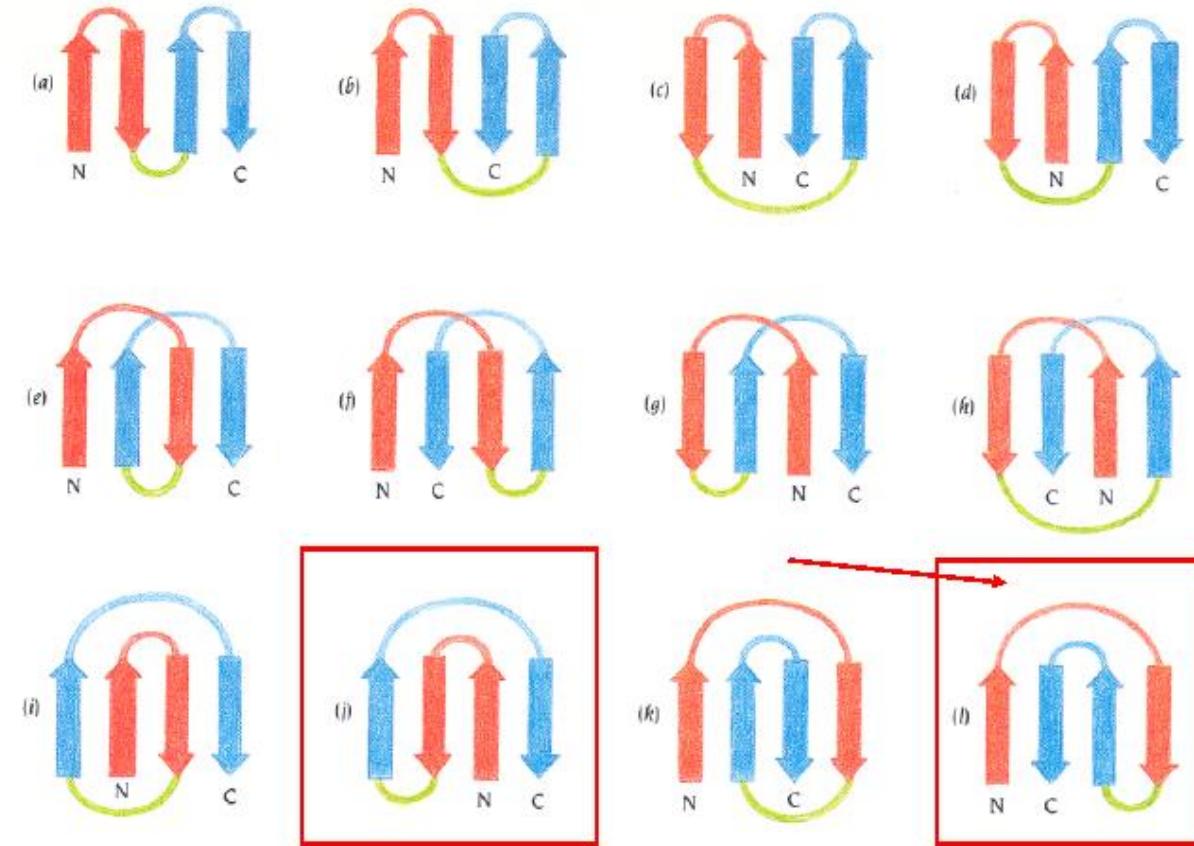


Proteine a motivi tutto β



Proteine a motivi tutto β

Motivi strutturali a foglietto β adiacenti possono originare numerose combinazioni

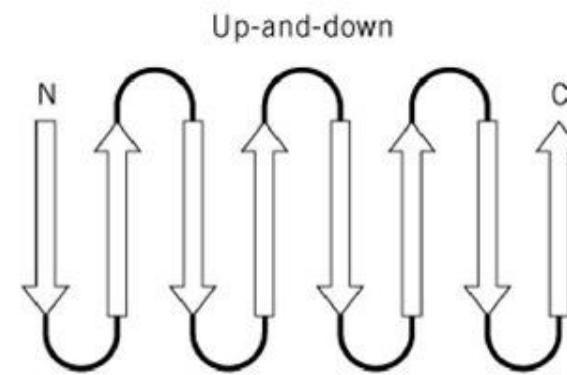


Proteine a motivi tutto β

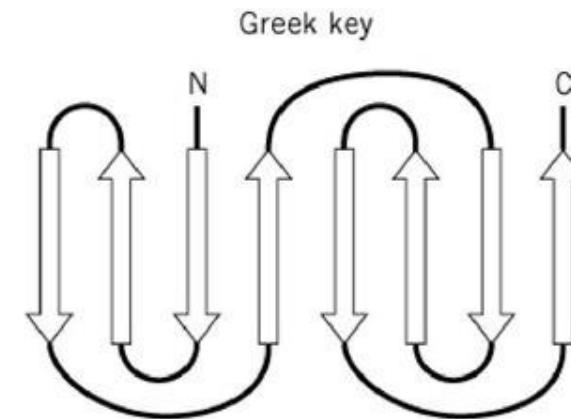
Le strutture composti da motivi tutto β sono di tre tipologie differenti :

- 1) Struttura a botte testa-coda
- 2) Struttura a botte a chiave greca
- 3) Struttura a botte jelly-roll

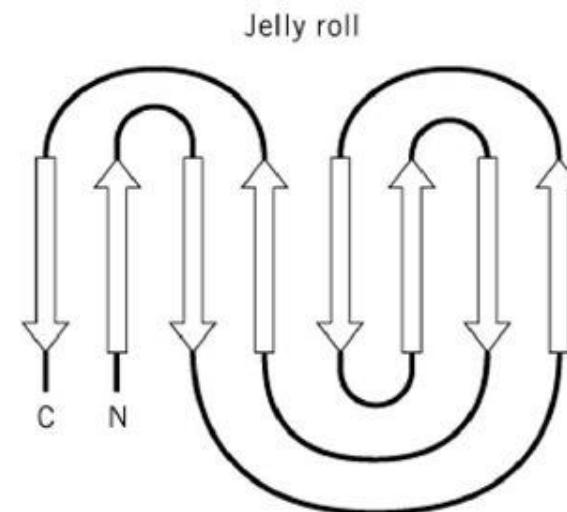
1) Struttura a botte testa-coda



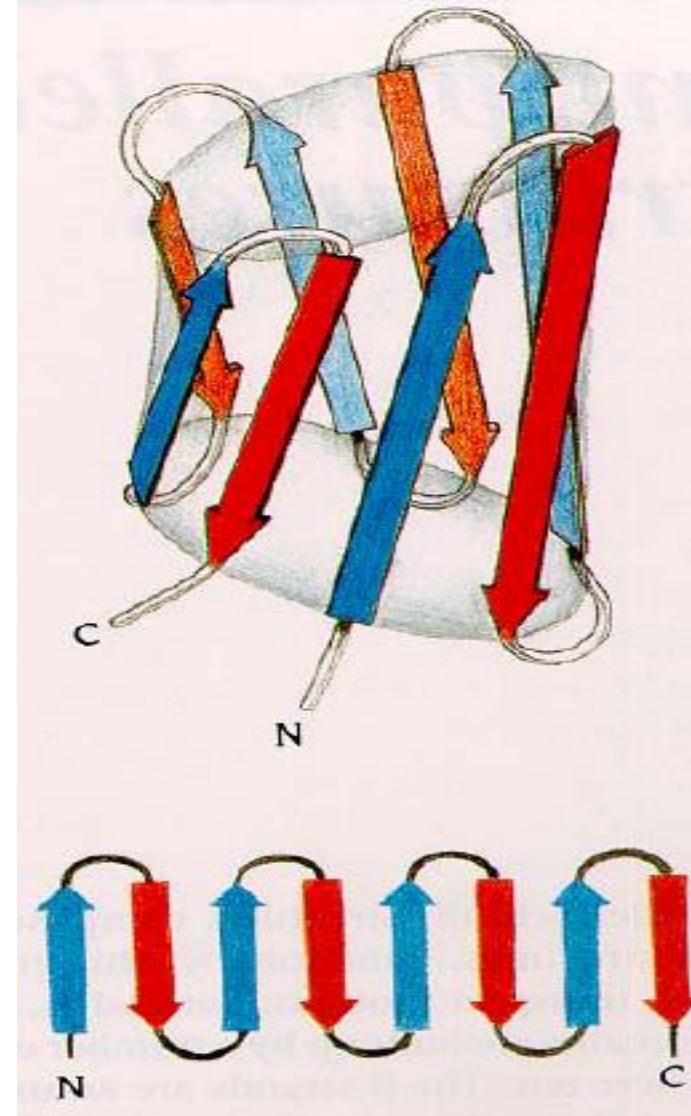
2) Struttura a botte a chiave greca



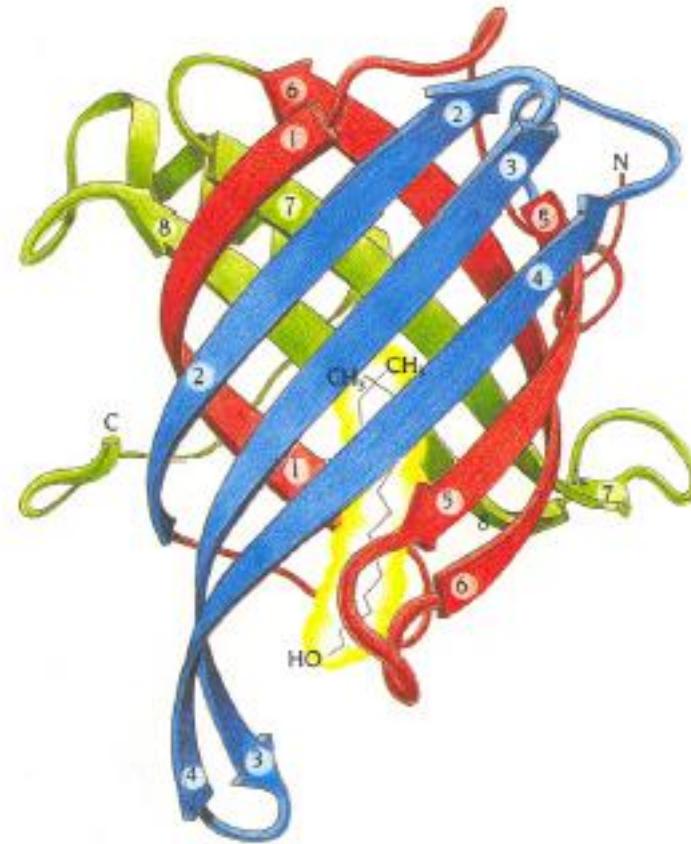
1) Struttura a botte jelly-roll



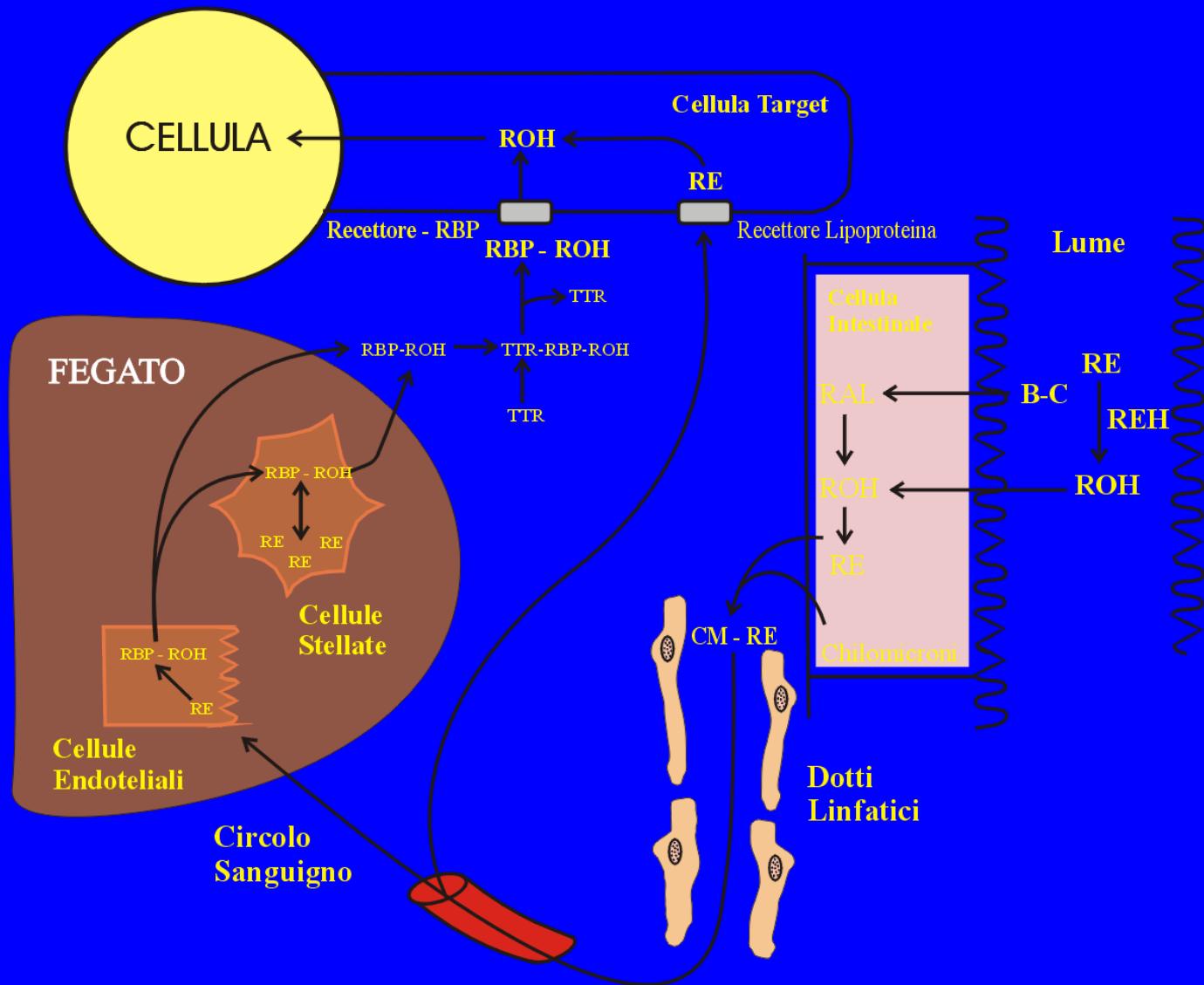
Schema generale di una struttura a botte testa-coda nelle proteine contenenti motivi tutto β



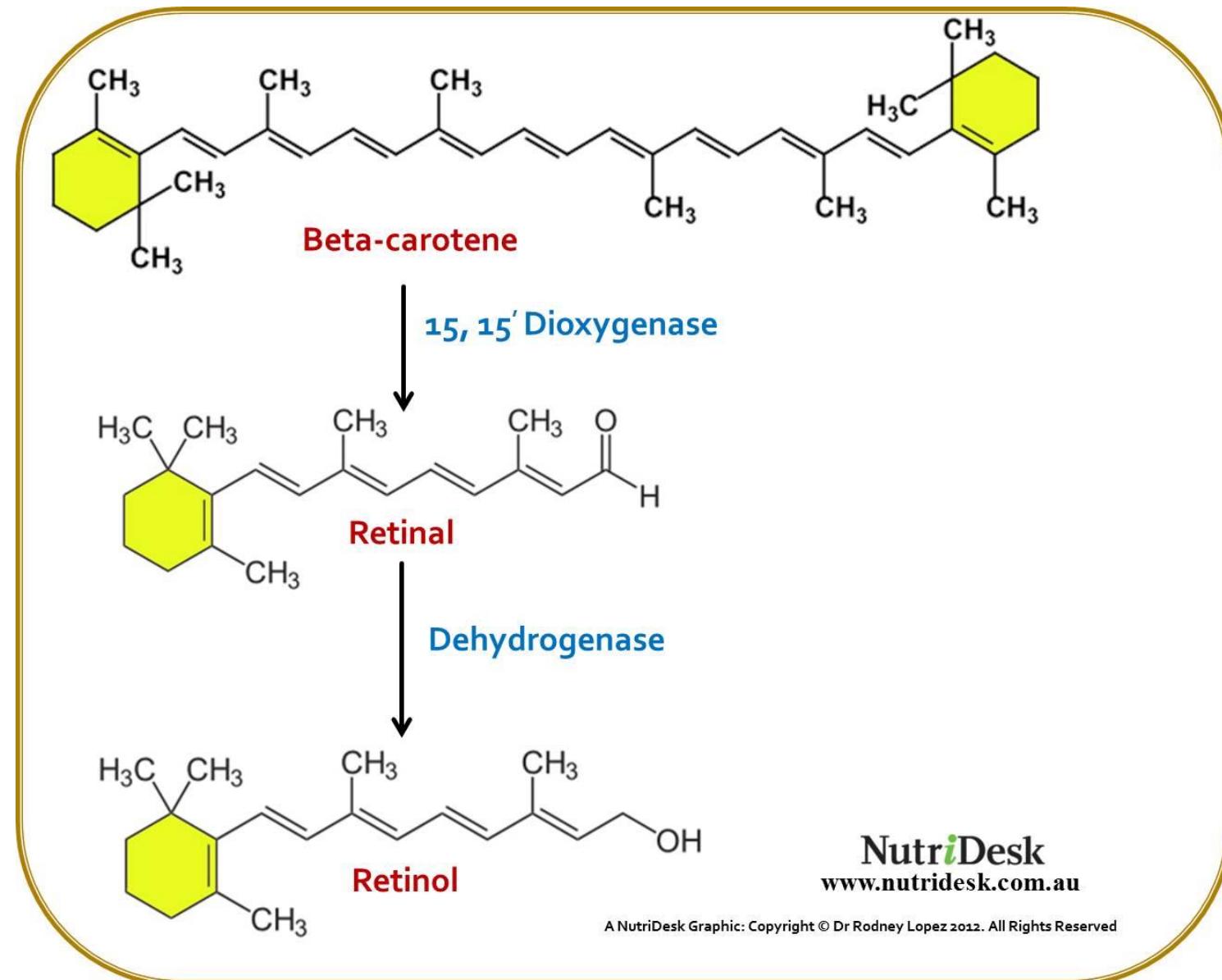
Un esempio di struttura a botte testa-coda: la proteina legante il retinolo RBP



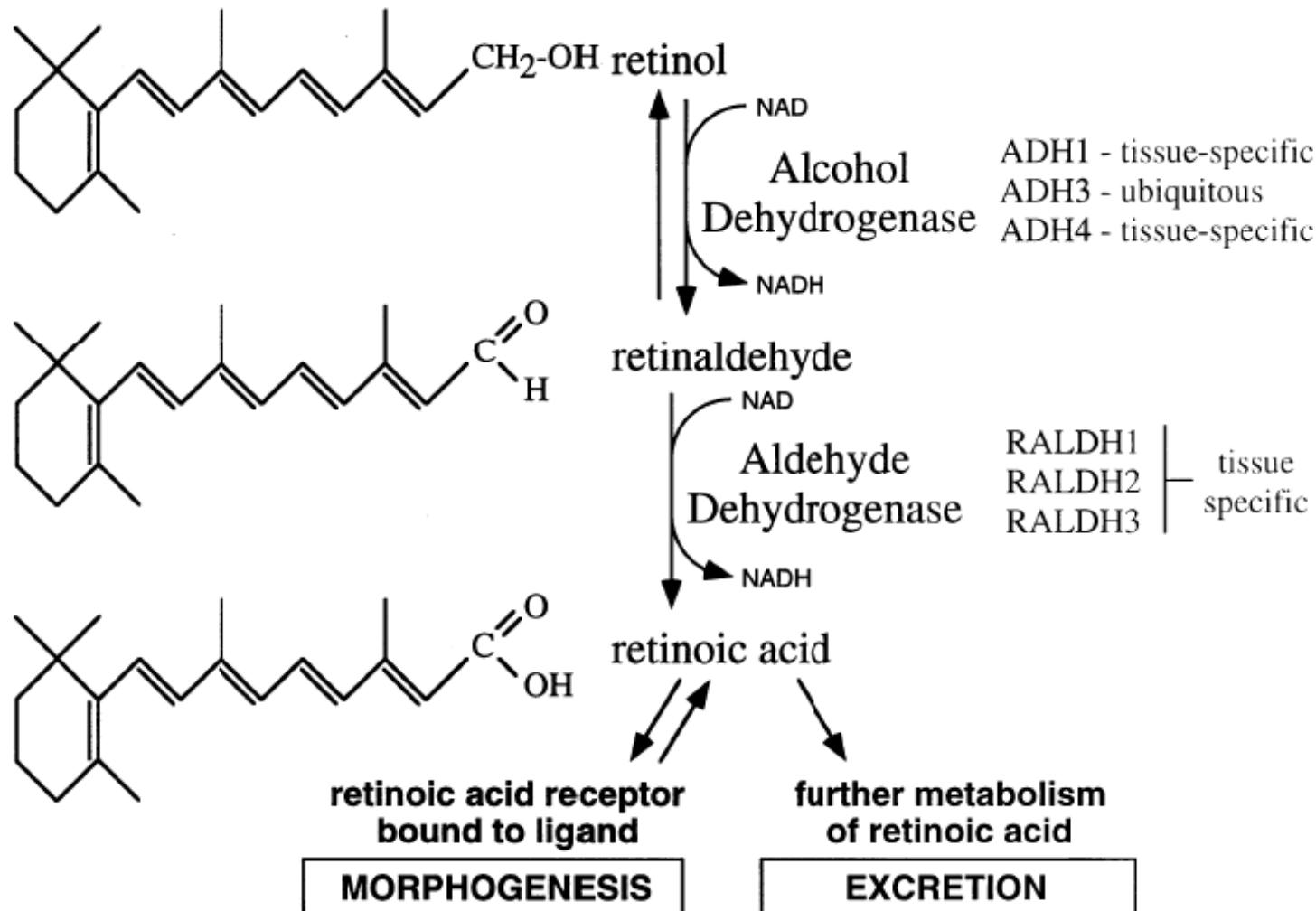
Ciclo vitale della proteina legante il retinolo (RBP)



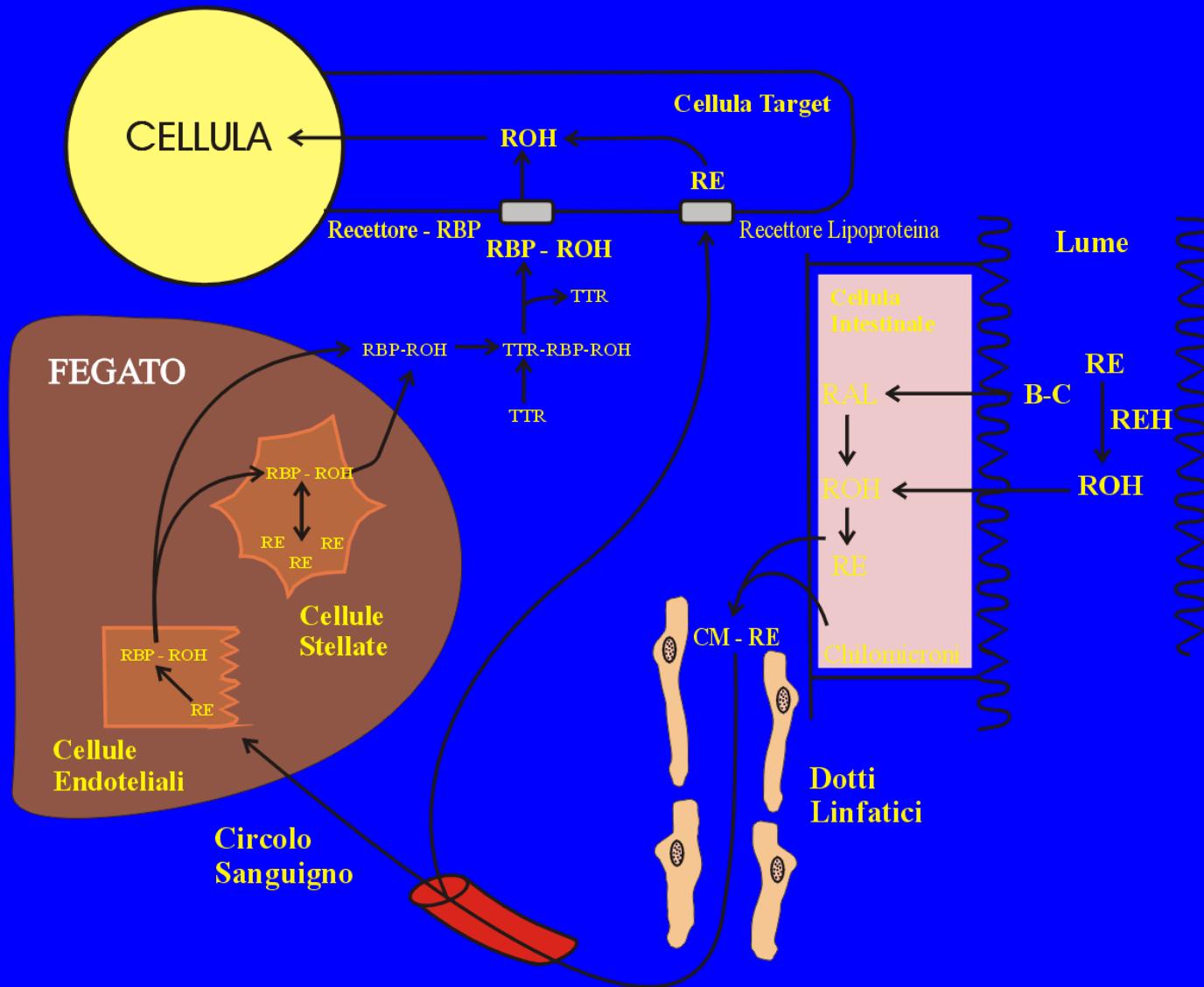
Beta-carotene, retinale e retinolo



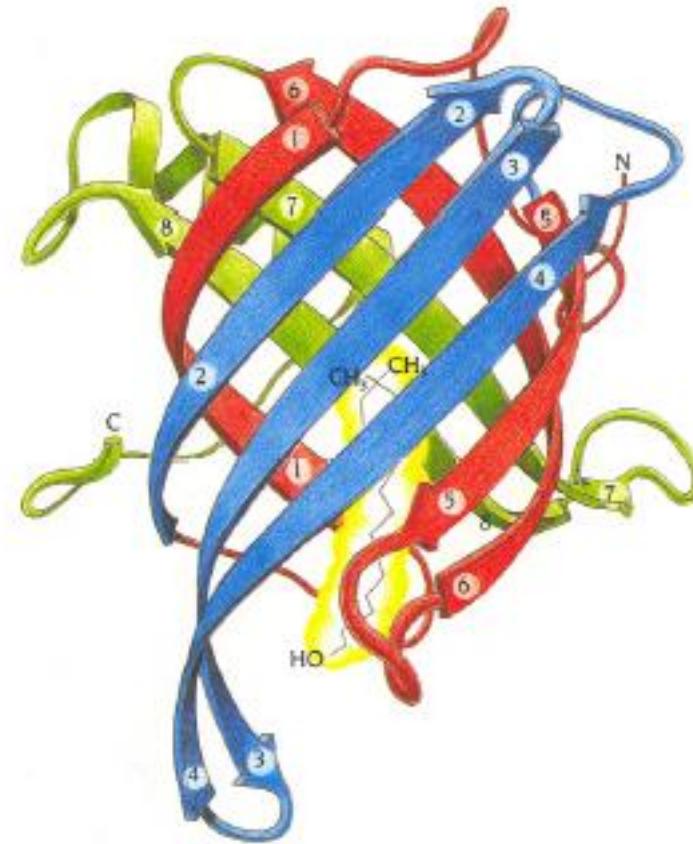
Acido retinoico, retinale e retinolo



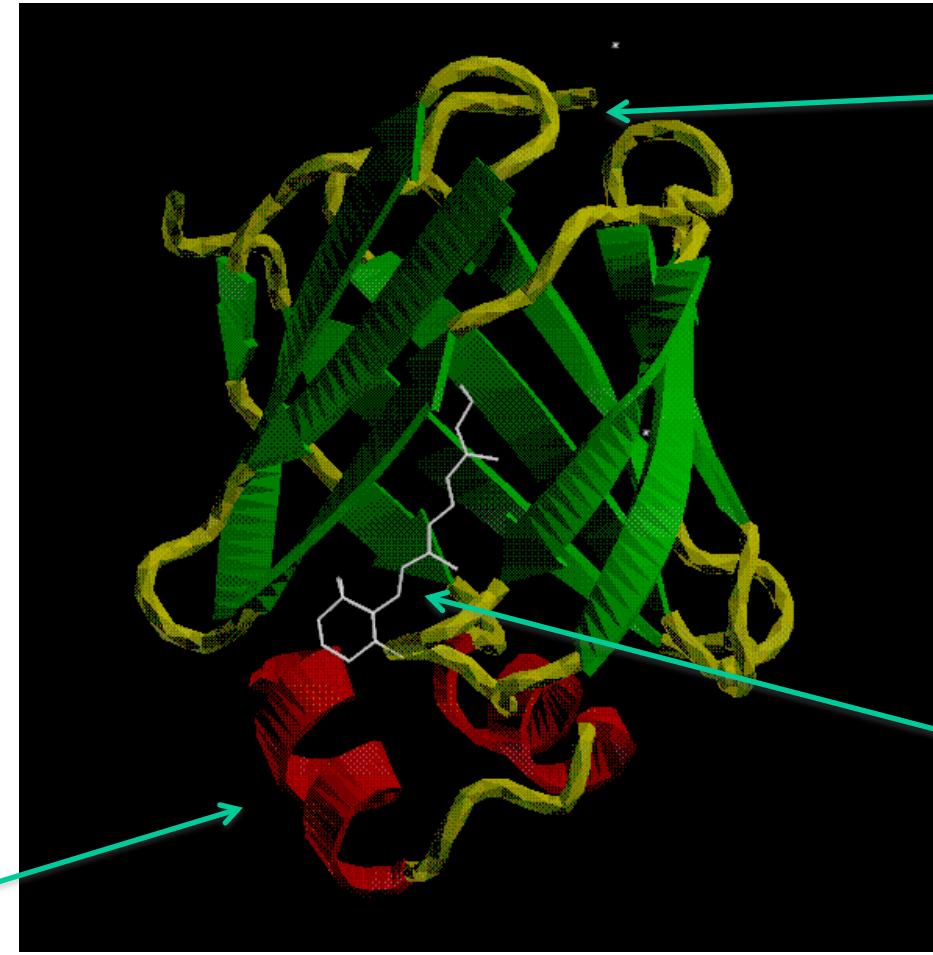
Ciclo vitale della la proteina legante il retinolo (RBP)



Un esempio di struttura a botte testa-coda: la proteina legante il retinolo (RBP)



Un esempio di struttura a botte testa-coda: la proteina legante il retinolo (RBP)

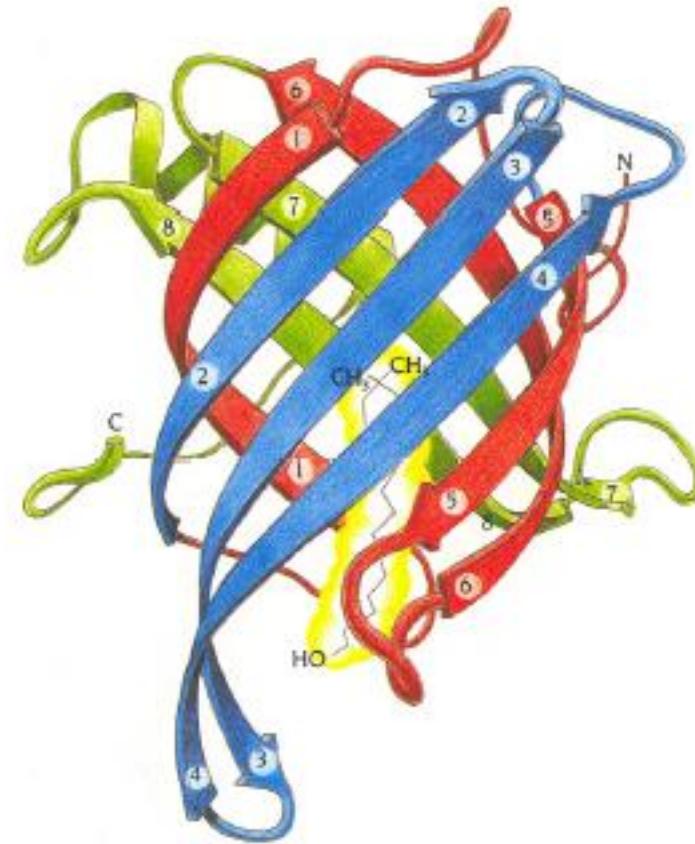


Sito di entrata
del retinolo

Molecola del
retinolo

Struttura ad
alfa-elica

Un esempio di struttura a botte testa-coda: la proteina legante il retinolo (RBP)



Un esempio di struttura a botte testa-coda: la proteina legante il retinolo (RBP)

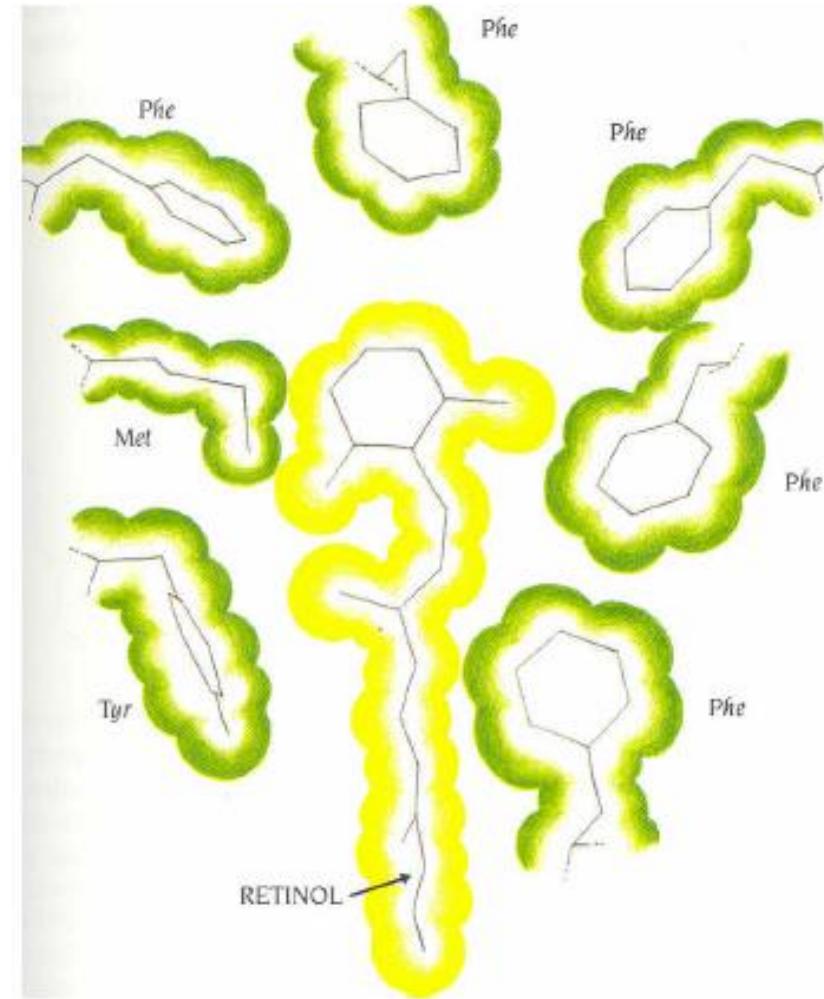
Altering patterns in amino acid sequence of rbp

<i>strand no.</i>	<i>residue no.</i>	<i>amino acid sequence</i>																
2	41-48	-	Ile	-	Val	-	Ala	-	Glu	-	Phe	-	Ser	-	Val	-	Asp	-
3	53-60	-	Met	-	Ser	-	Ala	-	Thr	-	Ala	-	Lys	-	Gly	-	Arg	-
4	71-78	-	Ala	-	Asp	-	Met	-	Val	-	Gly	-	Thr	-	Phe	-	Thr	-

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- Amino acid sequence of β strands 2, 3, and 4 in human plasma retinol-binding protein.
- The sequences are listed in such a way that residues which point into the barrel are aligned.
- These hydrophobic residues are shown by arrows and are colored green. The remaining residues are exposed to the solvent. Hydrophobic amino acids are facing the core
- Polar, charged and a few small hydrophobic are exposed to the solvent

Schema delle interazioni idrofobiche che stabilizzano il ligando nella proteina legante il retinolo



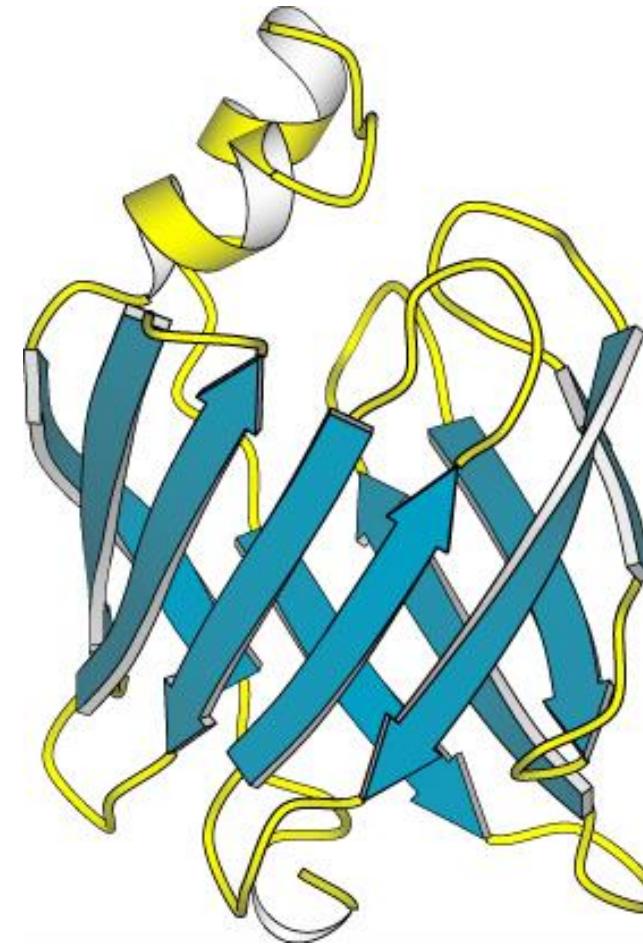
Alcuni esempi di proteine appartenenti alla famiglie delle lipocaline

Table 1 Properties of members of the Lipocalin protein family

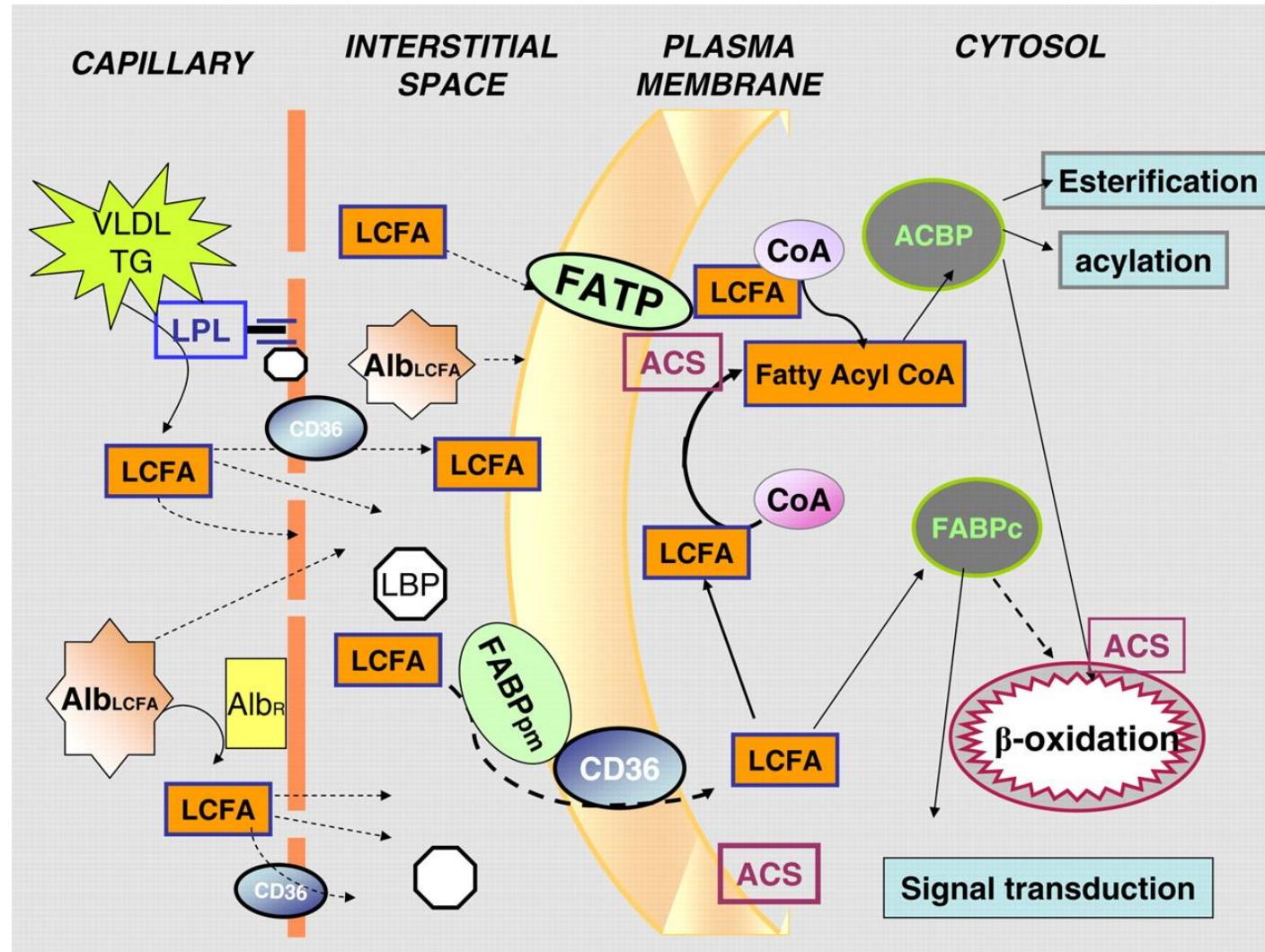
Members of the lipocalin protein family listed as a Table with a summary of their physical and chemical properties; the proteins listed are divided between kernel and outlier lipocalins (2,3). Molecular masses are given in kDa. Where a property, such as glycosylation, has been shown to be present experimentally this is indicated by a +, shown to be absent by a -; otherwise, where this is unknown the value is left blank. Data are taken from references cited in the text. Well-established abbreviations of particular lipocalins, as used in the text, are given in the last column.

Protein	Subunit molecular mass	pI	No. of residues	Oligomeric state	Glycosylation	Number of disulphides	Abbreviation
Kernel lipocalins							
Retinol-binding protein	21.0	5.5	183	Monomer	-	3	RBP
Purpurin	20.0		175				PURP
Retinoic acid-binding protein	18.5	5.2	166	Monomer	-	1	RABP
α_2 -Globulin	18.7	5.7–6.7	162	Dimer	-	1	A2U
Major urinary protein	17.8	5.5–5.7	161	Dimer	-	1	MUP
Bilin-binding protein	19.6		173	Tetramer	-	2	BBP
α -Crustacyanin	350.0	4.3–4.7	174/181	Octamer of heterodimers	-	2/2	
Pregnancy protein 14	56.0		162	Homodimer	+		PP14
β -Lactoglobulin	18.0	5.2	162	Dimer/monomer	-	2	Blg
α_1 -Microglobulin	31.0	4.3–4.8	188	Monomer + complexes	+	1	A1M
C8 γ	22.0		182	Part of complex	-	1	C8 γ
Apolipoprotein D	29.0–32.0	4.7–5.2	169	Dimer + complexes	+	2	ApD
Lazatin	45.0		183	Monomer	+	+	LAZ
Prostaglandin D synthase	27.0	4.6	168	Monomer	+	1	PGDS
Quiescence-specific protein	21.0	6.3	158			1	QSP
Neutrophil lipocalin	25.0		179	Monomer/dimer + complexes	-		NGAL
Choroid plexus protein	20.0		183	Monomer	-		
Outlier lipocalins							
Odorant-binding protein	37.0–40.0	4.7	159	Dimer	-	0	OBP
von Ebner's-gland protein	18.0	4.8–5.2	170	Dimer	-	1	VEGP
α_1 -Acid glycoprotein	40.0	3.2	183	Monomer	+	2	AGP
Probasin	20.0	11.5	160				PBAS
Aphrodisin	17.0		151		+	2	

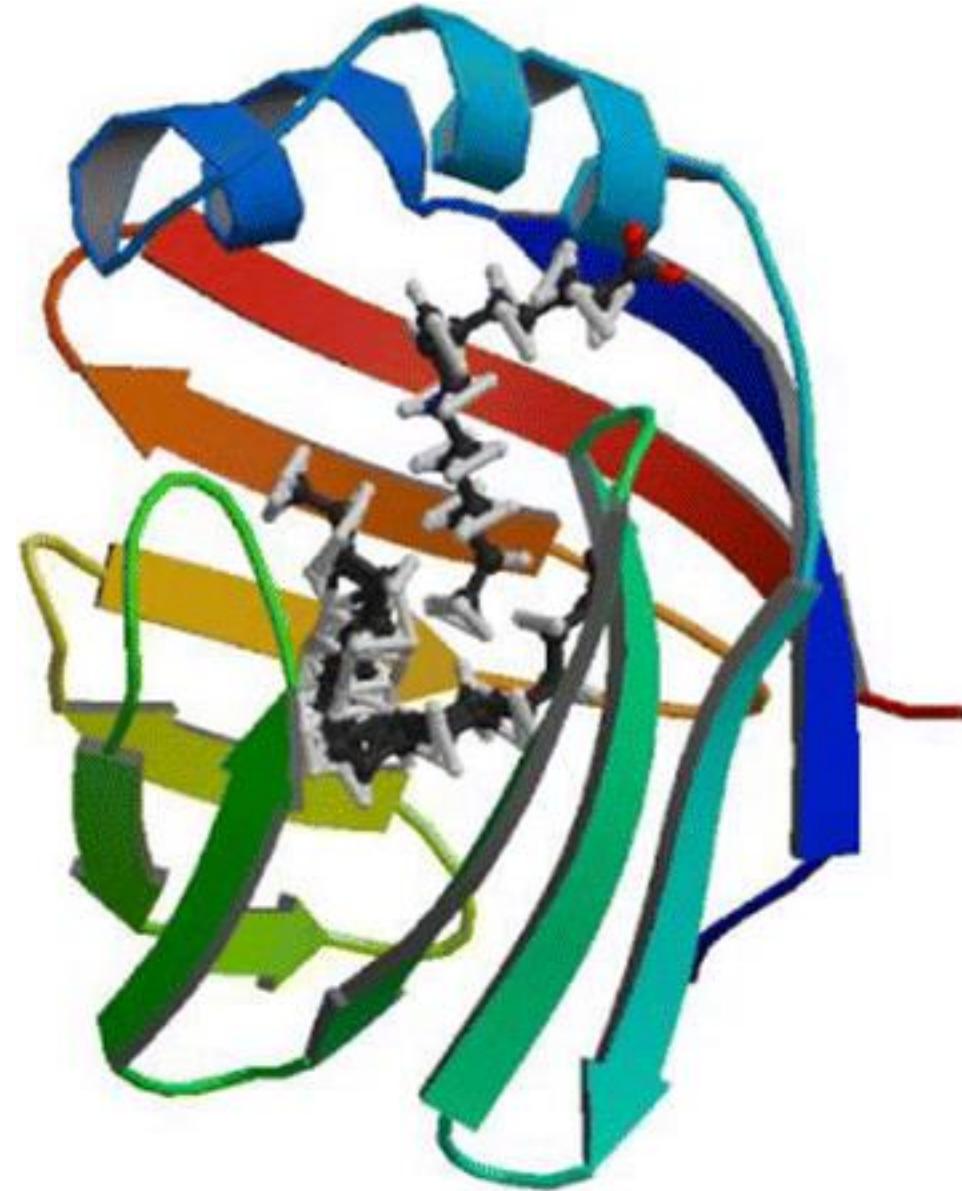
Un esempio di struttura a botte testa-coda: la proteina legante gli acidi grassi della famiglia delle P2



Un esempio di struttura a botte testa-coda:
la proteina legante gli acidi grassi della famiglia delle P2

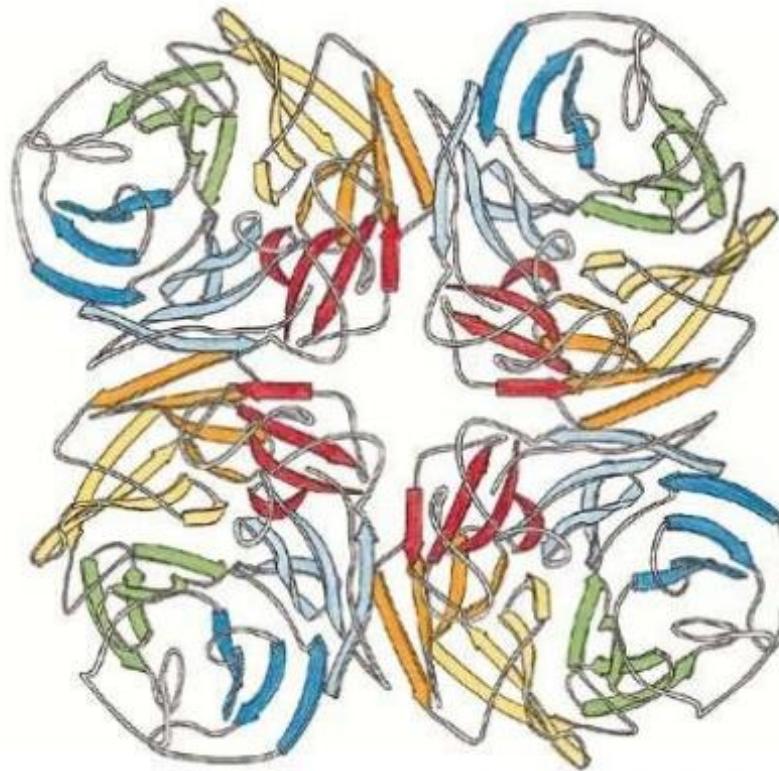


Un esempio di struttura a botte testa-coda: la proteina legante gli acidi grassi della famiglia delle P2



Un esempio di struttura complessa formata da domini
a tutto β : la neuraminidasi

Neuraminidase tetramer



Un esempio di struttura complessa formata da domini a tutto β : la neuraminidasi

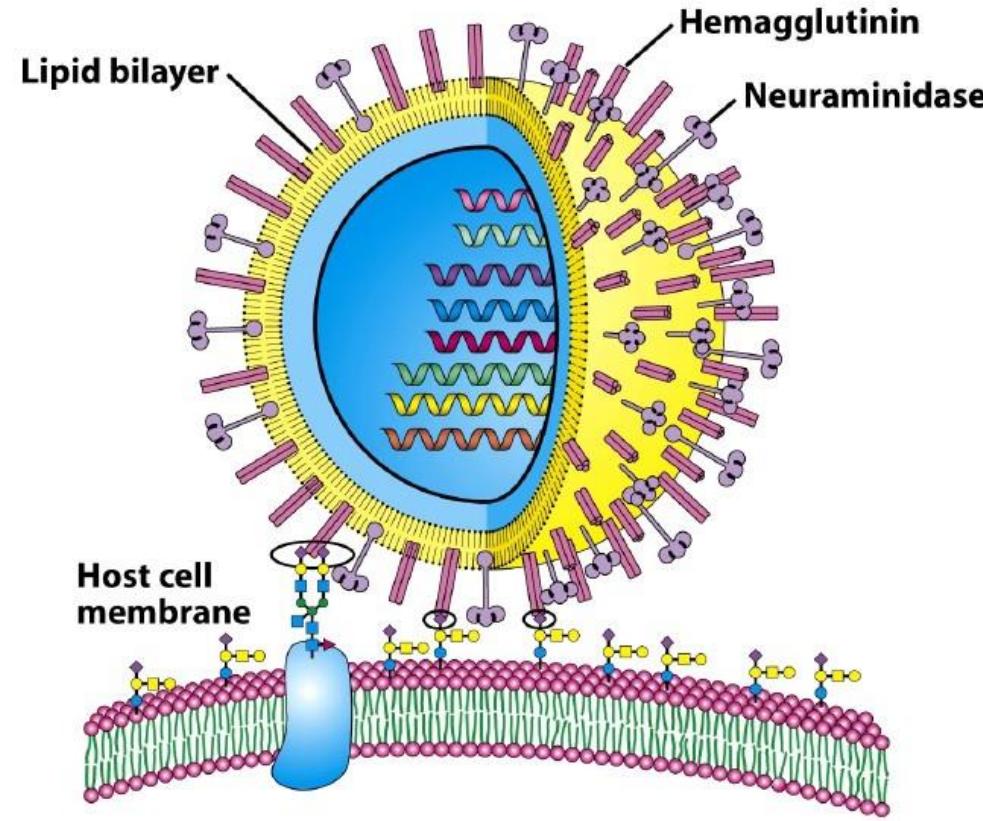
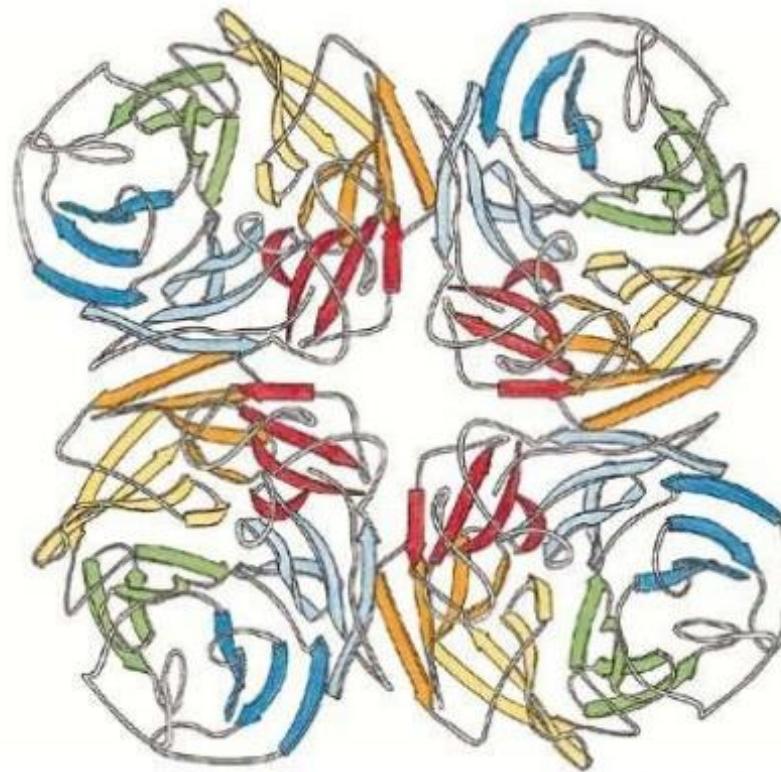


Figure 11-29
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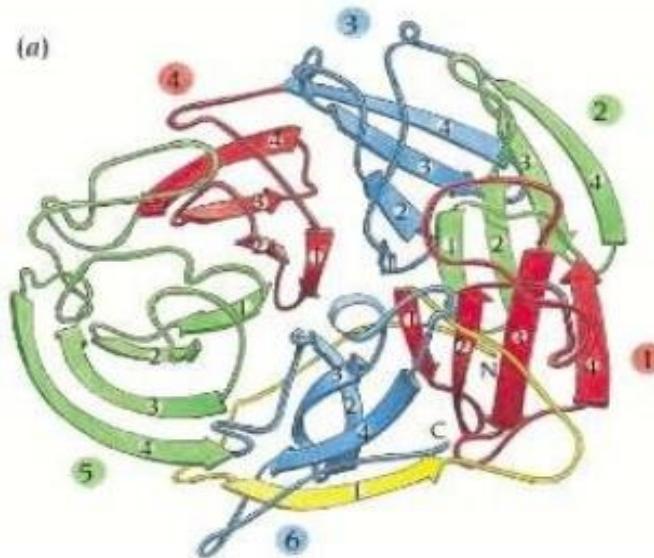
Un esempio di struttura complessa formata da domini
a tutto β : la neuraminidasi

Neuraminidase tetramer

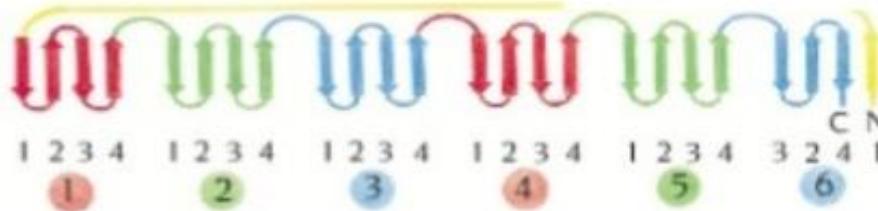


Un esempio di struttura complessa formata da domini a tutto β : la neuramminidasi

β propeller in neuraminidase

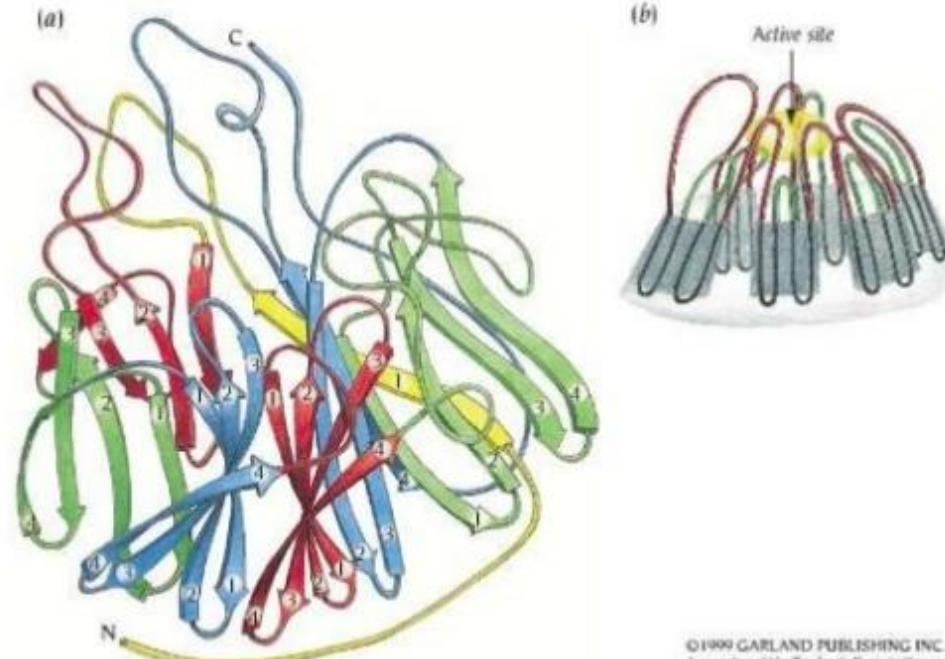


- Influenza virus protein, involved in virion release from cells
- Tetrameric protein, one monomer consists of 6 up-and down β sheets
- Builds a propeller-like structure



Un esempio di struttura complessa formata da domini
a tutto β : la neuramminidasi

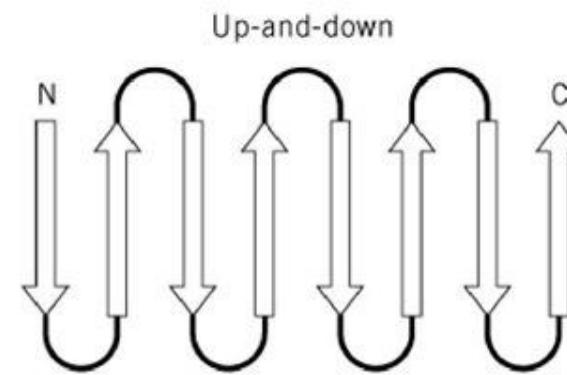
Active site in β -propeller proteins



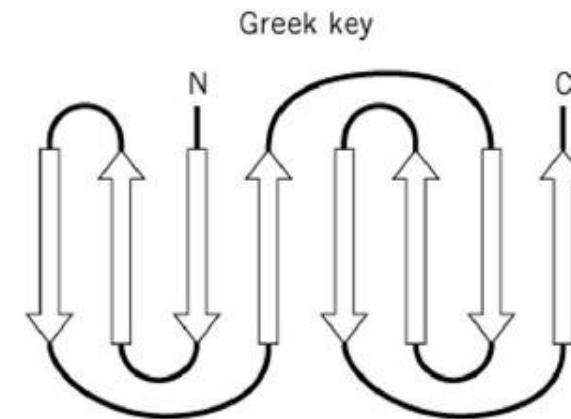
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- On the top of propeller there are extensive loops
- The loops form active site

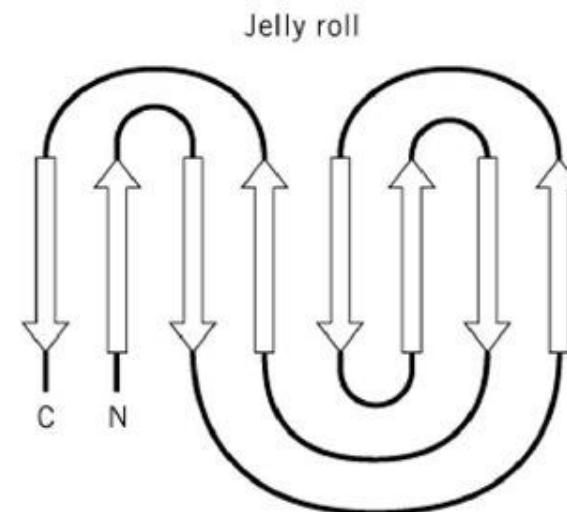
1) Struttura a botte testa-coda



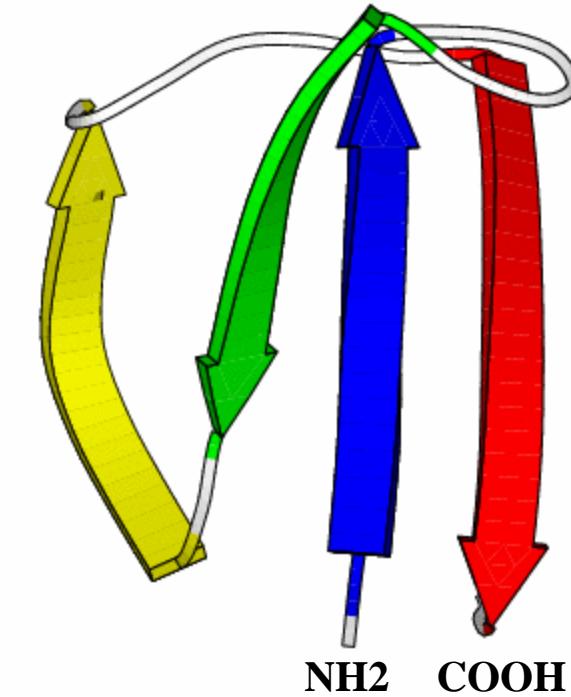
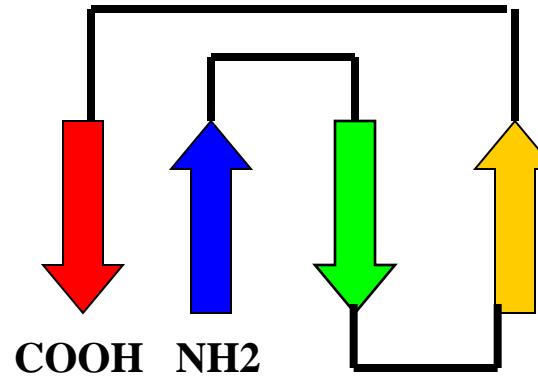
2) Struttura a botte a chiave greca



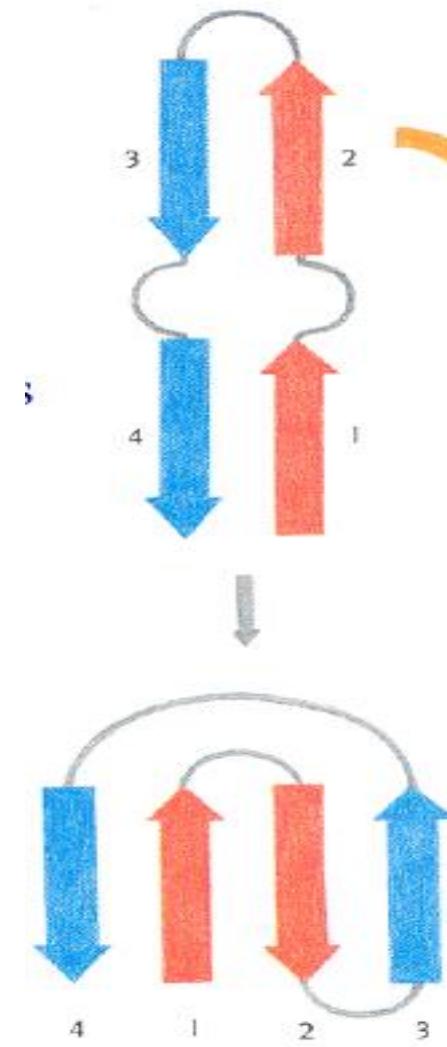
1) Struttura a botte jelly-roll



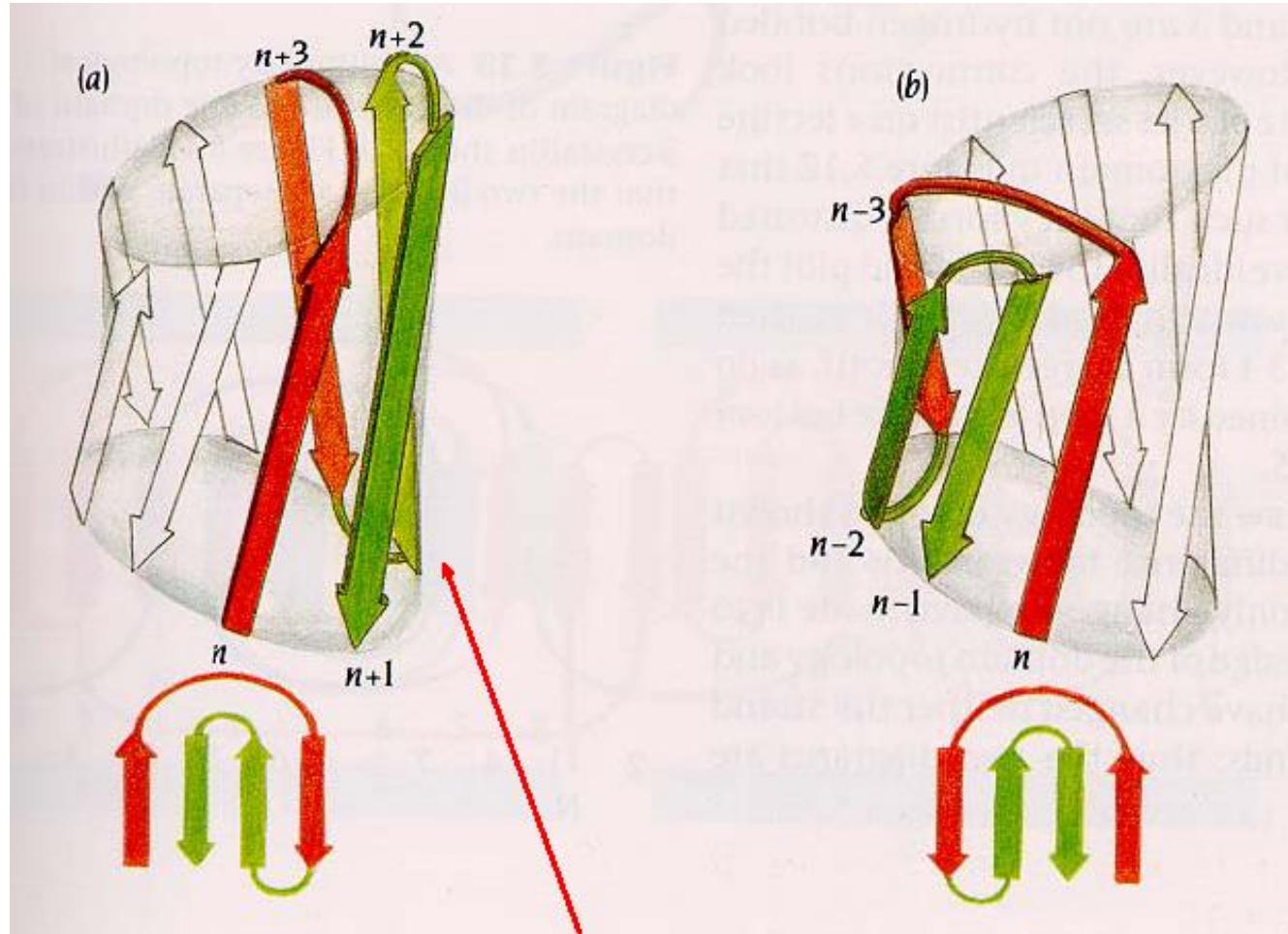
Proteine a struttura a chiave greca



Il ripiegamento di due strutture a forcina β adiacenti determina la formazione del motivo a chiave greca

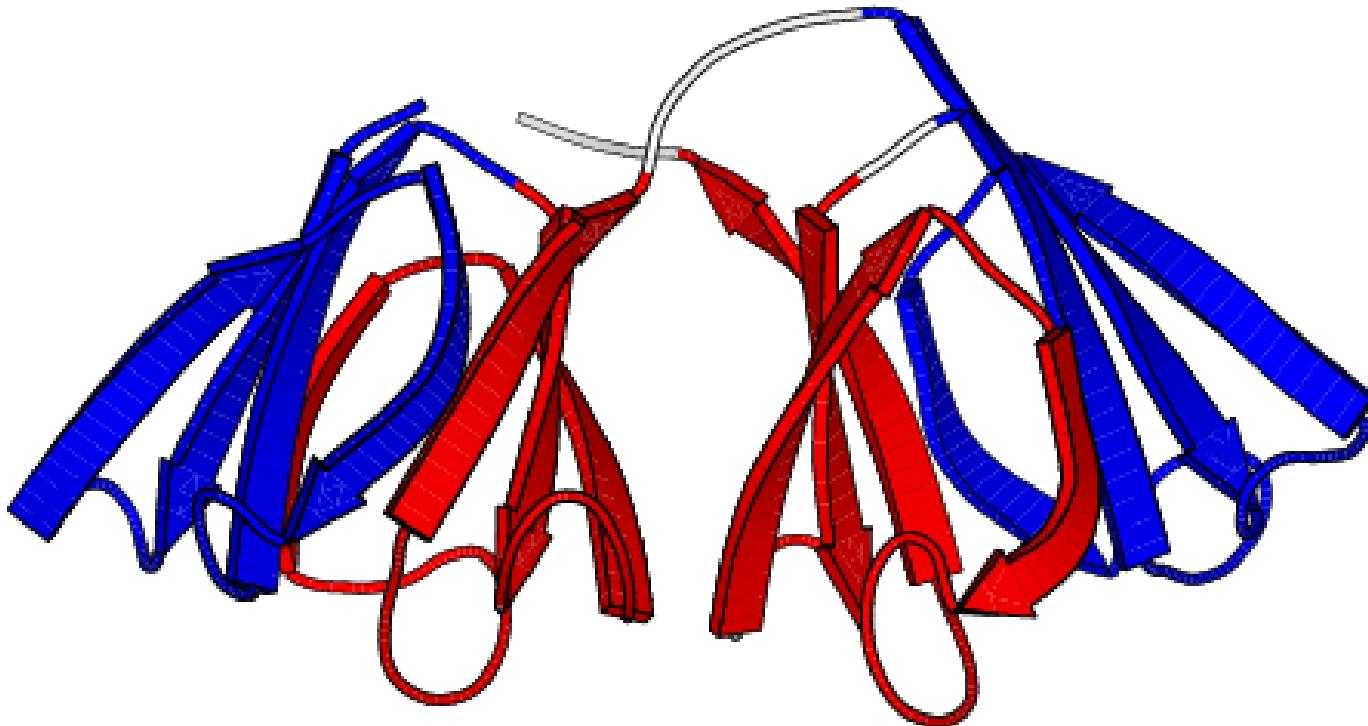


Disegno schematico del motivo a chiave greca nella struttura a botte

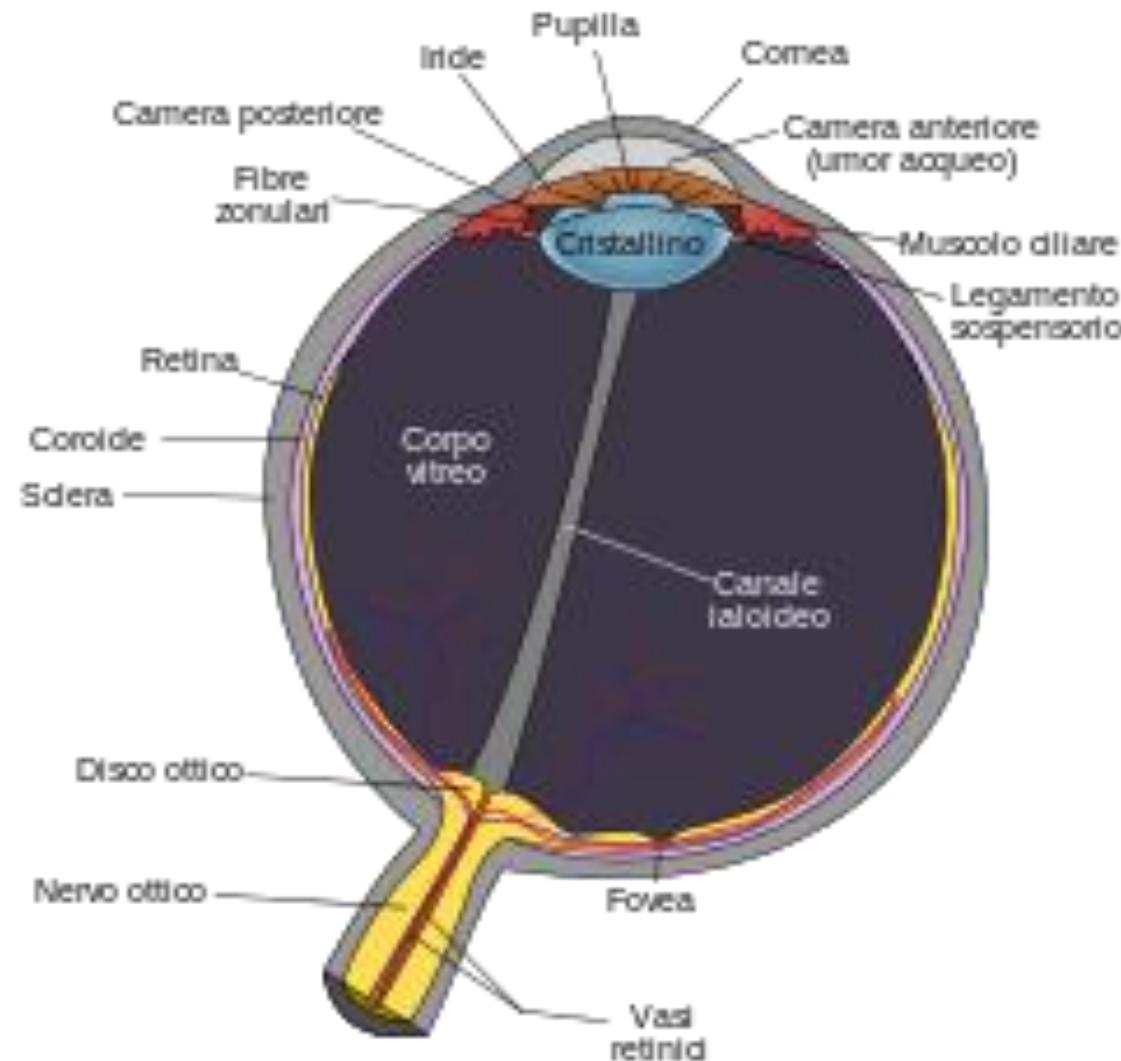



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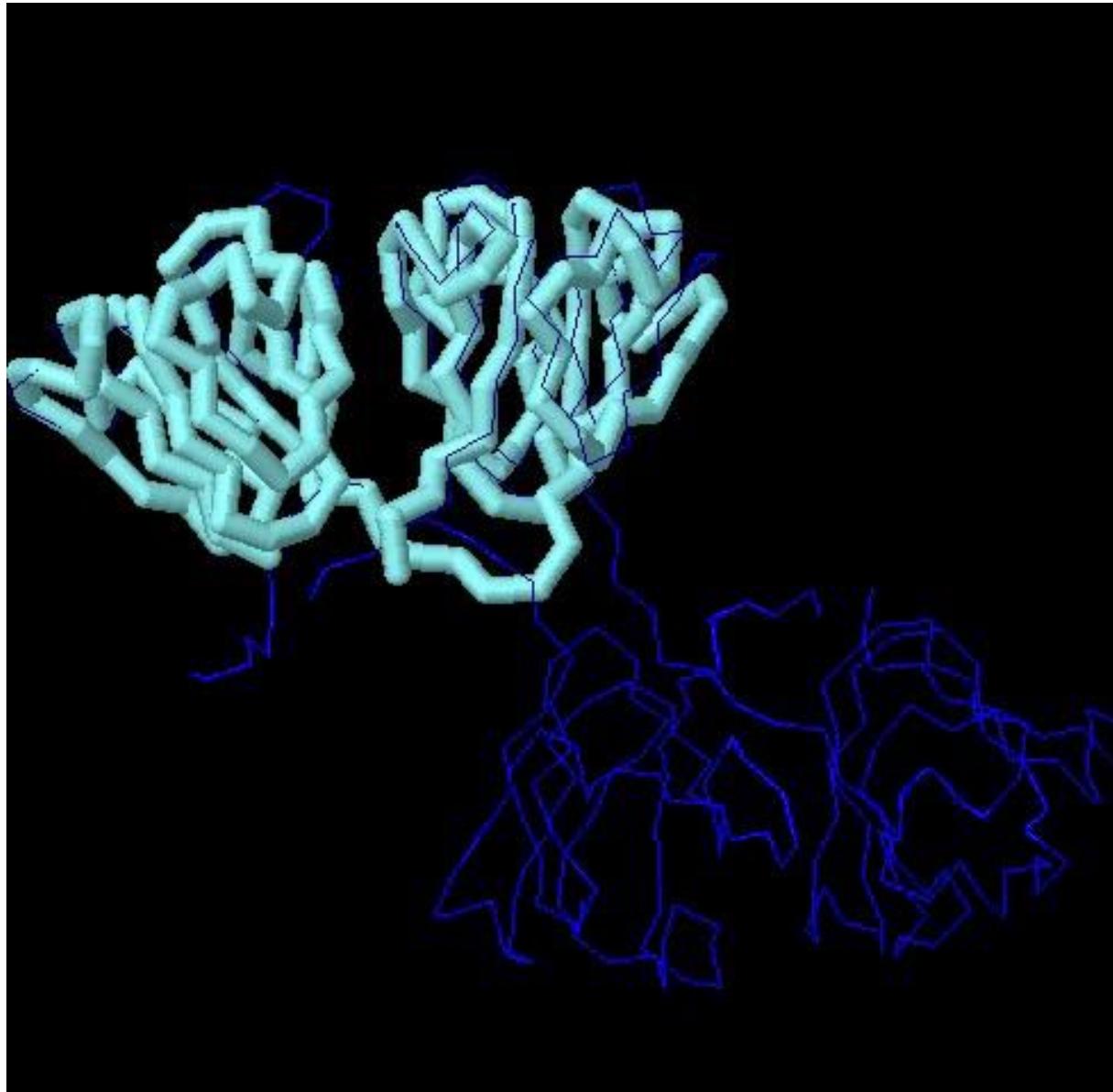
Proteine a struttura a chiave greca: la cristallina γ



Proteine a struttura a chiave greca: la cristallina γ



Struttura dimerica della cristallina γ (170 aa)



Struttura a doppia chiave greca nel monomero di cristallina γ (83 aa)

- Two Greek key motifs form a barrel like structure in γ -crystallin

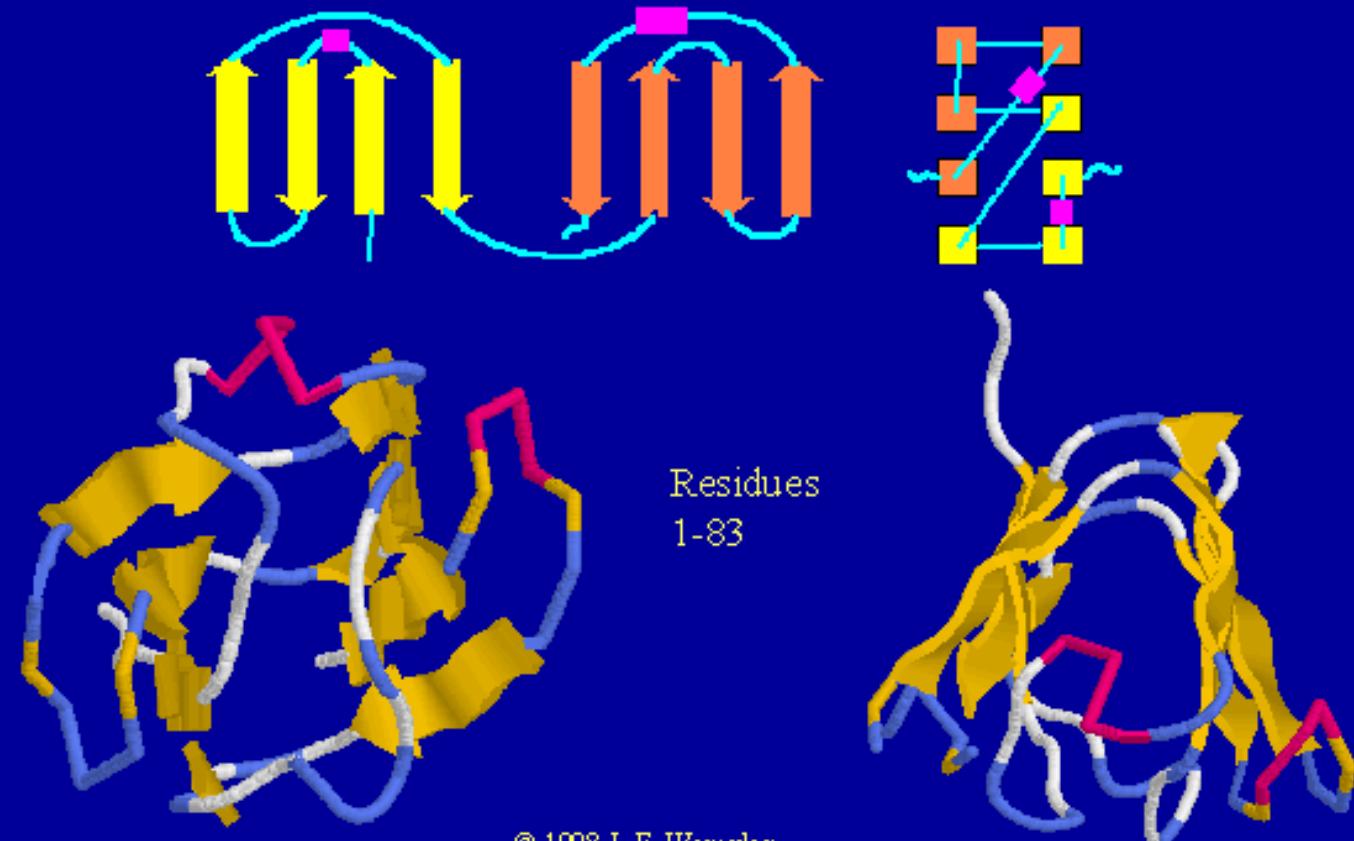


Diagramma di topologia della proteina cristallina γ

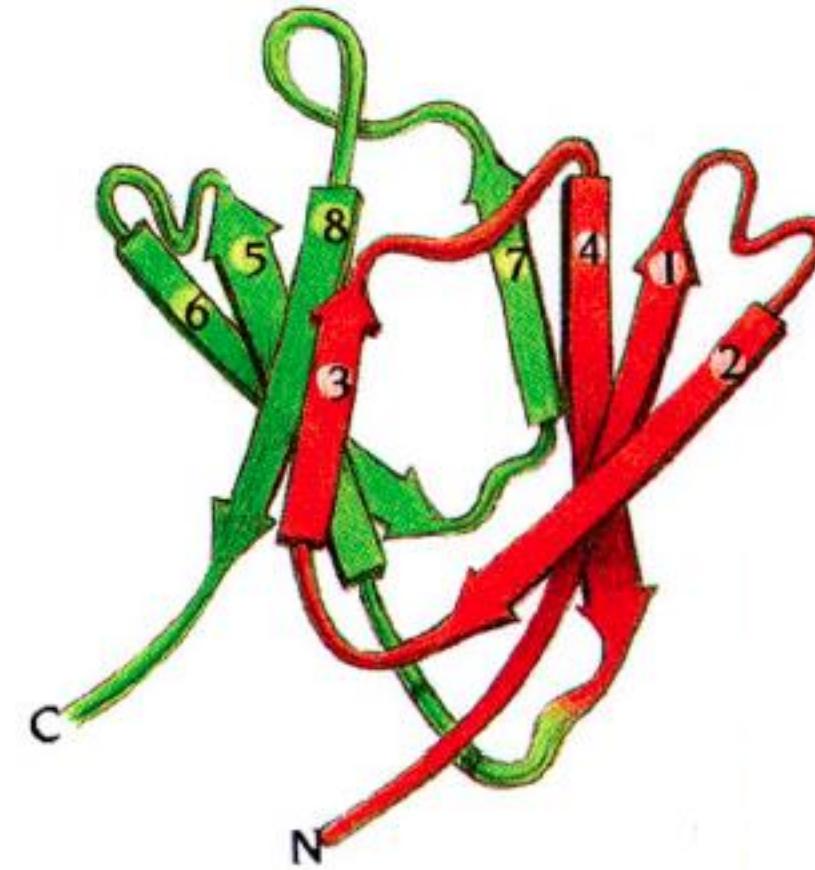


Diagramma di topologia della proteina cristallina γ

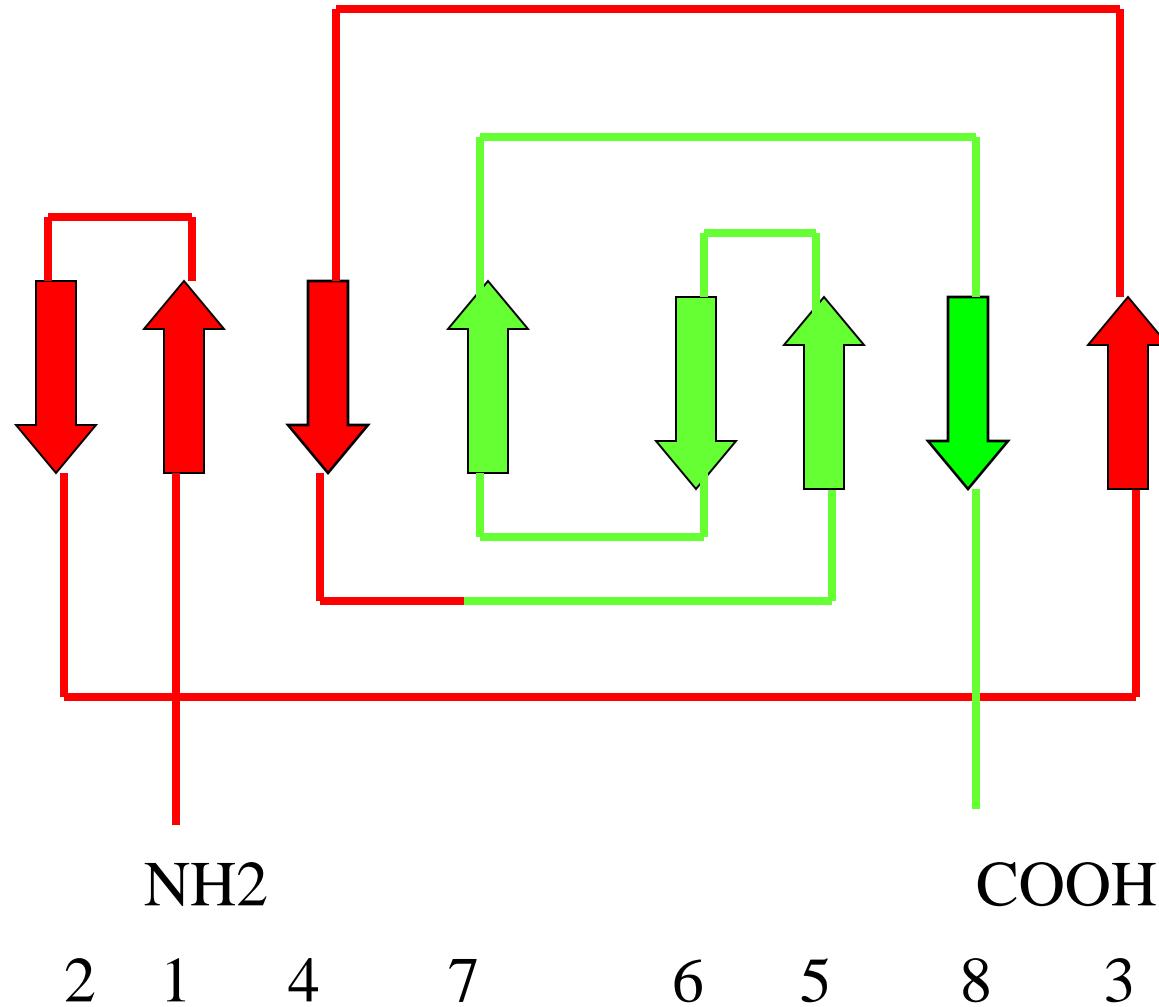
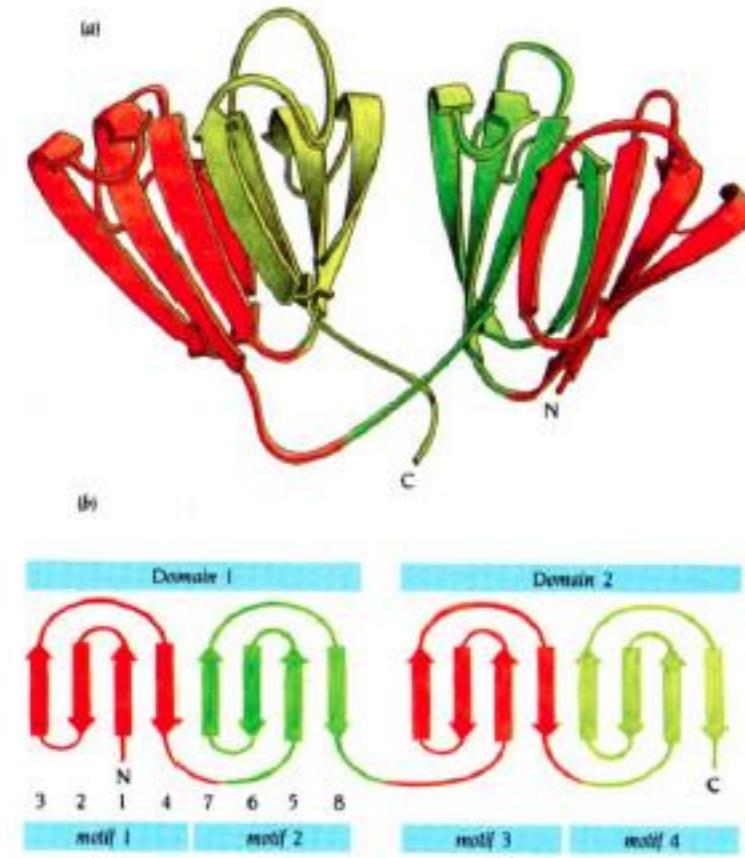
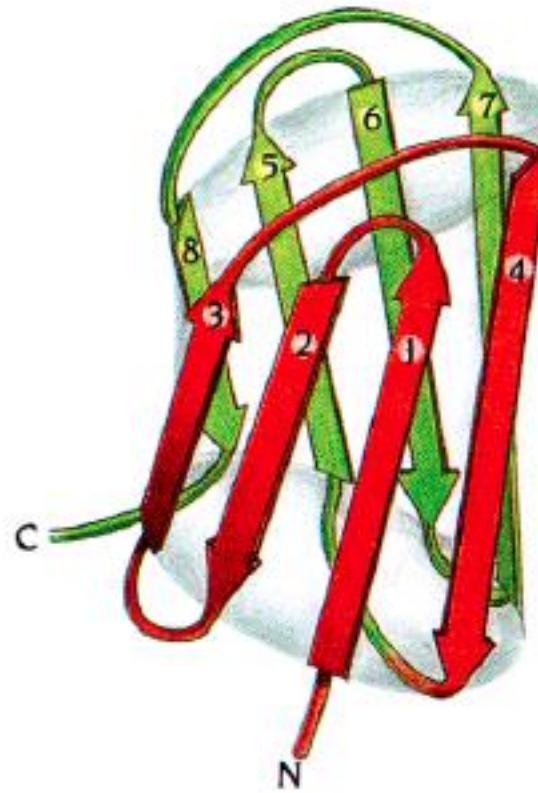
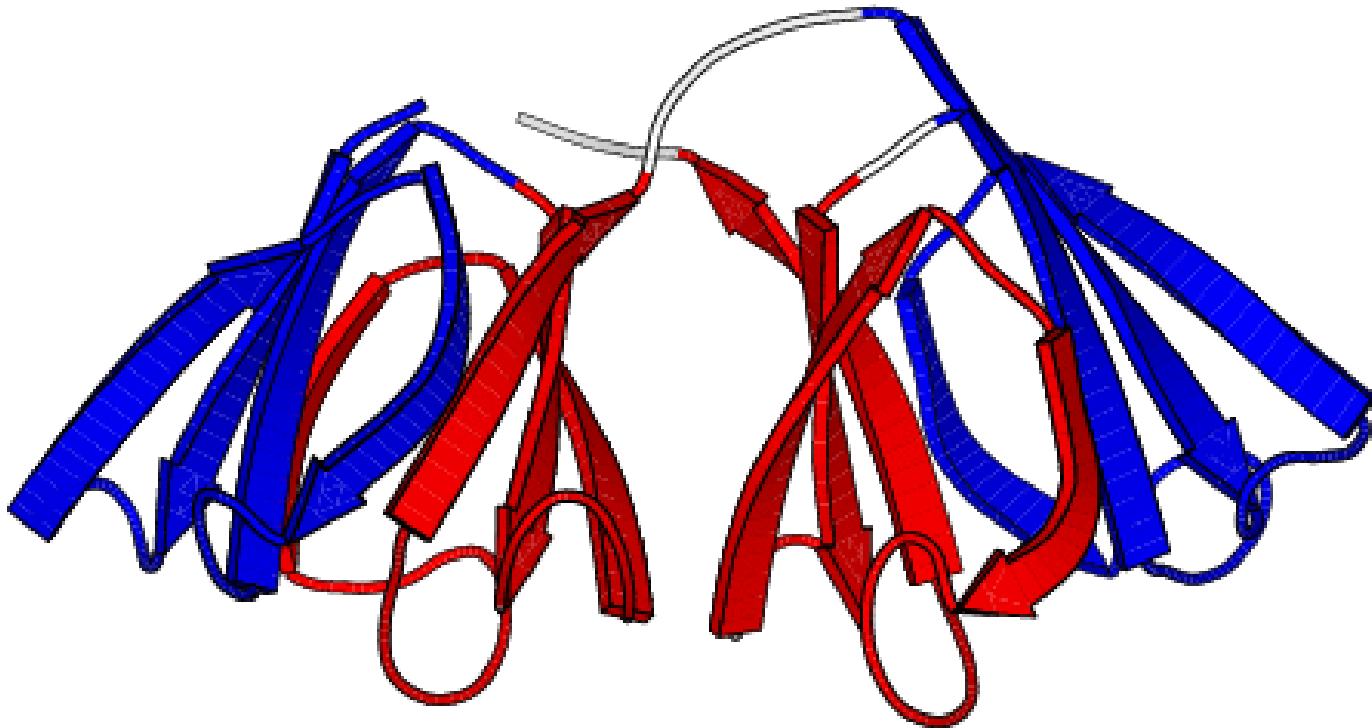


Diagramma di topologia della proteina cristallina γ

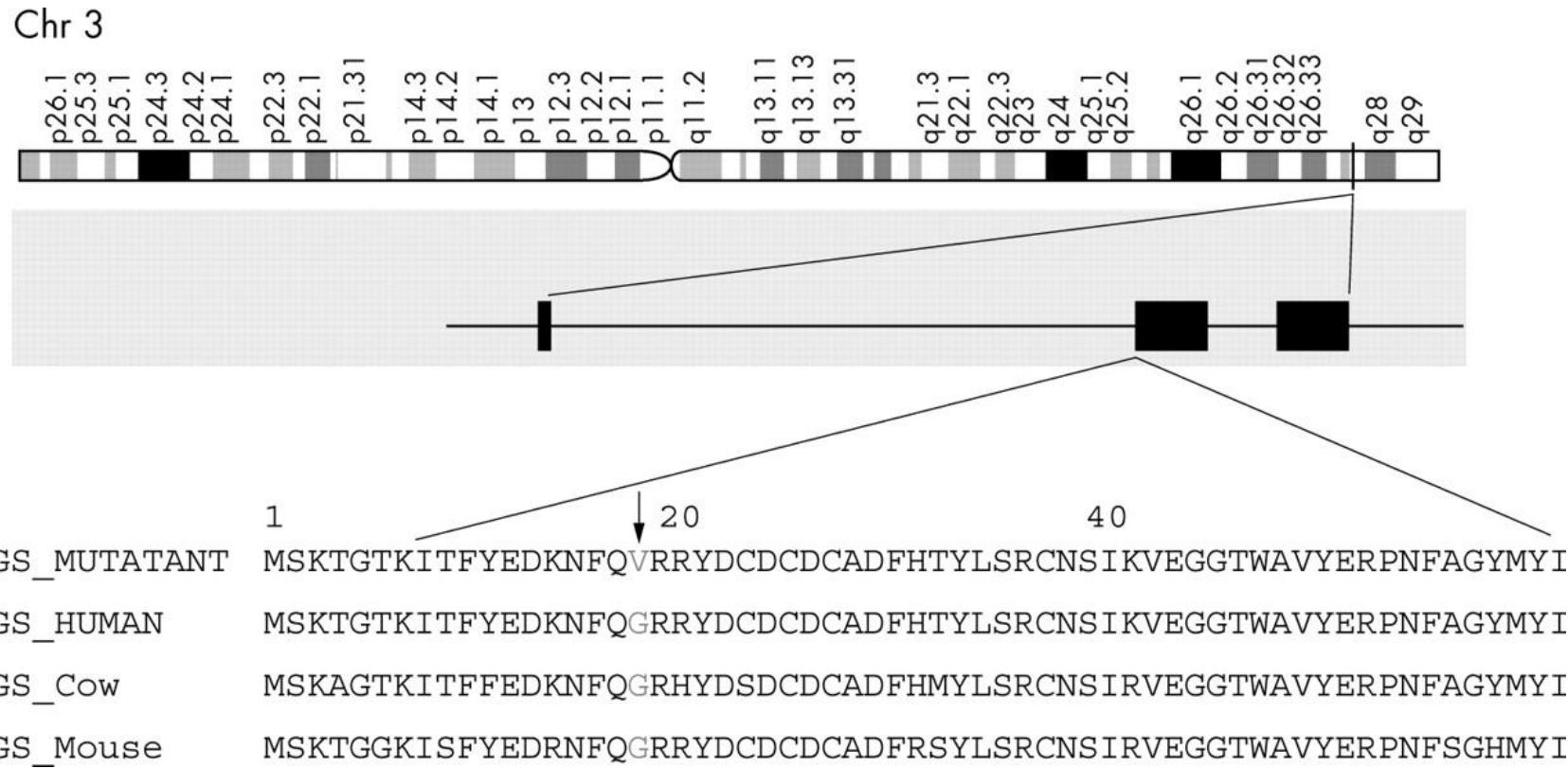



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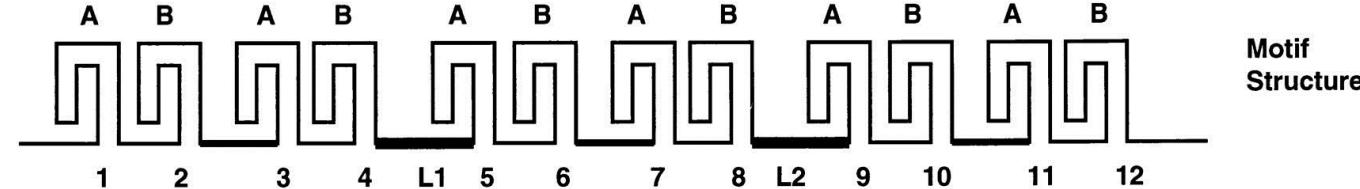
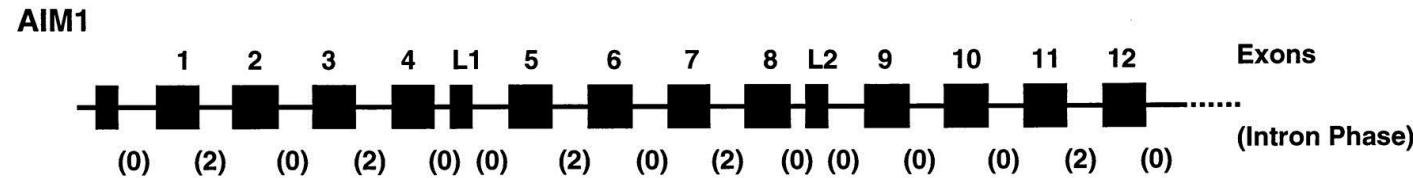
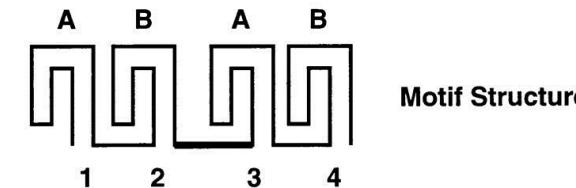
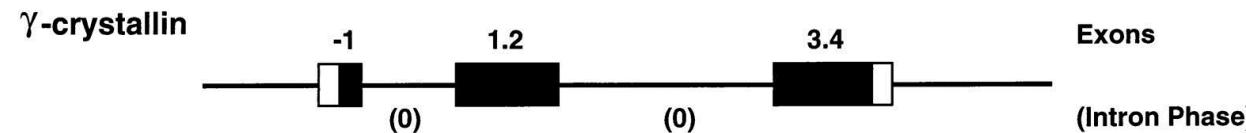
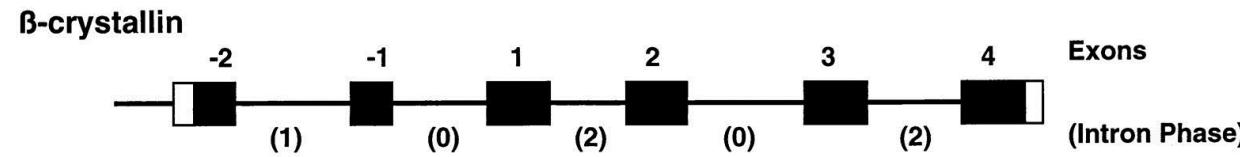
Proteine a struttura a chiave greca: la cristallina γ



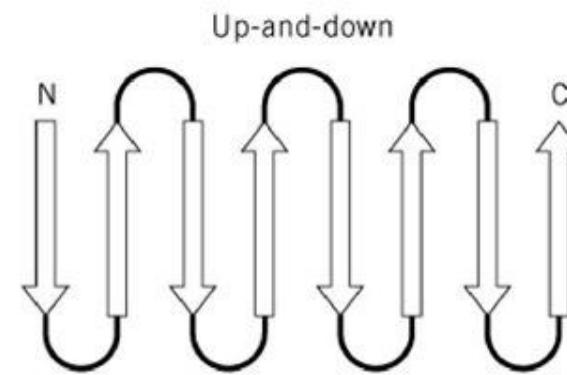
Proteine a struttura a chiave greca: il gene della cristallina γ



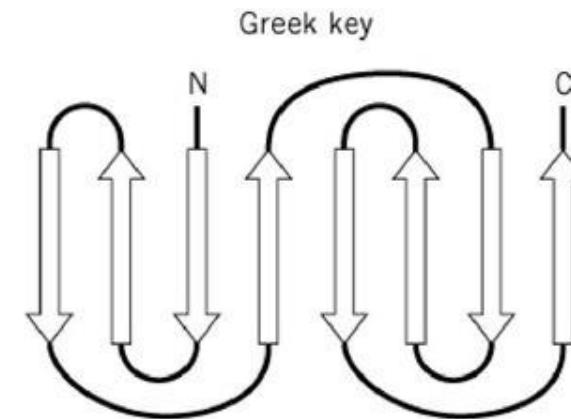
Proteine a struttura a chiave greca: la cristallina γ



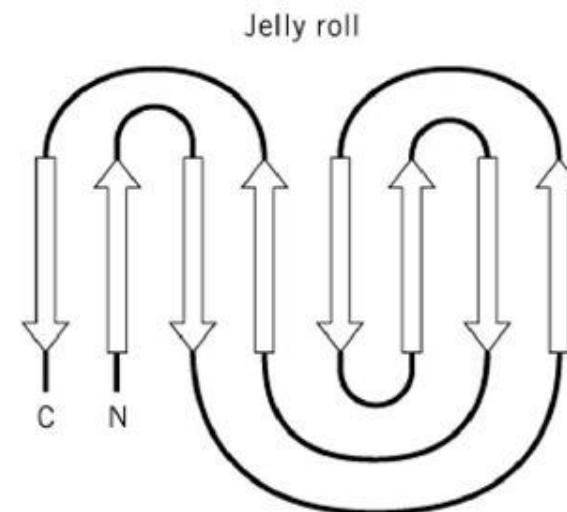
1) Struttura a botte testa-coda



2) Struttura a botte a chiave greca



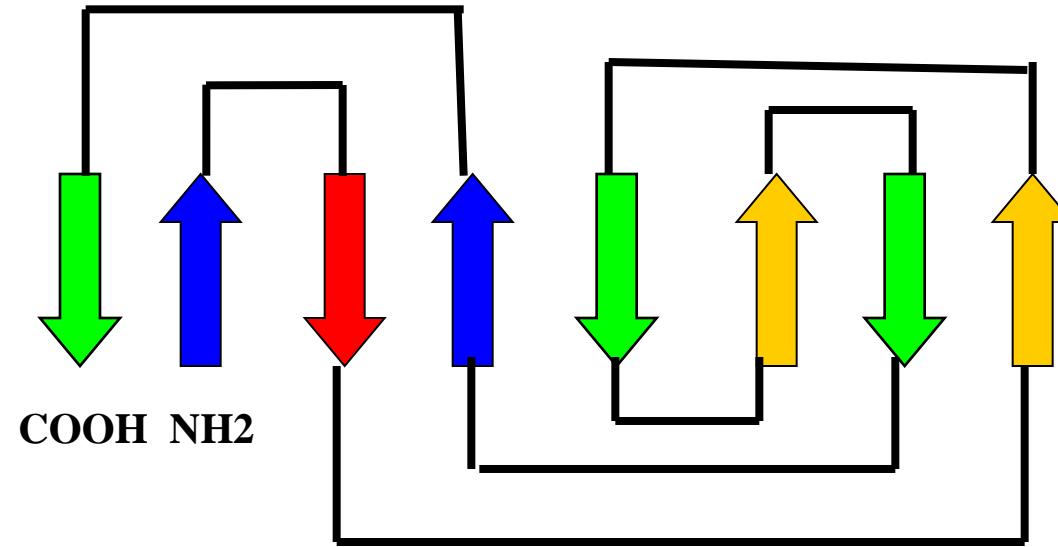
1) Struttura a botte jelly-roll



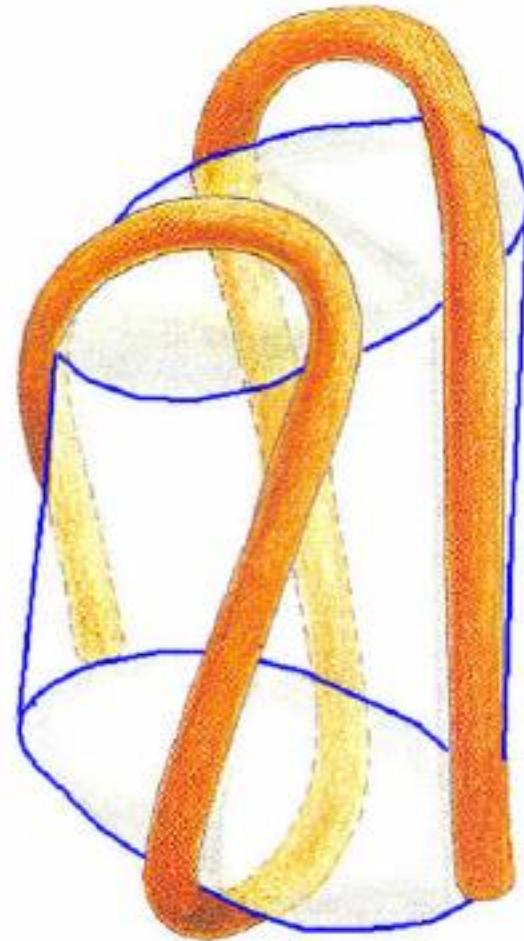
Struttura a botte jelly-roll : cosa ci ricorda ?



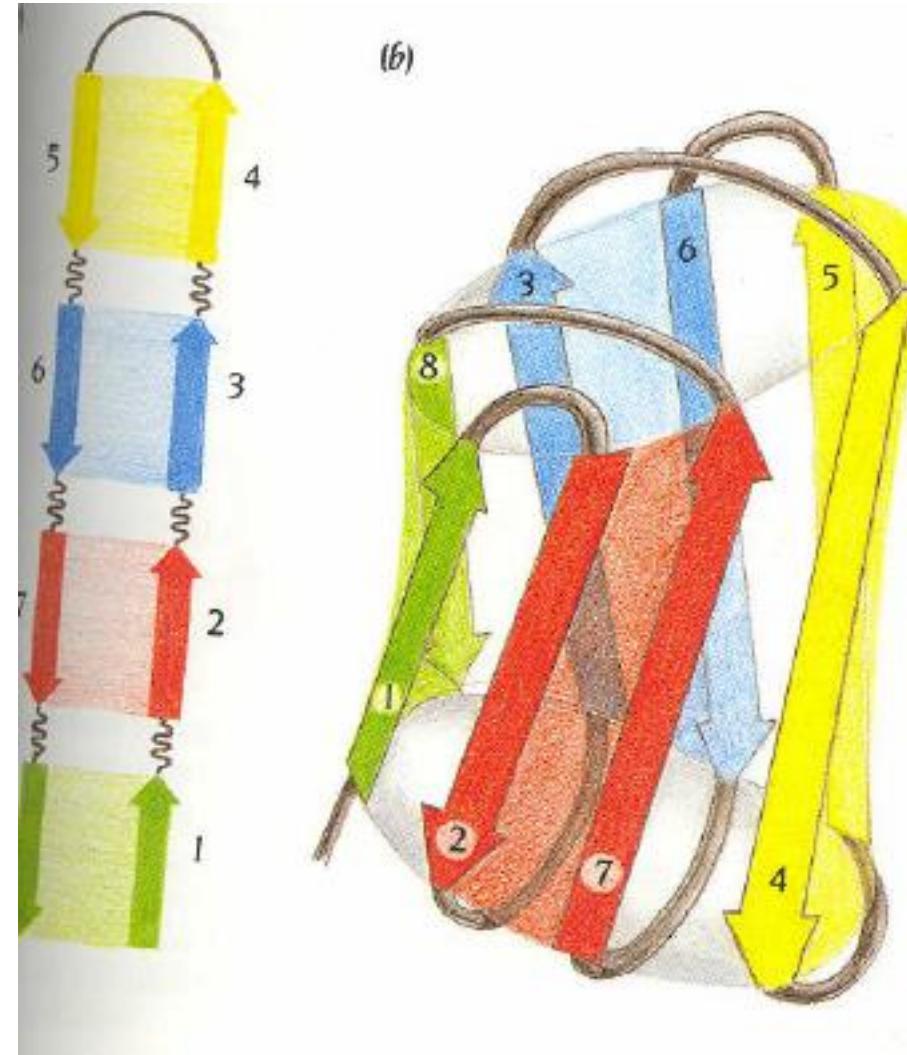
Proteine a struttura a botte jelly roll



Motivo a struttura a botte jelly roll



Motivo a struttura a botte jelly roll



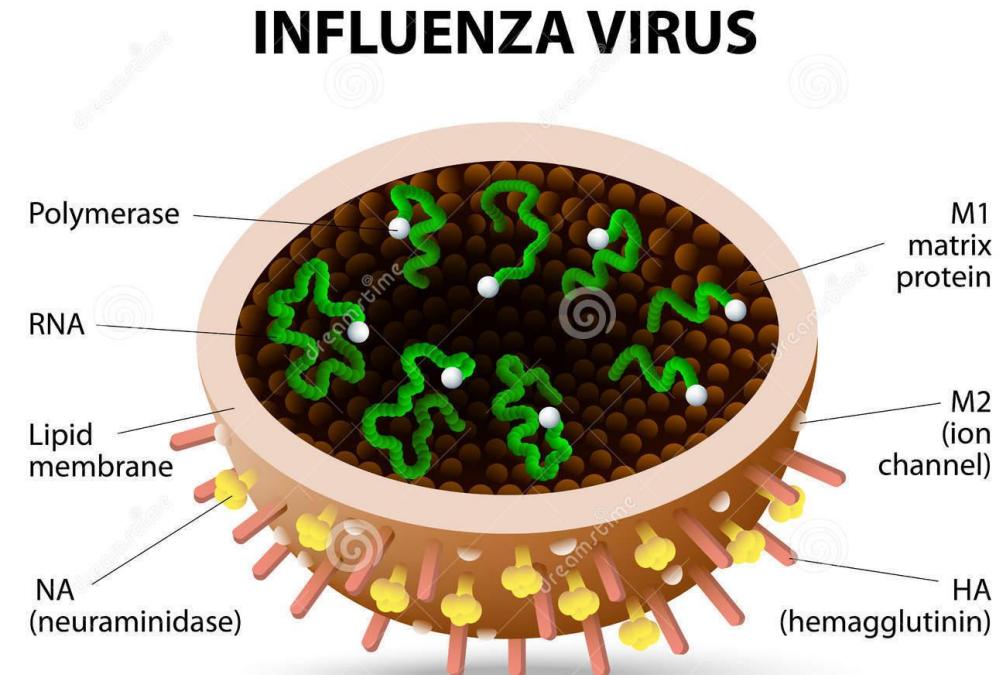
Motivo a struttura a botte jelly roll



L'emoagglutinina, la proteina di rivestimento del capsid del virus dell'influenza



L'emoagglutinina, la proteina di rivestimento del capsid del virus dell'influenza



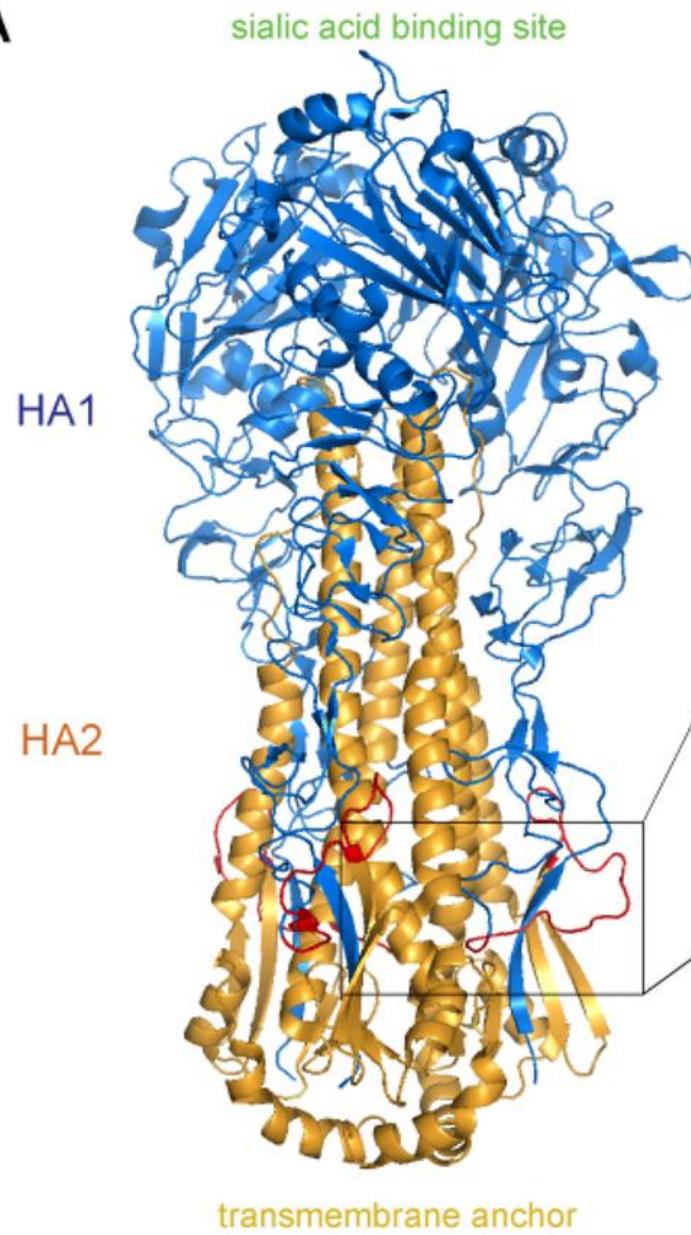
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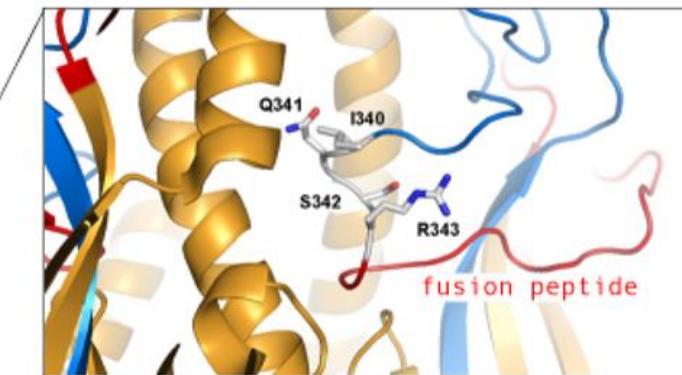
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Proteina di rivestimento del capsid del virus dell' influenza

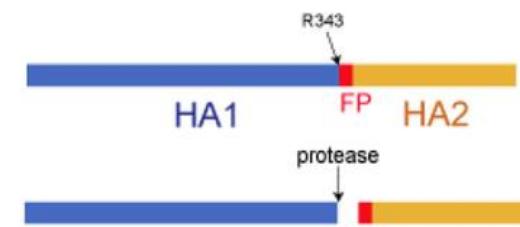
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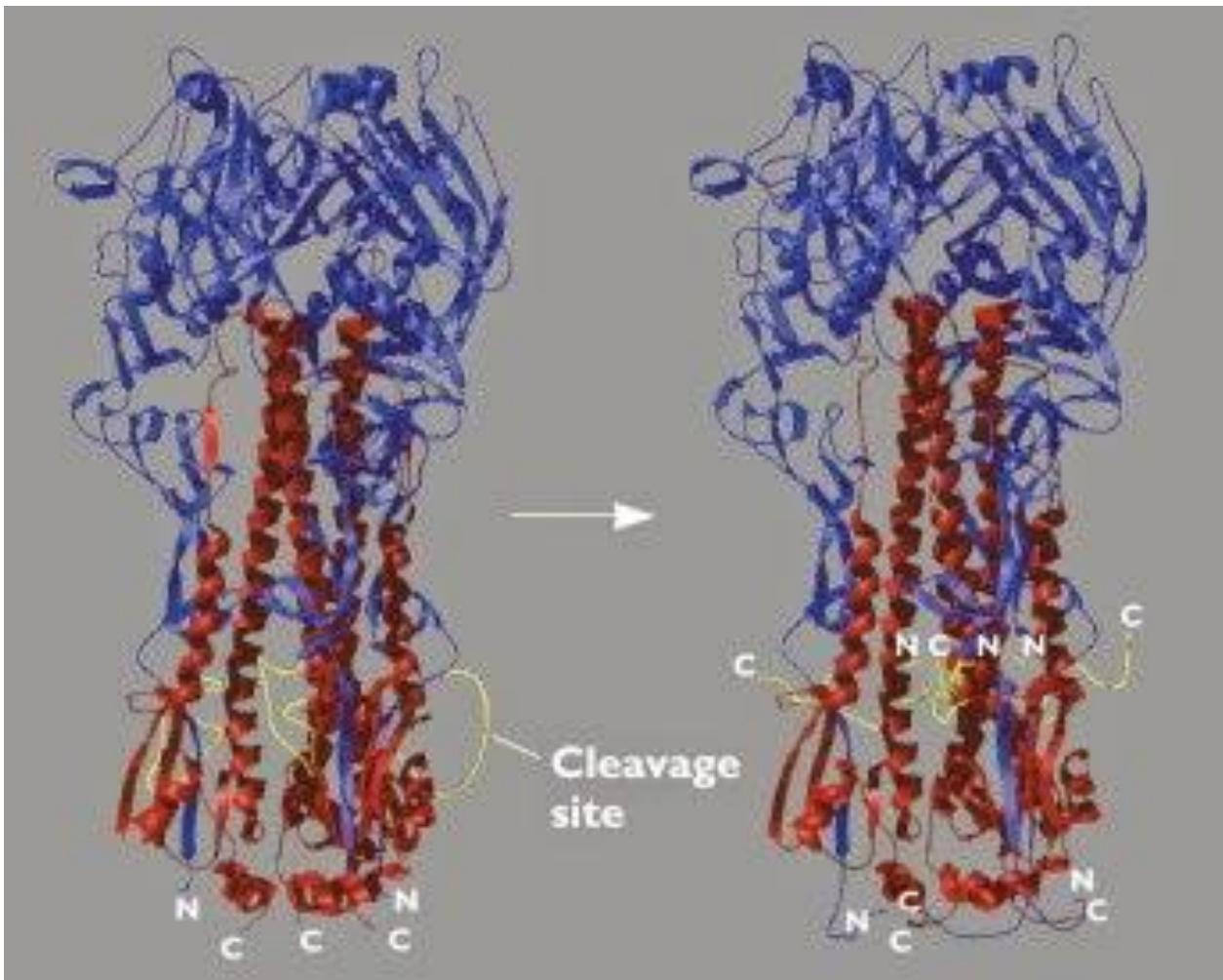
H1 consensus	IQSR GLFG
H2 consensus	IESR GLFG
H3 consensus	KQTR GLFG
H5 HPAI	RRRKRR GLFG



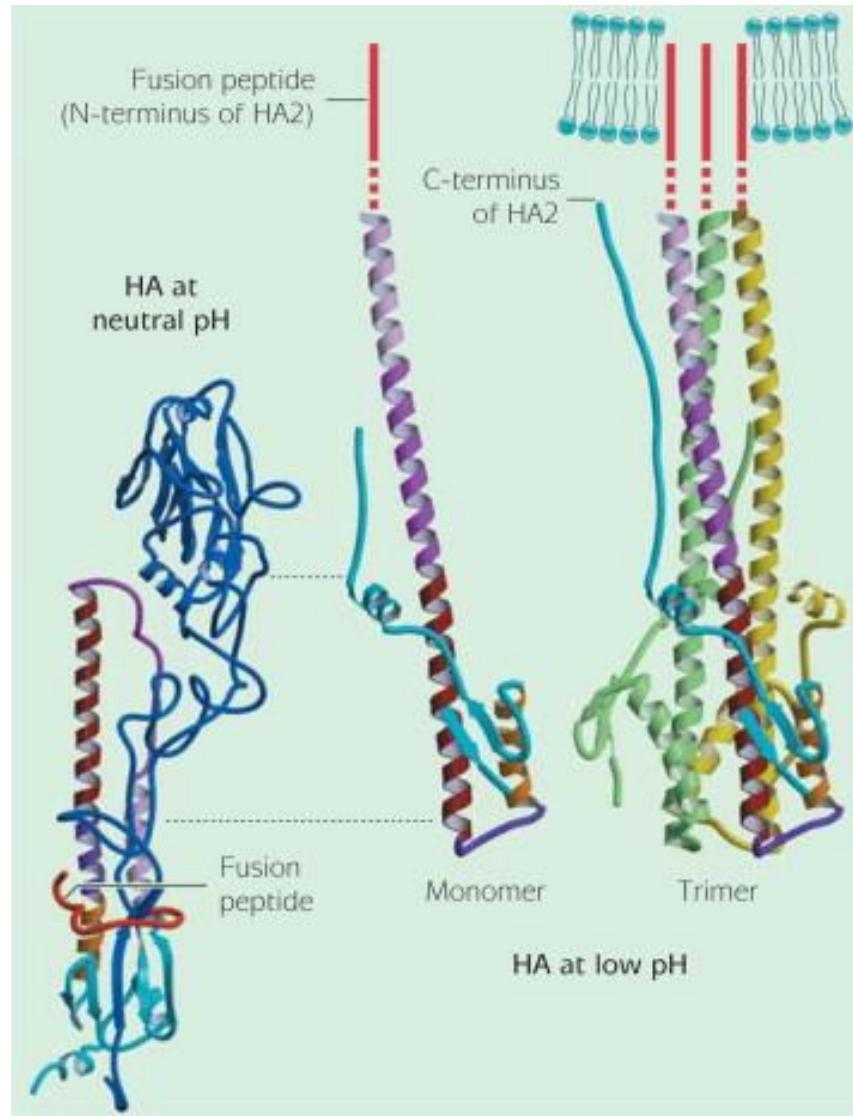
B



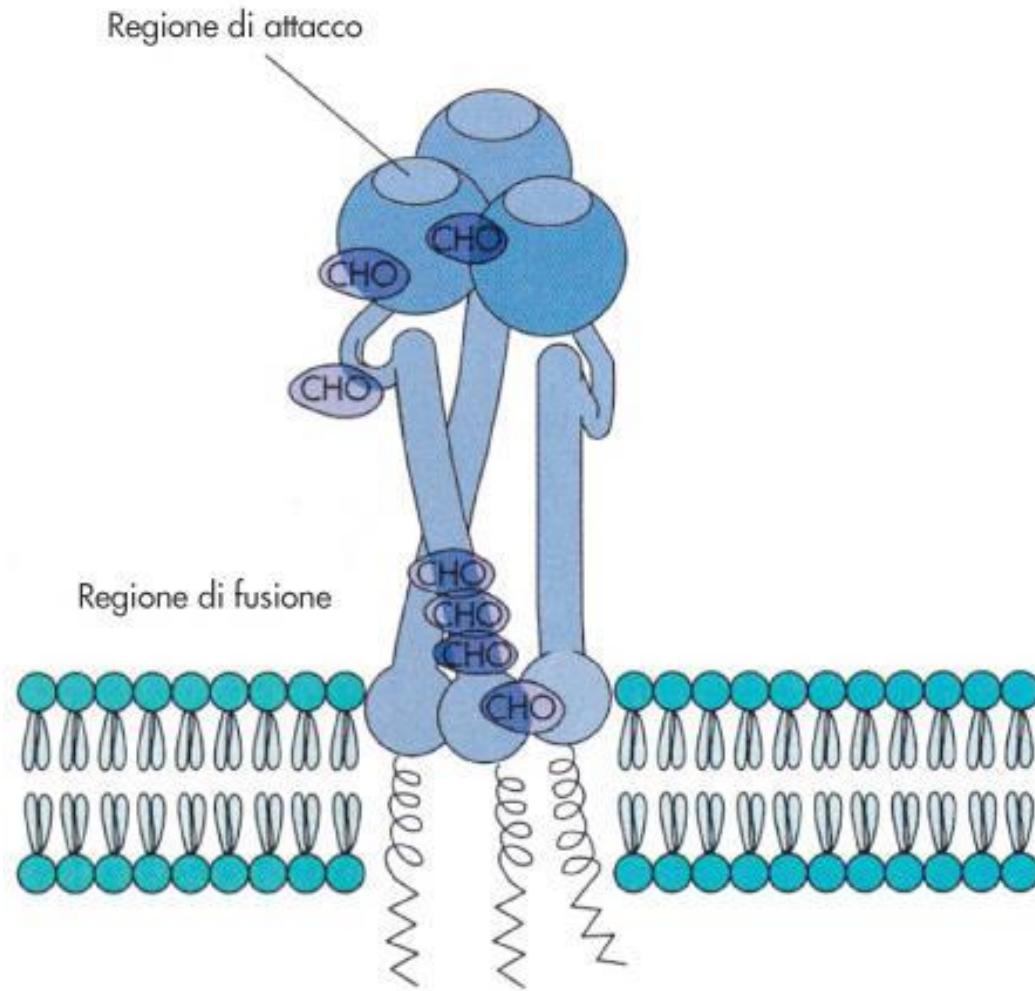
Proteina di rivestimento del capsid del virus dell' influenza



Proteina di rivestimento del capsid del virus dell' influenza

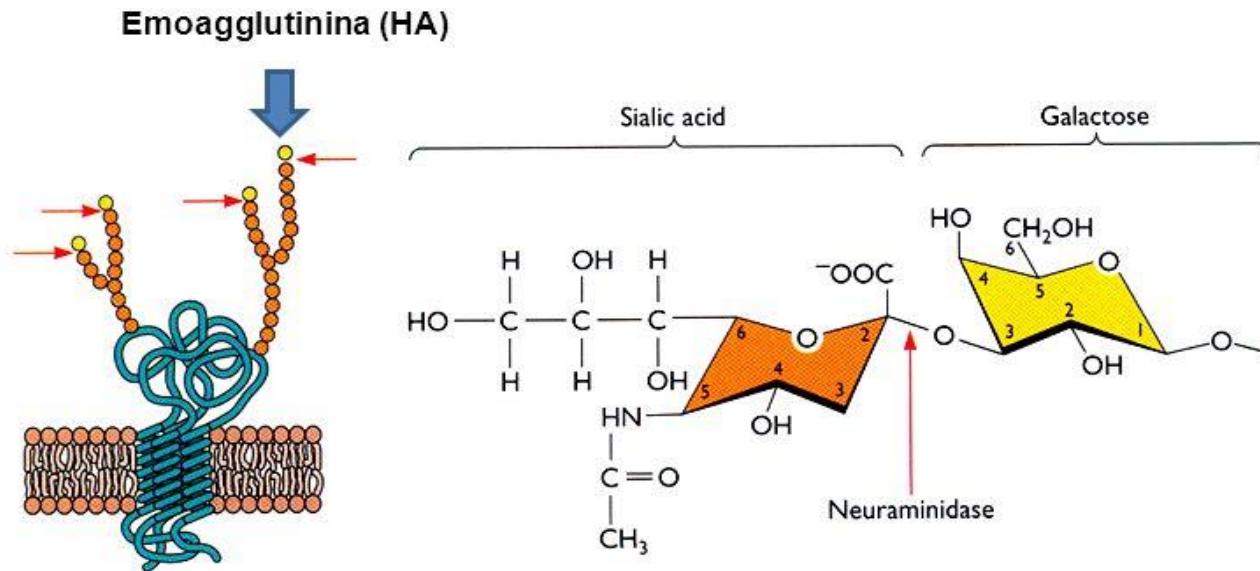


Proteina di rivestimento del capsid del virus dell' influenza



L'emoagglutinina, la proteina di rivestimento del capsid del virus dell'influenza

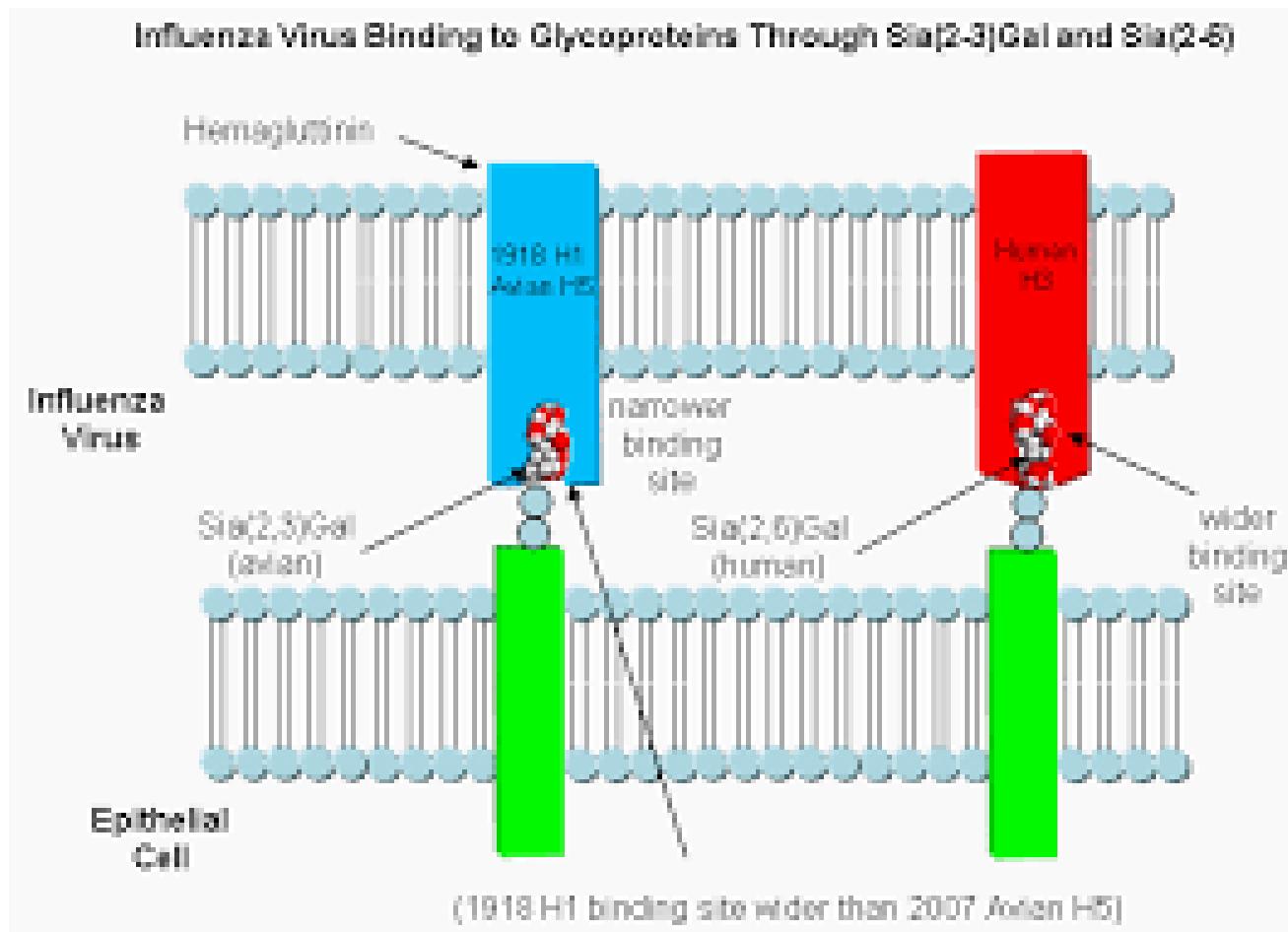
ANTIRECETTORE-RECETTORE



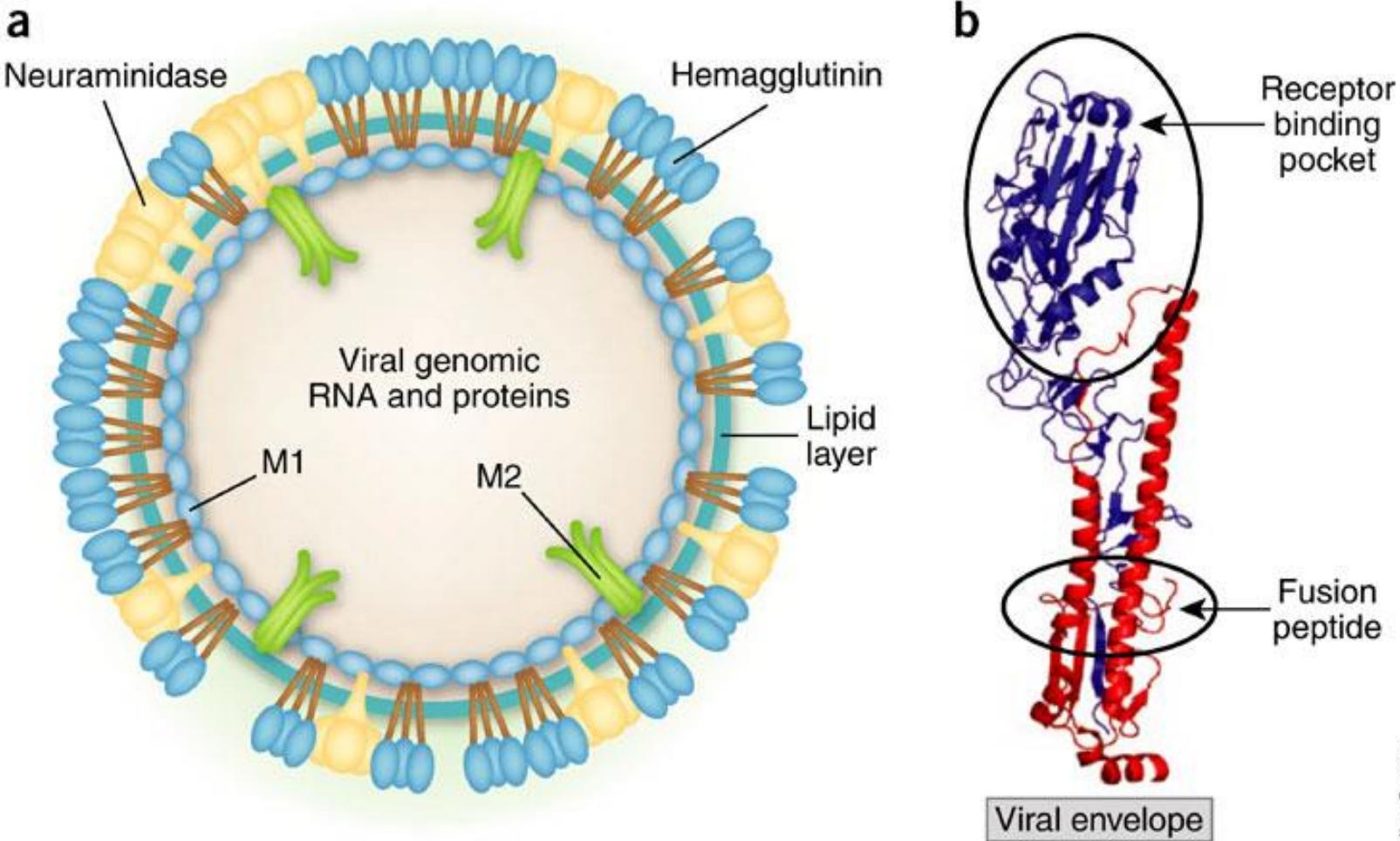
L'acido sialico presente sulle glicoproteine delle membrane cellulari è il RECETTORE del virus dell'influenza e l'HA l'antirecettore. Affinchè il nucleocapside possa essere liberato nel citoplasma cellulare è necessario che la HA subisca una modifica proteolitica, all'interno dell'endosoma, ad opera di proteasi cellulari, con l'esposizione di un peptide fusogeno in grado di favorire la fusione fra pericapside e membrana endosomica. L'attivazione proteolitica di HA è essenziale per l'infettività del virus e la sua diffusione ad altri tessuti/organi.

- **HA dei virus aviari** si lega a residui di acido sialico con legame □ 2,3 galattoso, presenti sulle cellule delle mucose respiratorie ed enteriche
- **HA dei virus umani** si lega a residui di acido sialico con legame □ 2,6 galattoso presenti alla superficie delle mucose respiratorie dell'uomo
- **HA dei virus suini** si lega a residui di acido sialico sia con legame □ 2,3 che □ 2,6 galattoso

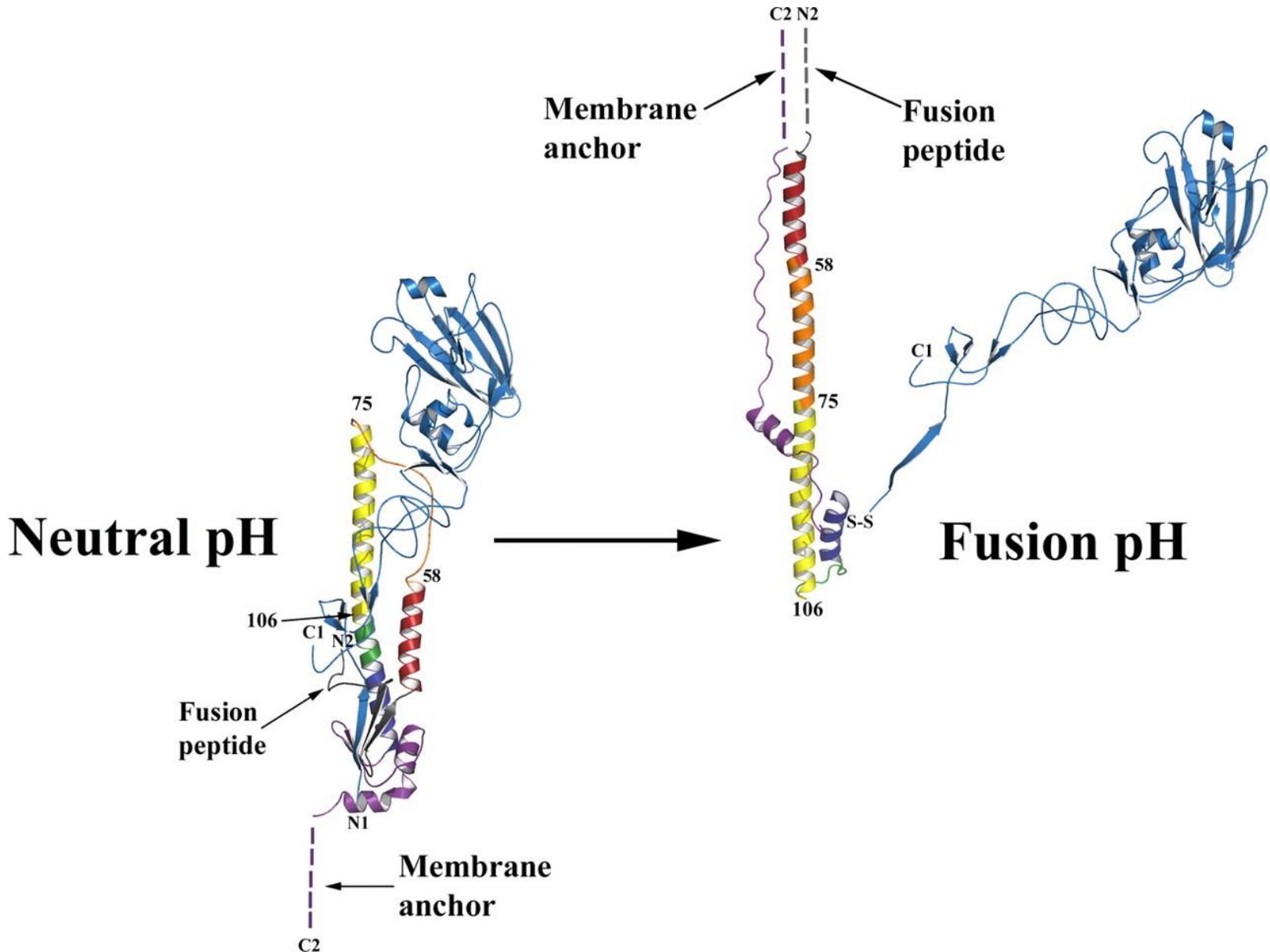
Proteina di rivestimento del capsid del virus dell' influenza



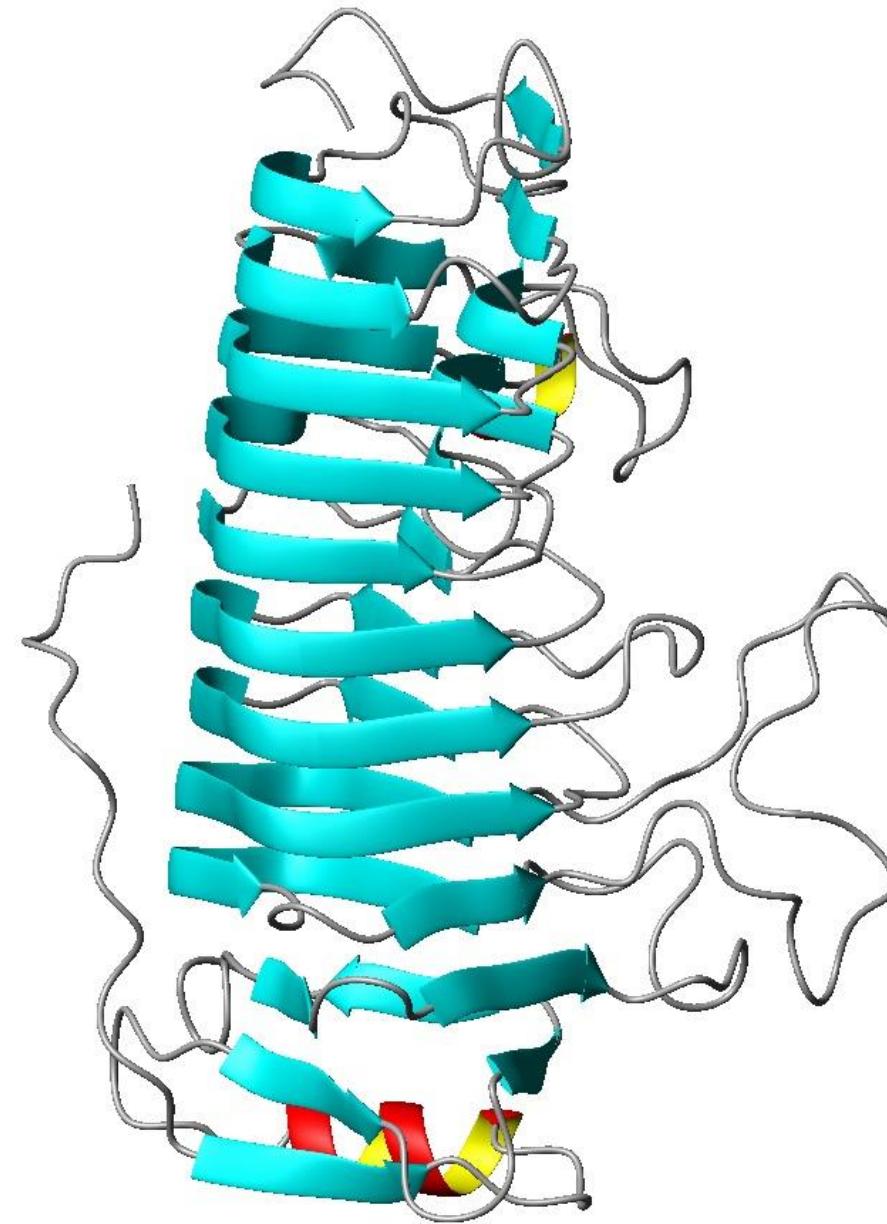
Proteina di rivestimento del capsid del virus dell' influenza



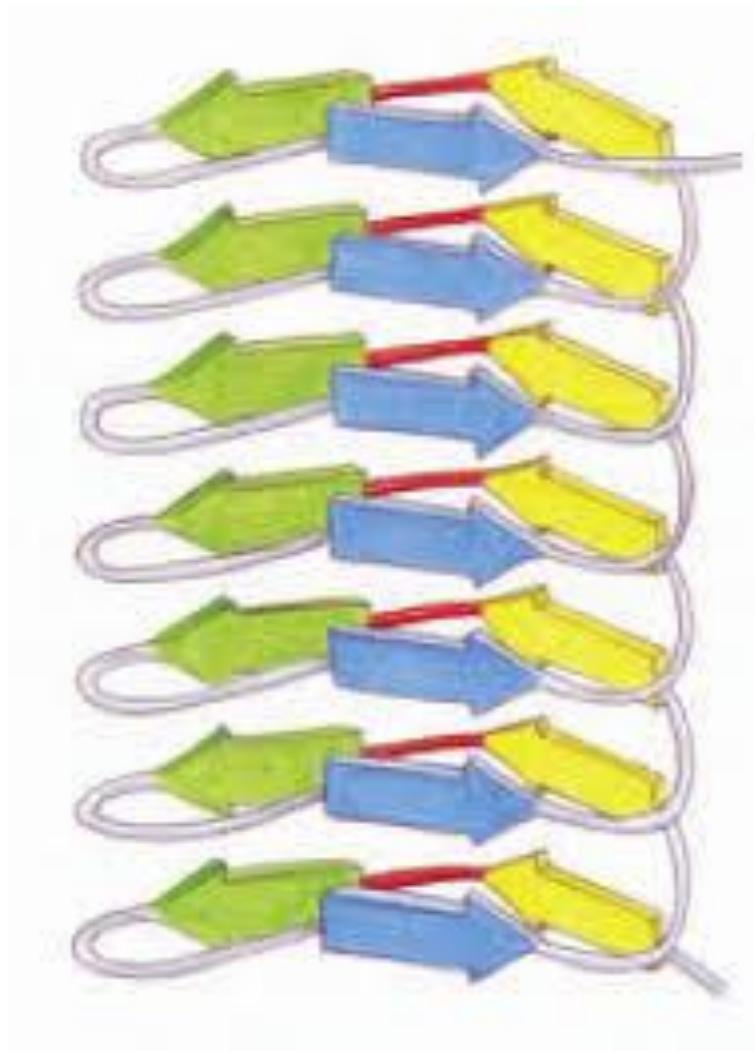
Proteina di rivestimento del capsid del virus dell' influenza



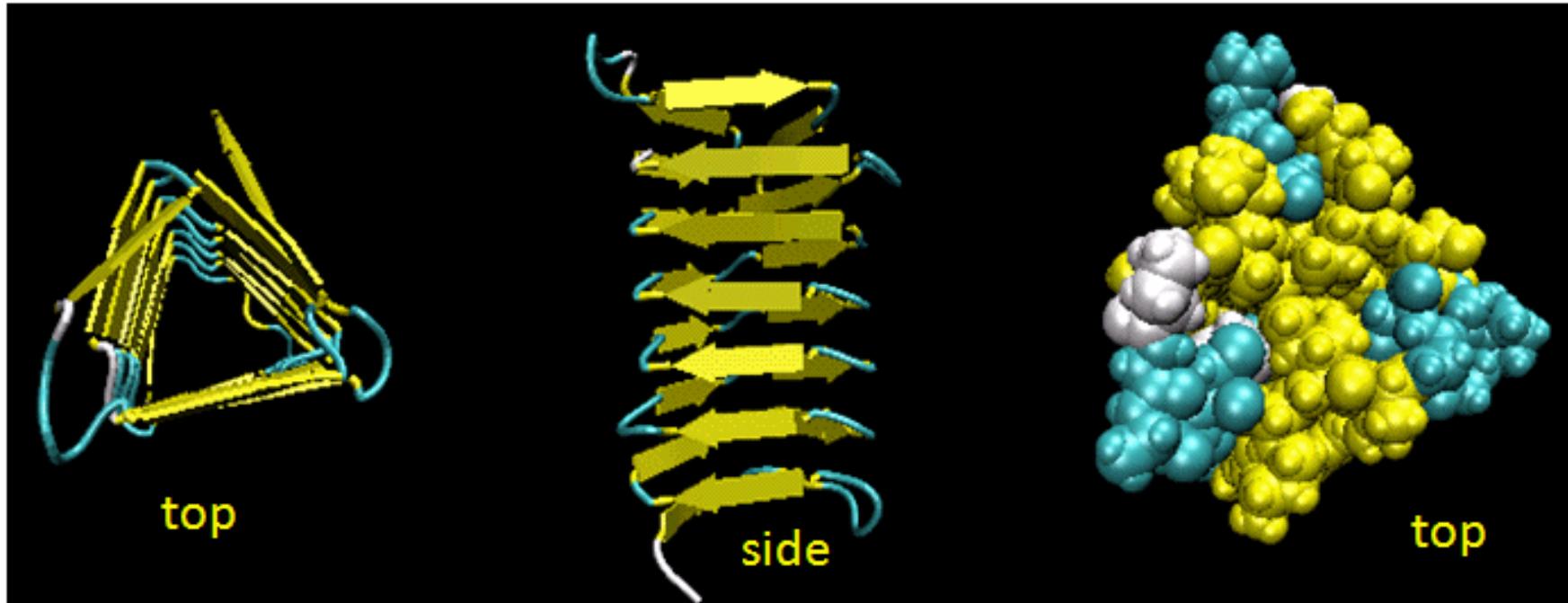
Proteine a struttura elicche β a due filamenti



Proteine a struttura eliche β parallele a tre filamenti



Proteine a struttura eliche β a tre filamenti

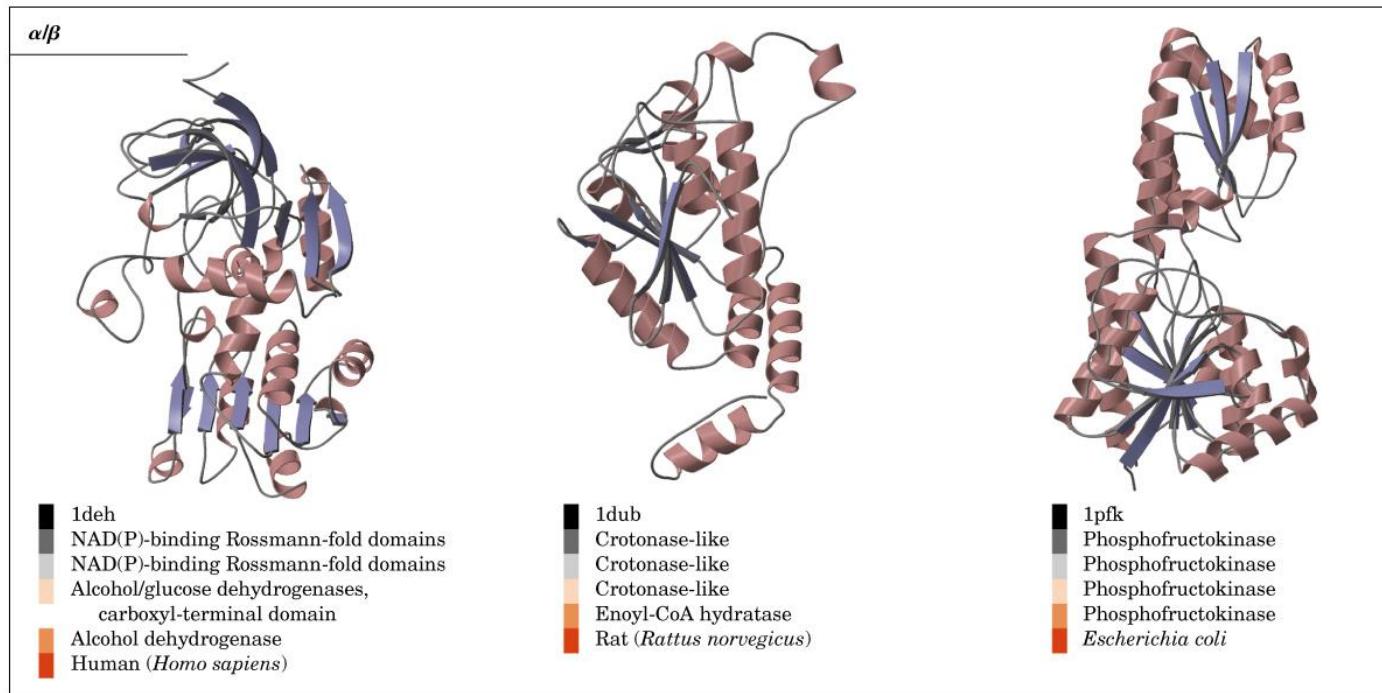


Proteine a struttura eliche β a tre filamenti

Pectinasi

- **pectinametilesterasi**: deesterifica la pectina a pectato e metanolo
- **pectina liasi**: attacca direttamente la pectina, tagliando i legami glicosidici interni
- **pectato liasi**: svolge la stessa azione della pectina liasi ma attacca i pectati
- **esopoligalatturonato liasi**: attacca le estremità del polimero (polipectato), rilasciando solo digalatturonati
- **poligalatturonasi**: la reazione di taglio del poligalatturonato avviene per idrolisi dei legami glicosidici all'interno del polimero e produce oligomeri

Proteine a motivi α/β



Key

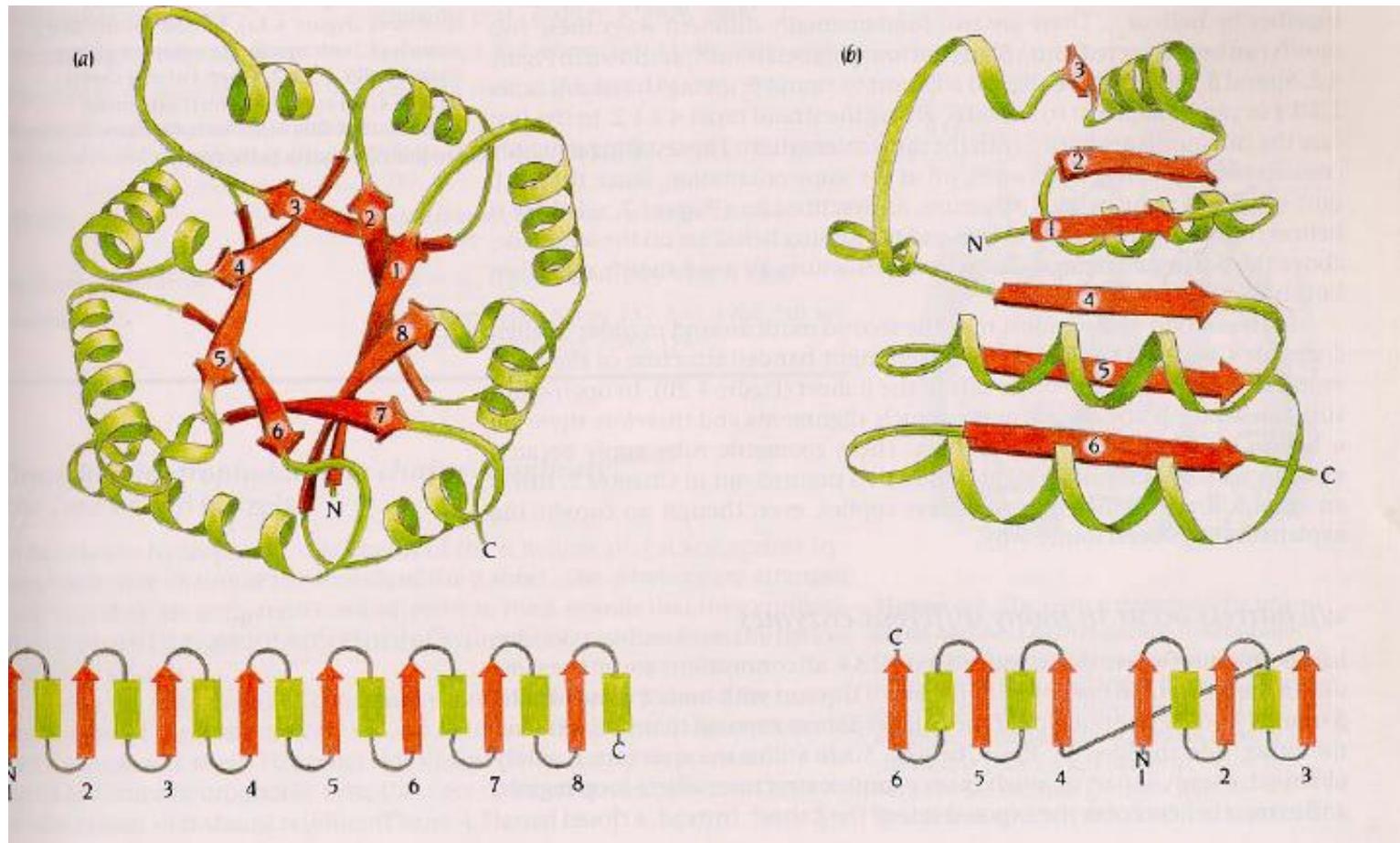
- PDB identifier
- Fold
- Superfamily
- Family
- Protein
- Species

Proteine a motivi α/β

Esistono tre classi di proteine α/β :

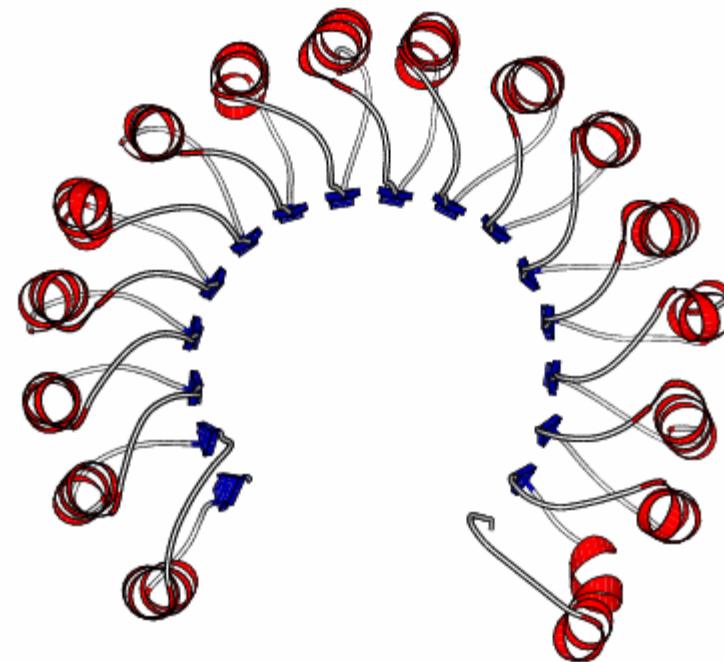
- 1) Le proteine a struttura botte TIM (triosofosfatoisomerasi)
- 2) Le proteine a foglietto aperto (riplegamento di Rosmann)
- 3) Le proteine con motivi ricchi di leucina (riplegamento a ferro di cavallo)

Proteine a botte TIM e a foglietto aperto

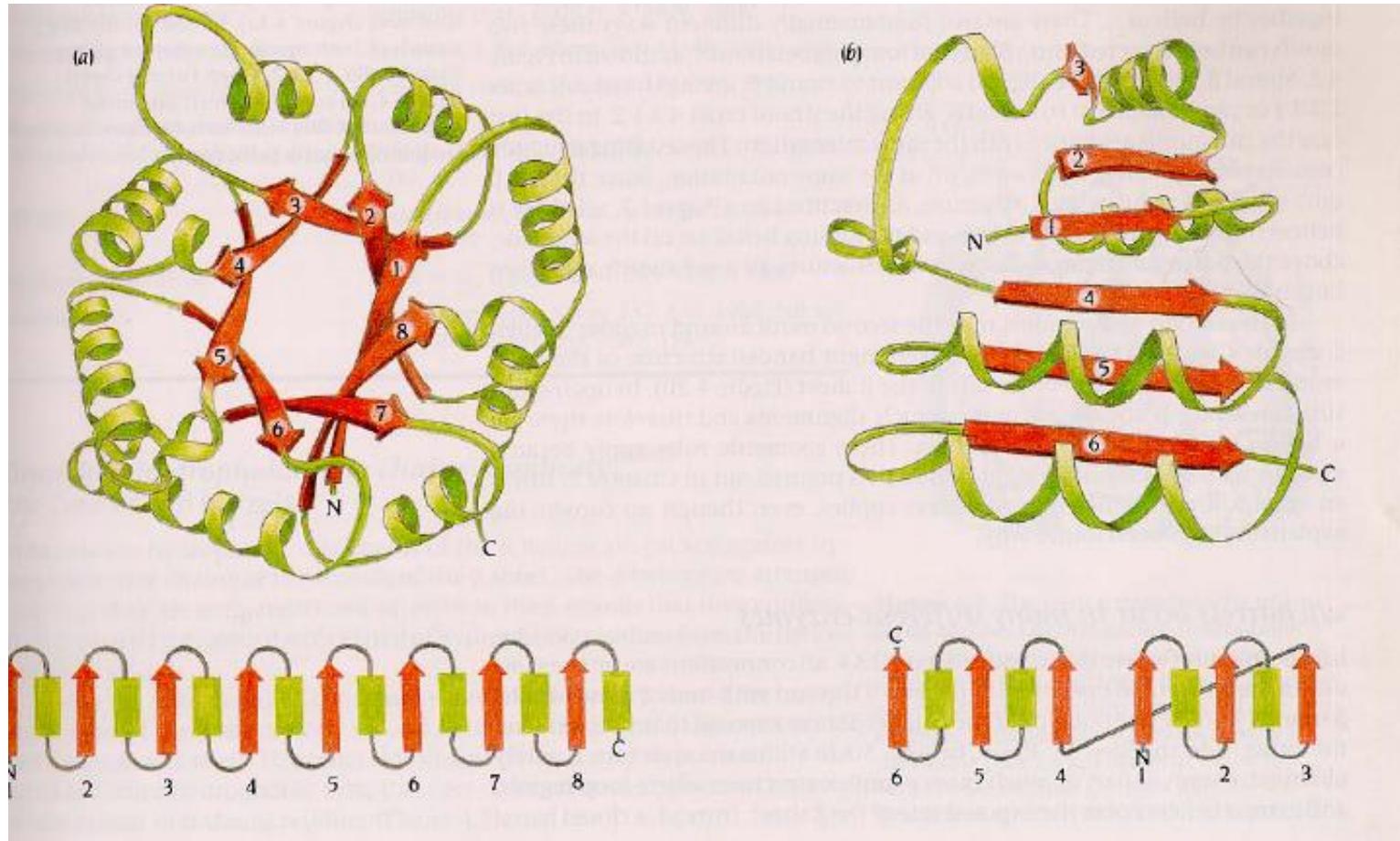


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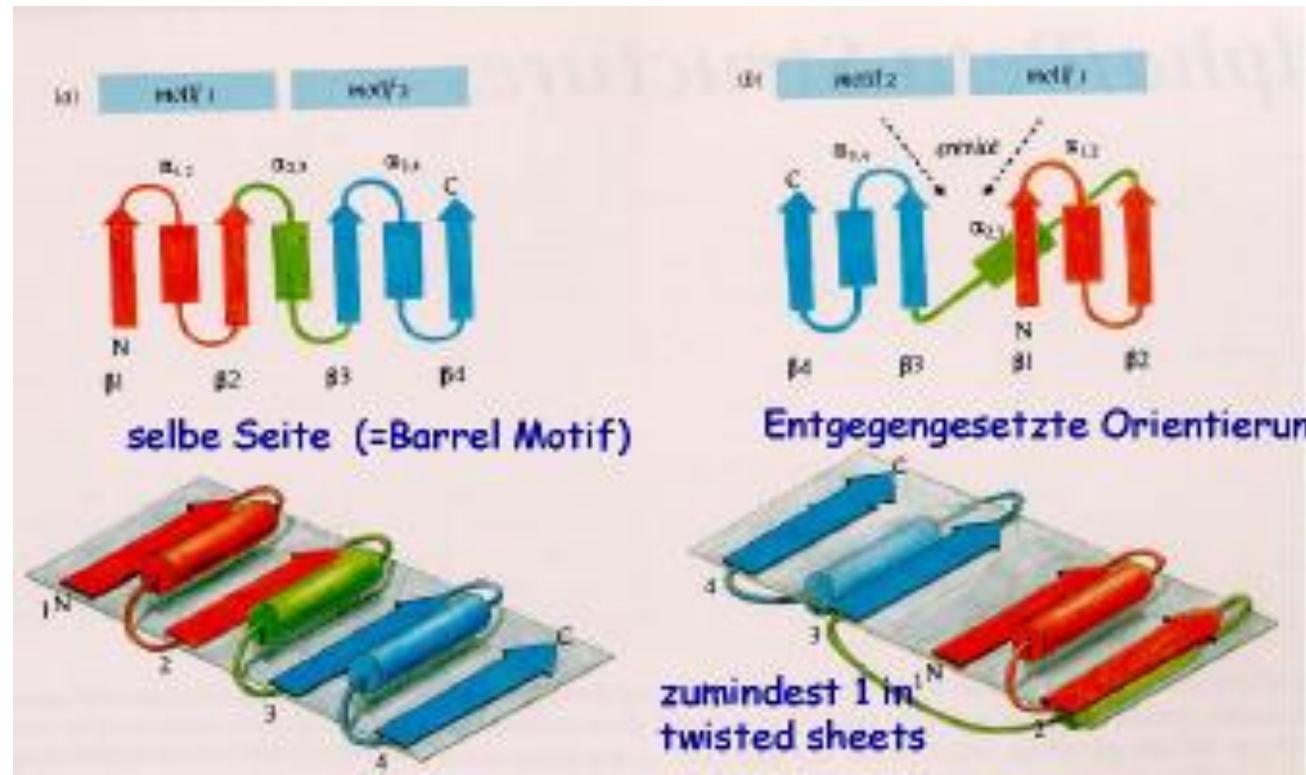
Proteine con motivi ricchi di leucina (ripiegamento a ferro di cavallo)



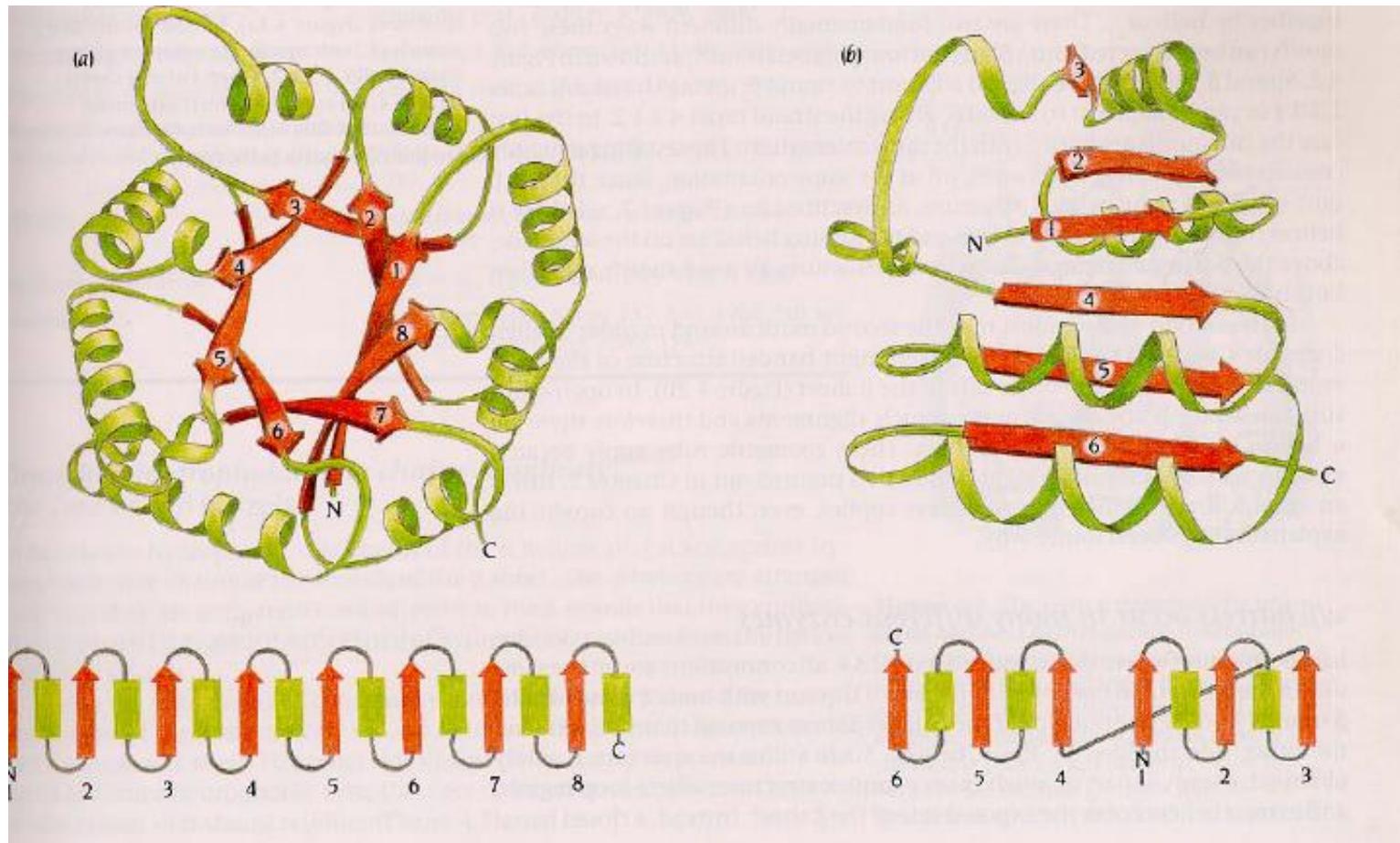
Proteine a botte TIM e a foglietto aperto



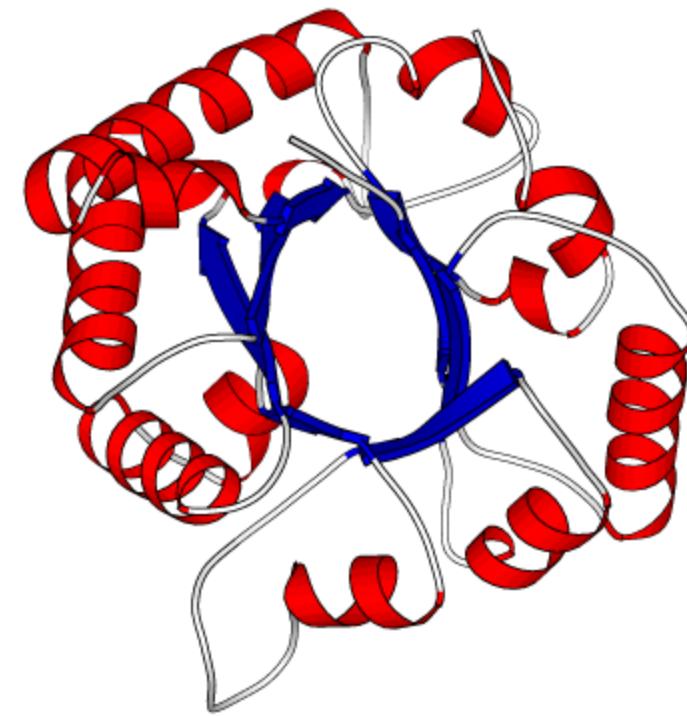
I motivi α/β sono strutture ad andamento destroso



Proteine a botte TIM e a foglietto aperto



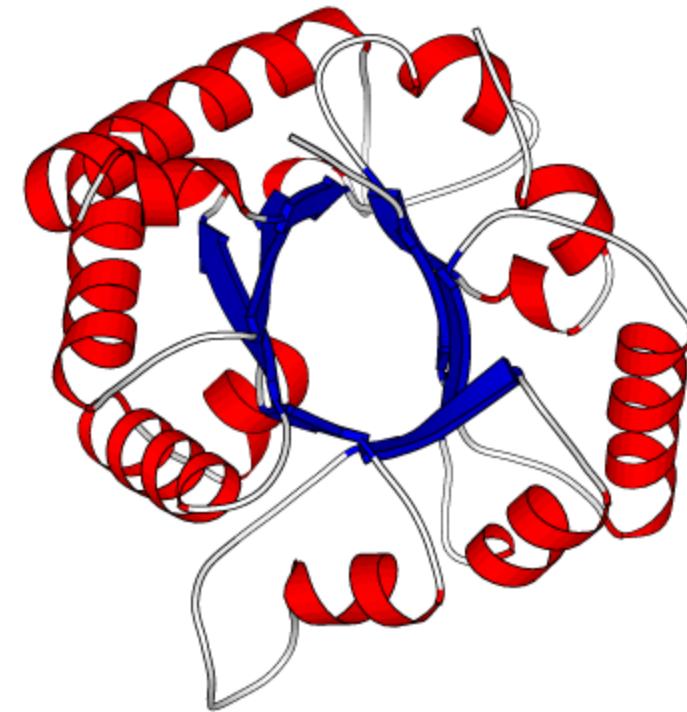
Proteine a botte α/β TIM



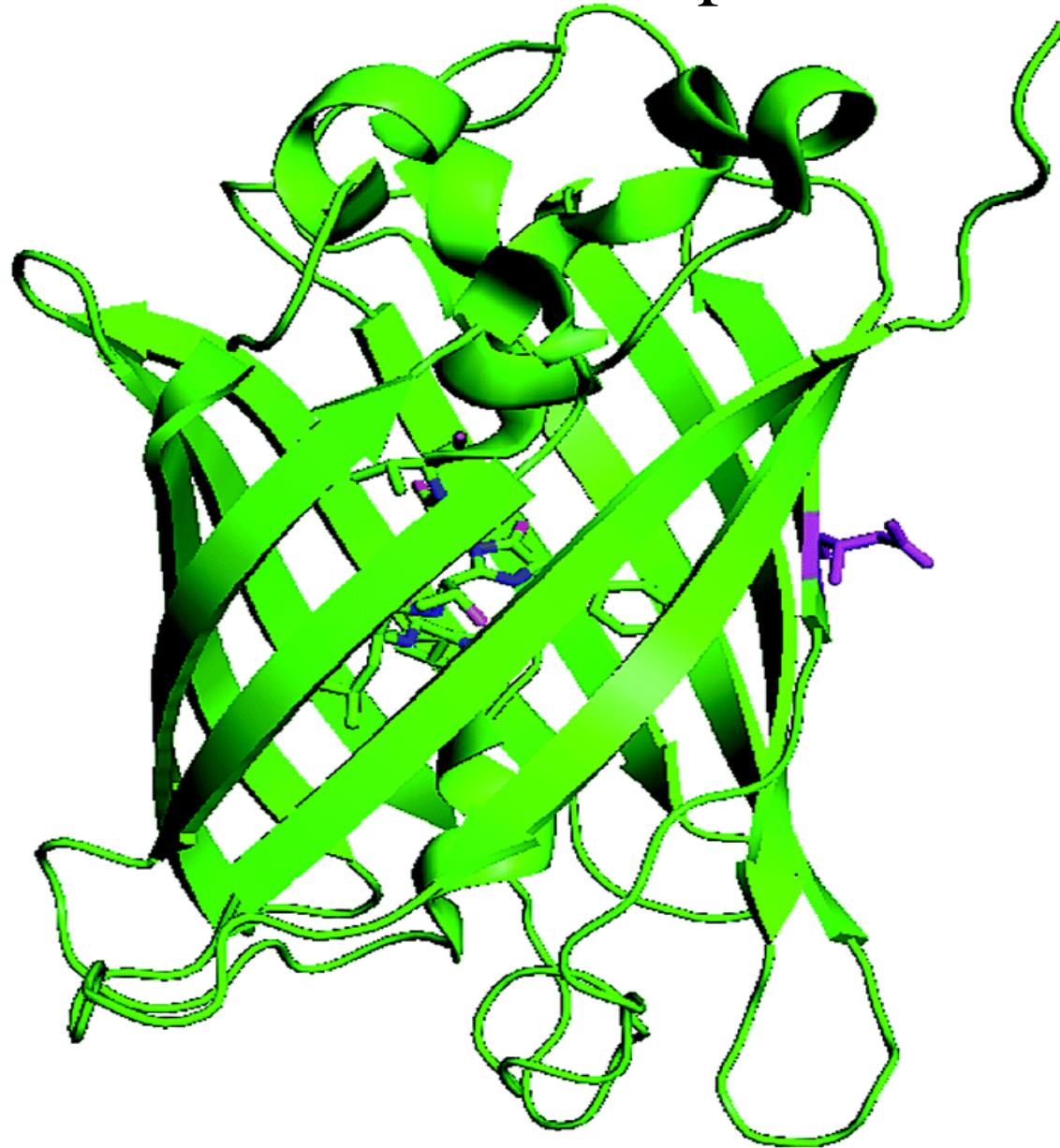
Proteine a botte α/β TIM e il castello di Federico II ad Andria



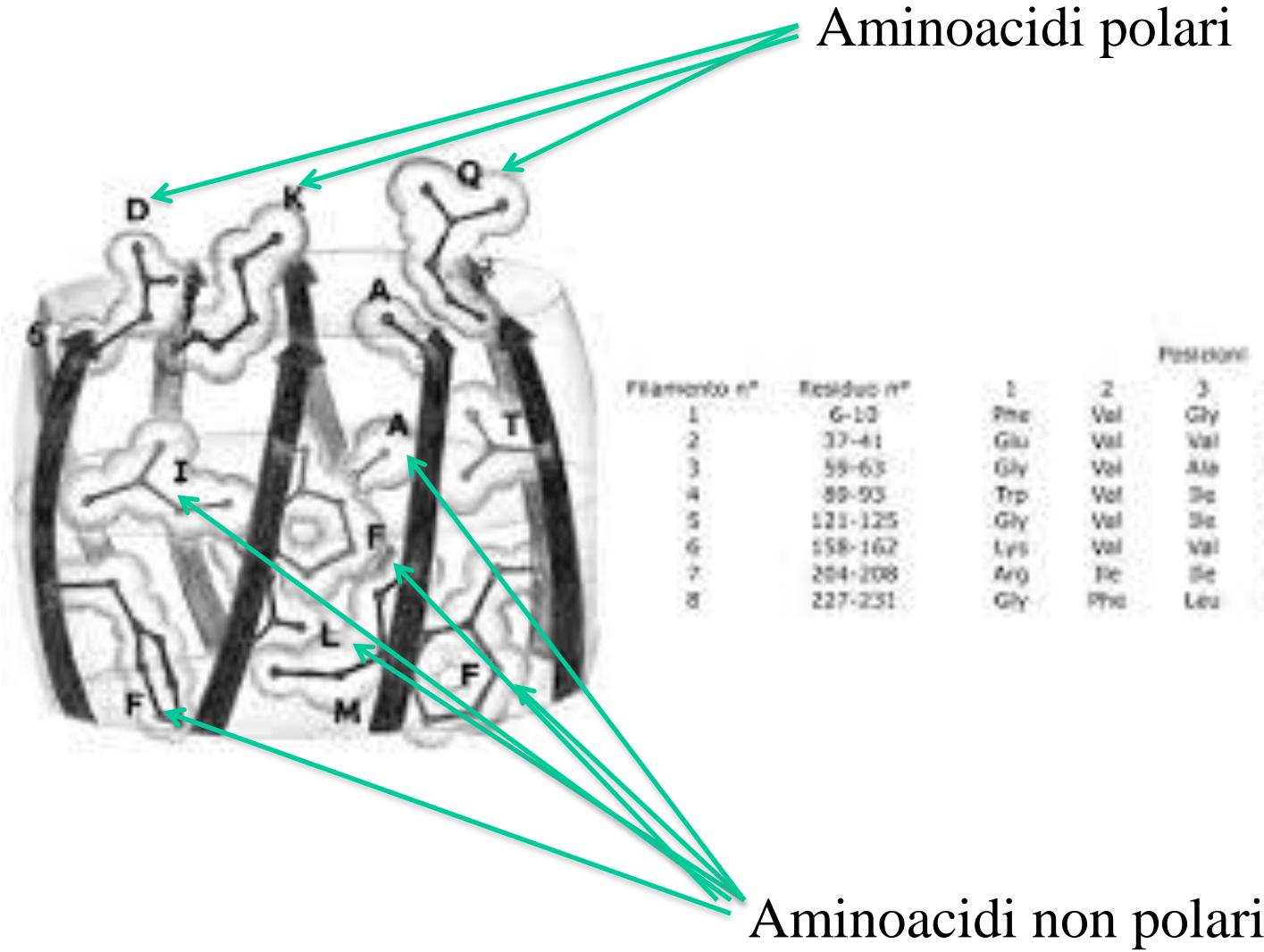
Proteine a botte α/β TIM



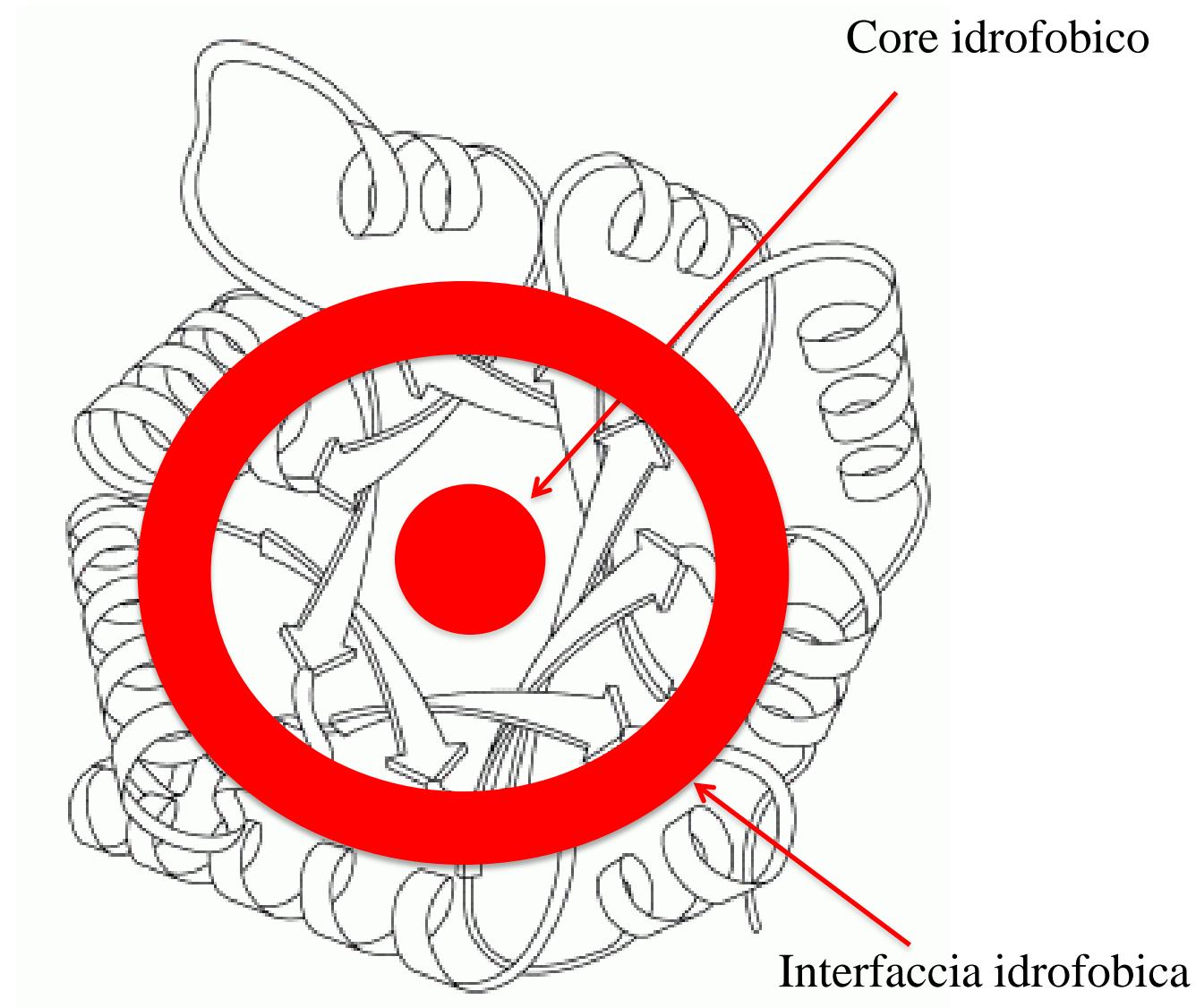
Proteine a β foglietto chiuse formate da filamenti antiparalleli



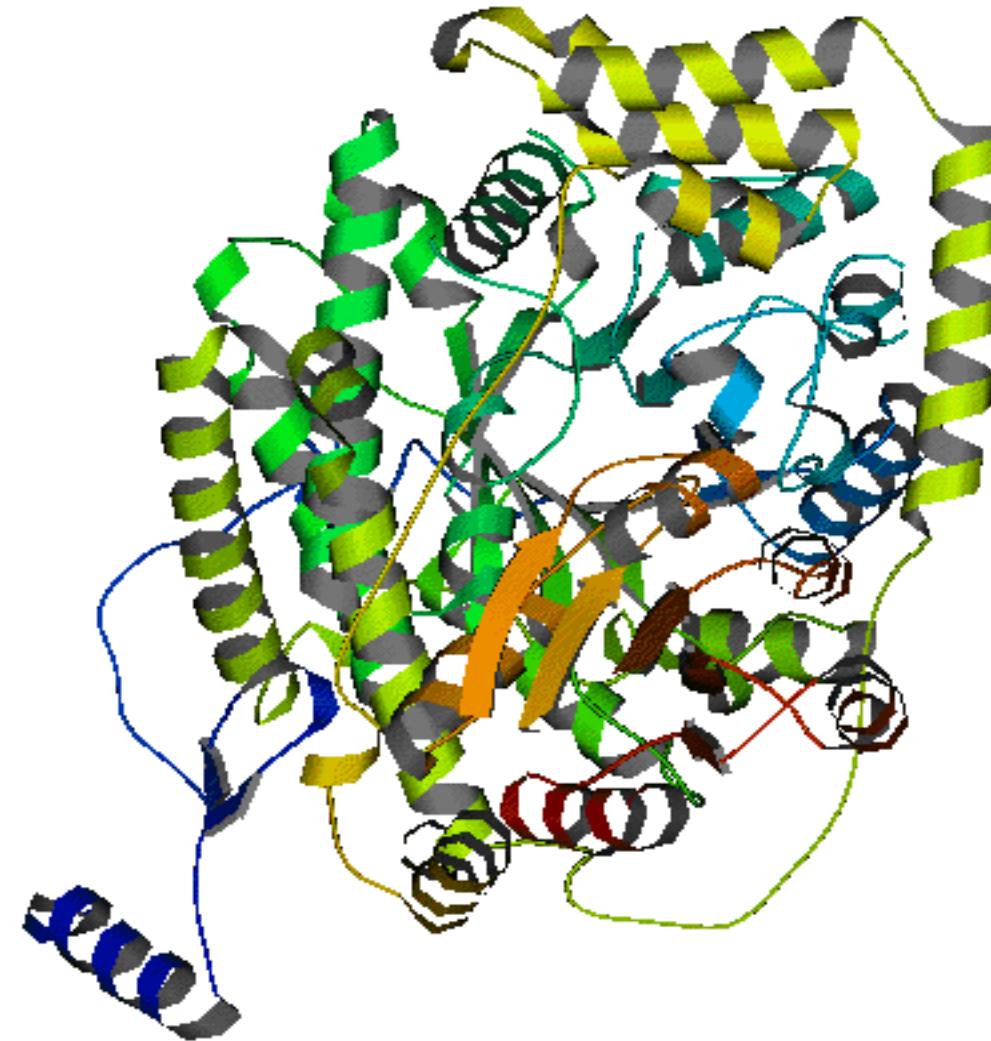
Proteine a β foglietto chiuse formate da filamenti paralleli



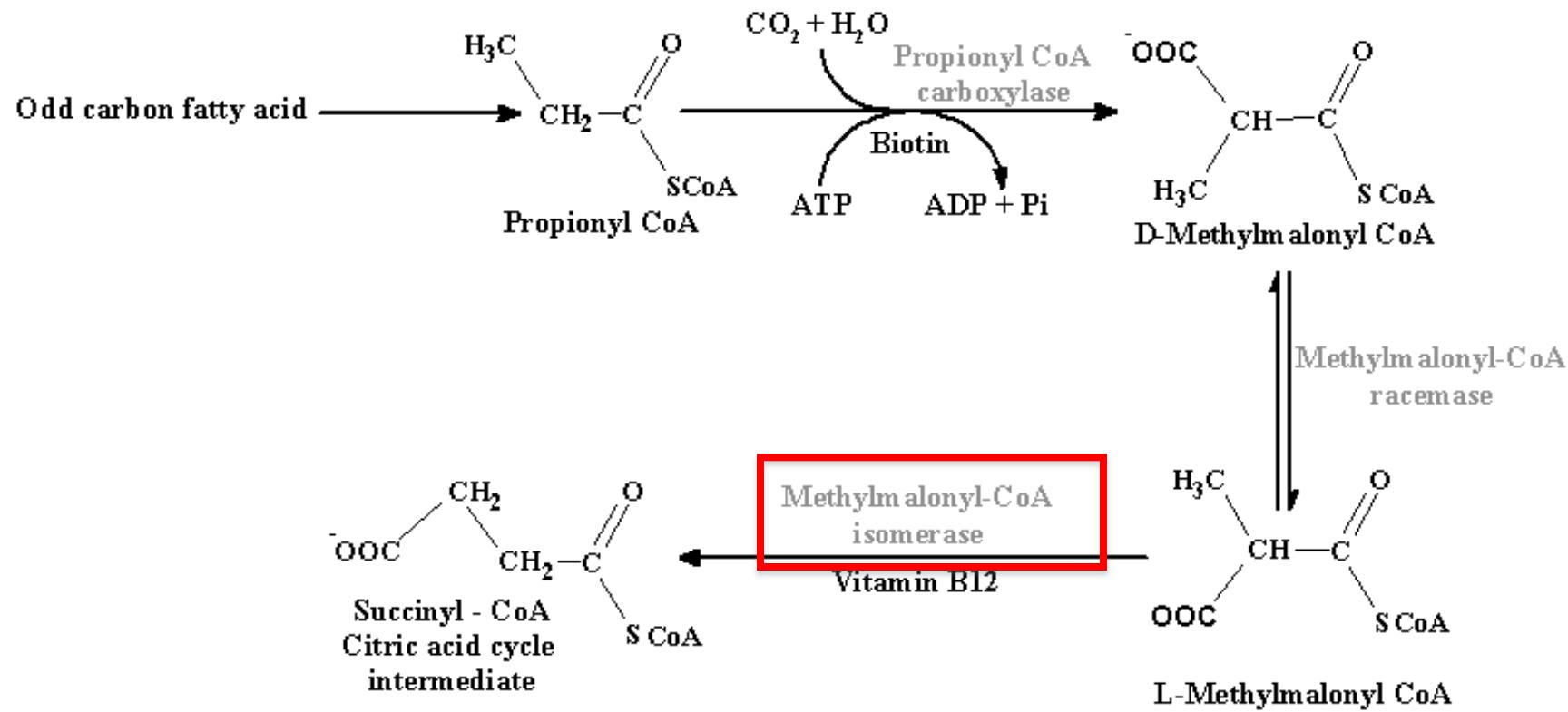
Proteine a botte α/β TIM formate da filamenti paralleli



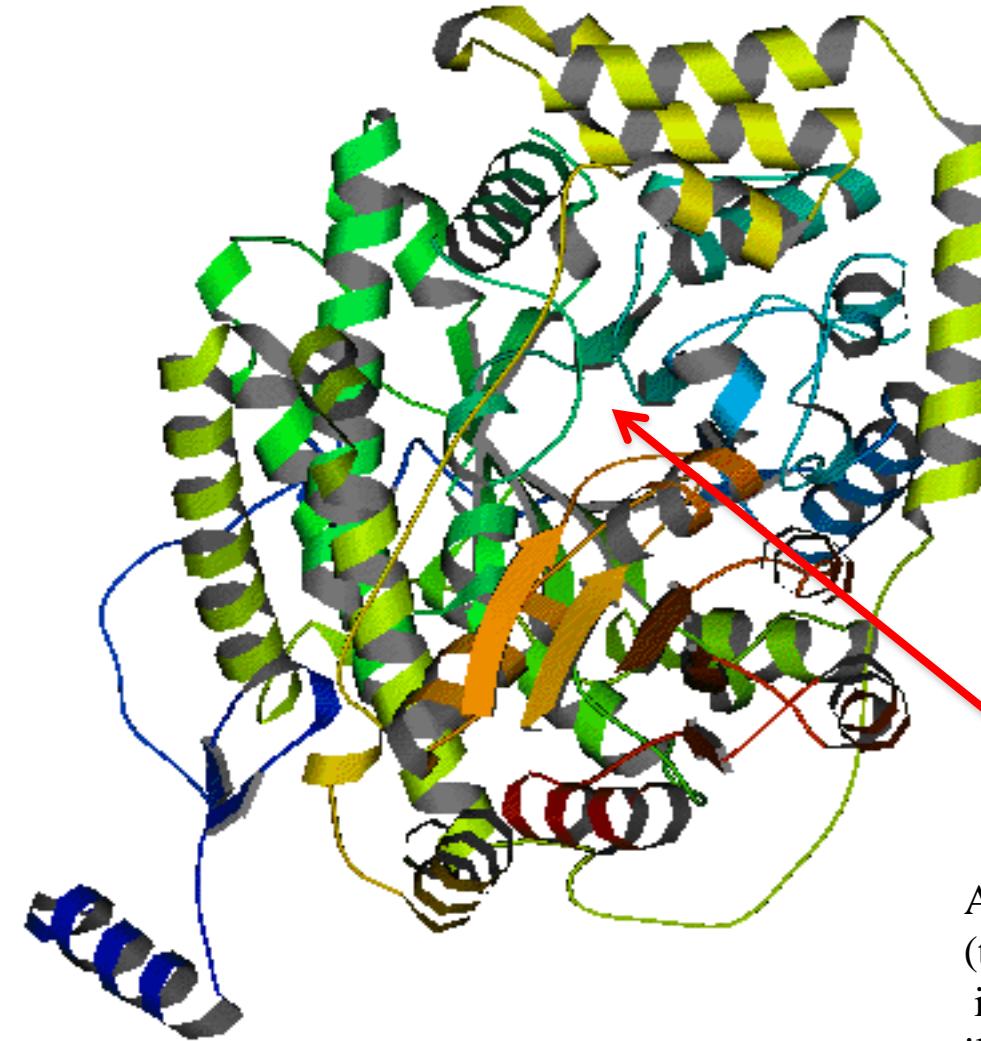
Un esempio di proteina a botte α/β TIM: metil malonil-coenzima A mutasi



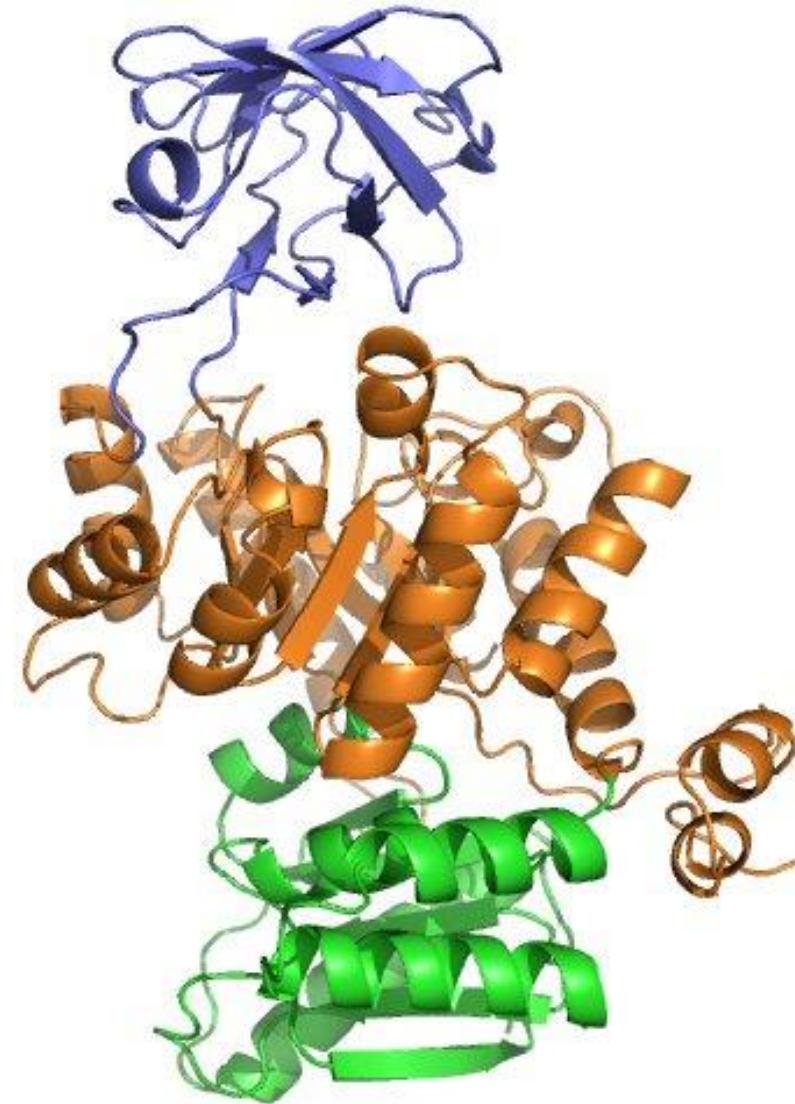
Un esempio di proteina a botte α/β TIM: metil malonil-coenzima A mutasi o isomerasi



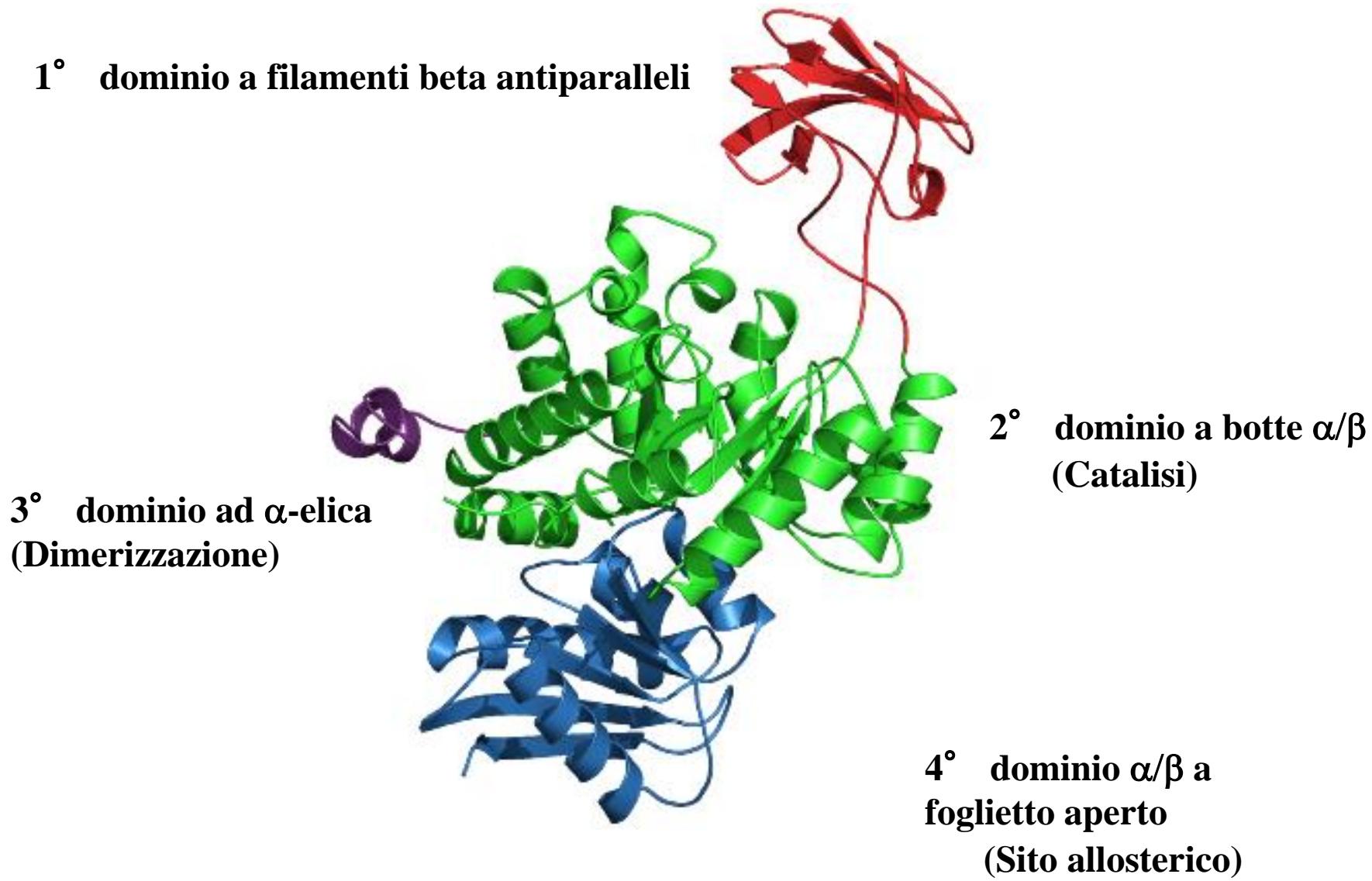
Un esempio di proteina a botte α/β TIM: metil malonil-coenzima A mutasi



Un esempio di proteina a botte α/β TIM: la piruvato chinasi

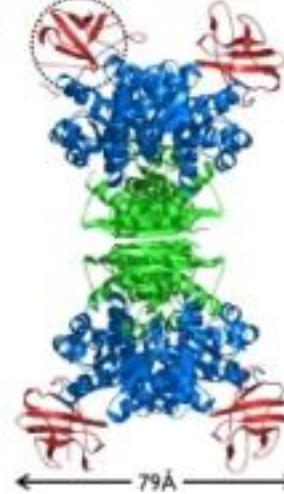
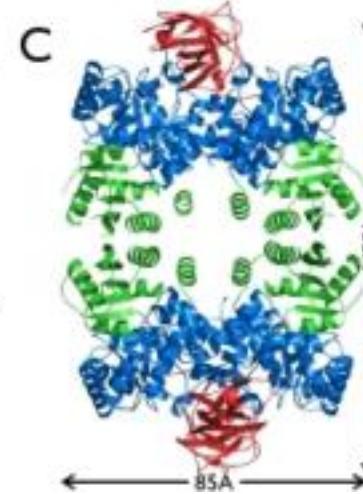
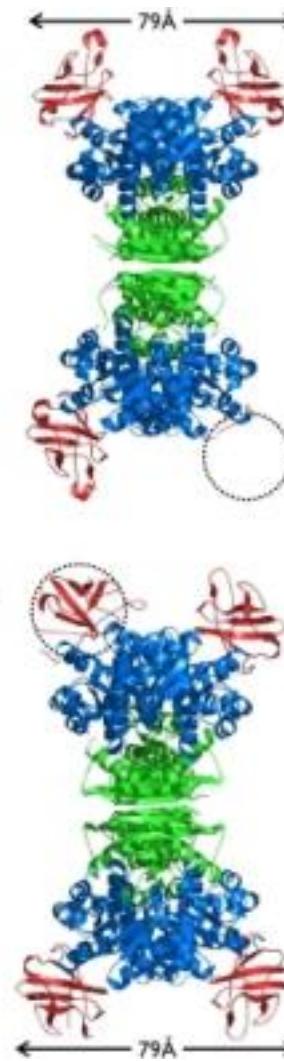
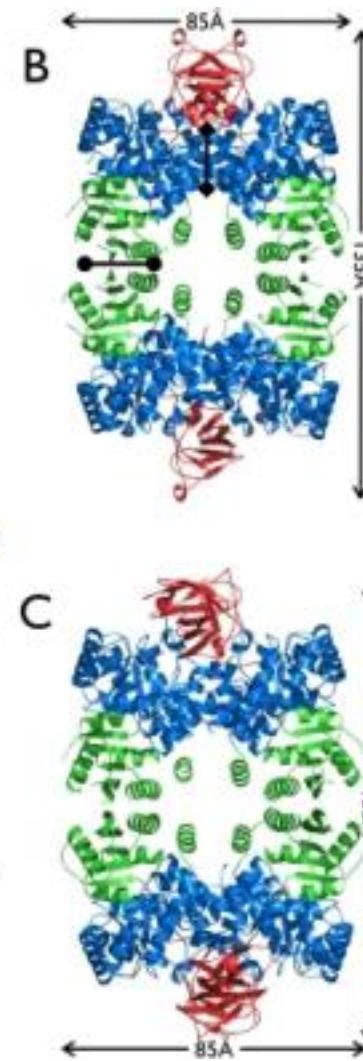
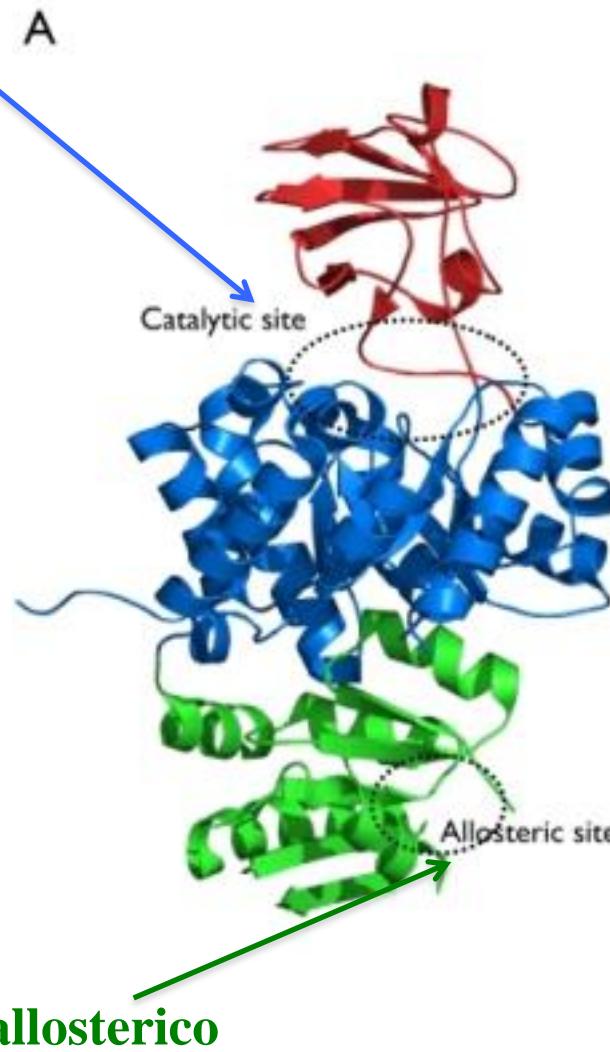


Un esempio di proteina a botte α/β TIM: la piruvato chinasi

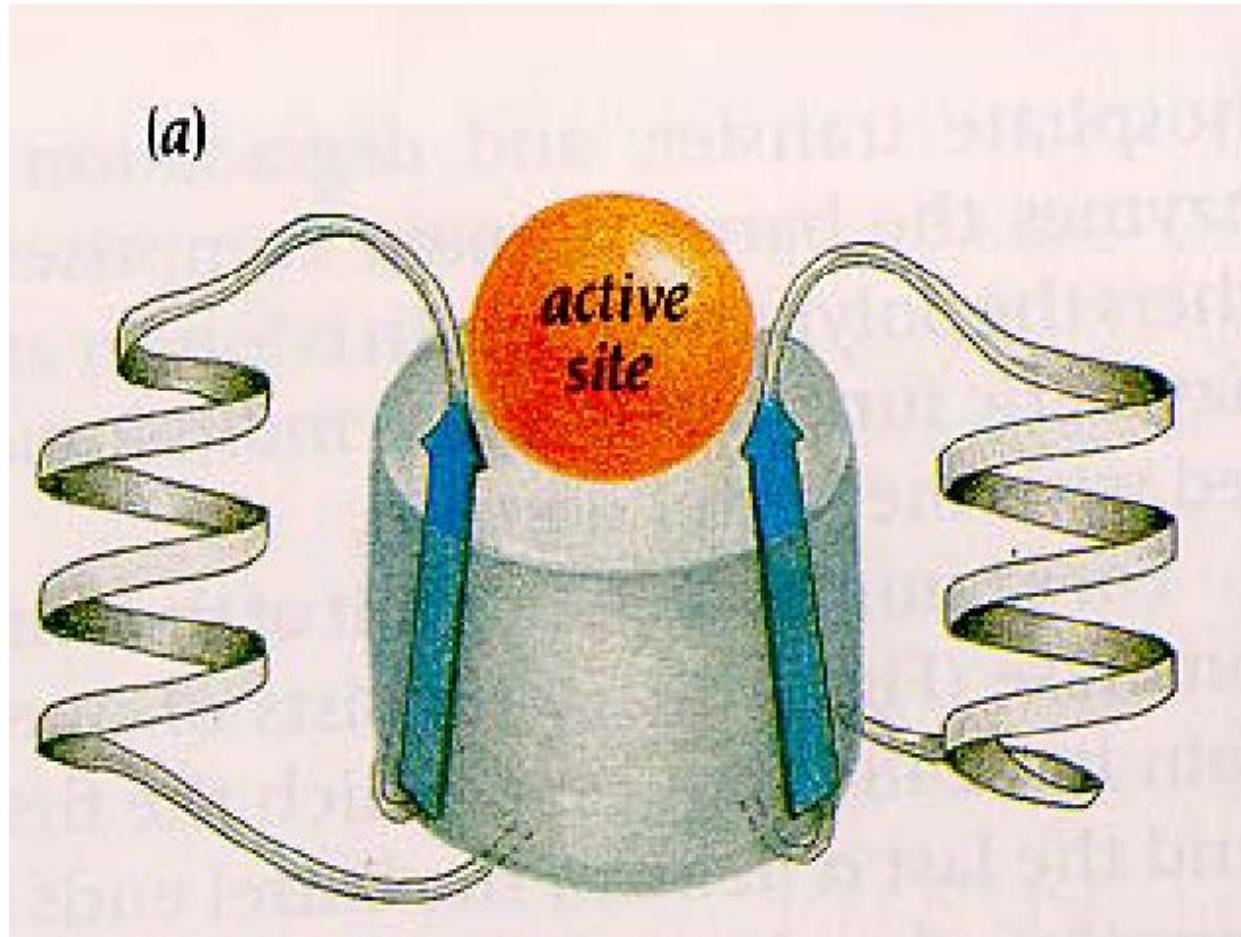


Un esempio di proteina a botte α/β TIM: la piruvato chinasi

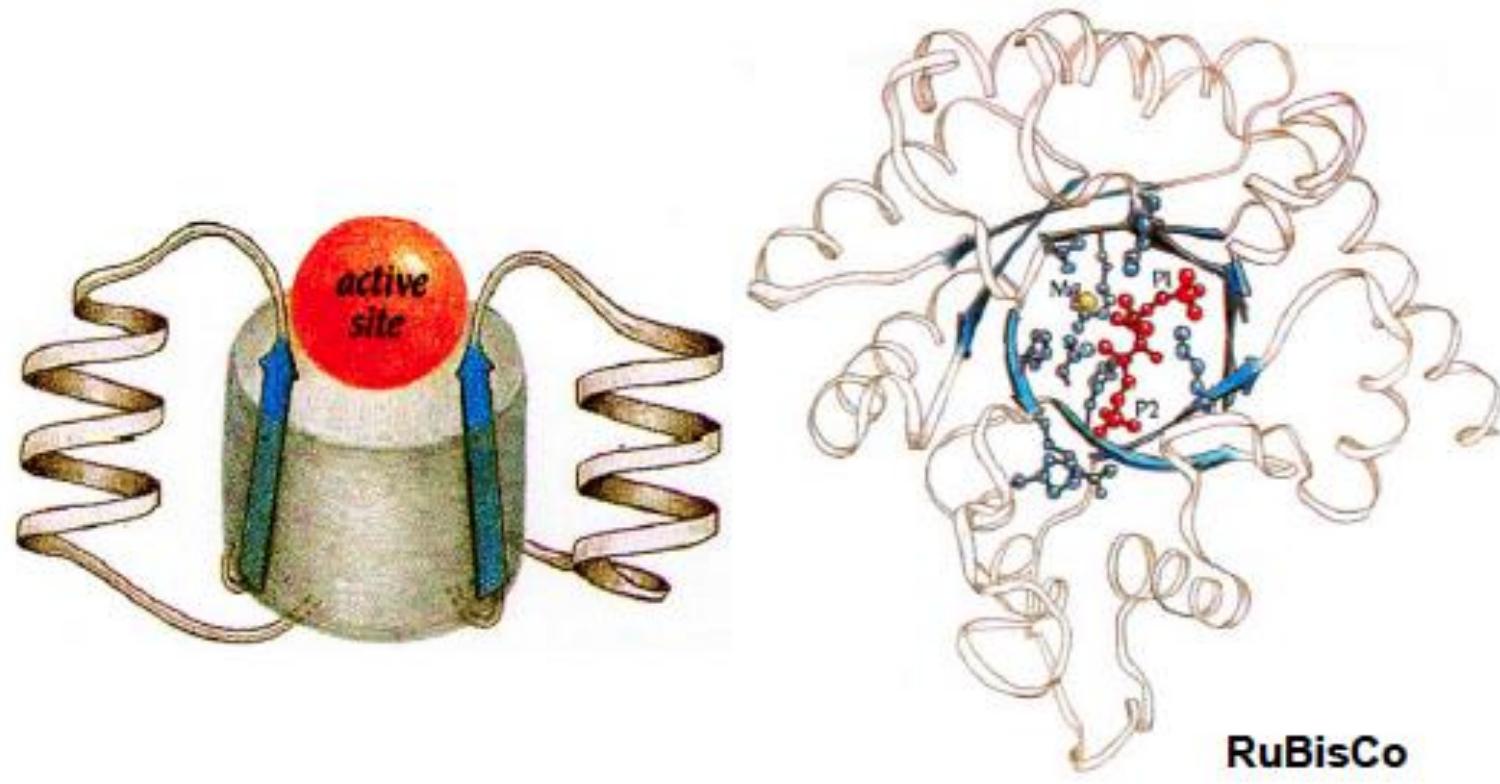
Sito attivo



Il sito attivo nelle proteine a struttura a botte α/β è al centro delle regioni loop



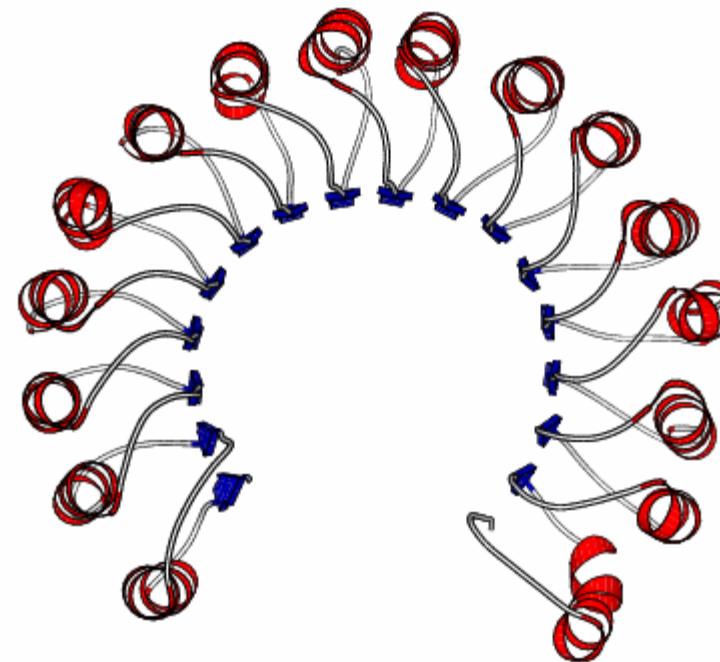
Il sito attivo in una proteina a struttura a botte α/β : la ribulosio 1,5 bisfosfato carbossilasi



(Ribulosio bisfosfato carbossilasi)

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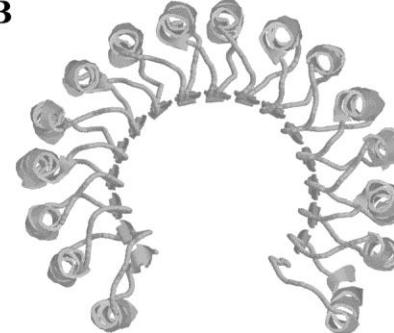
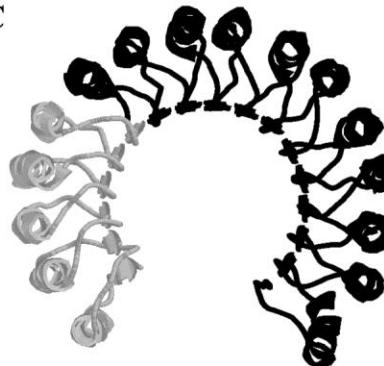
Proteine con motivi ricchi di leucina (ripiegamento a ferro di cavallo)



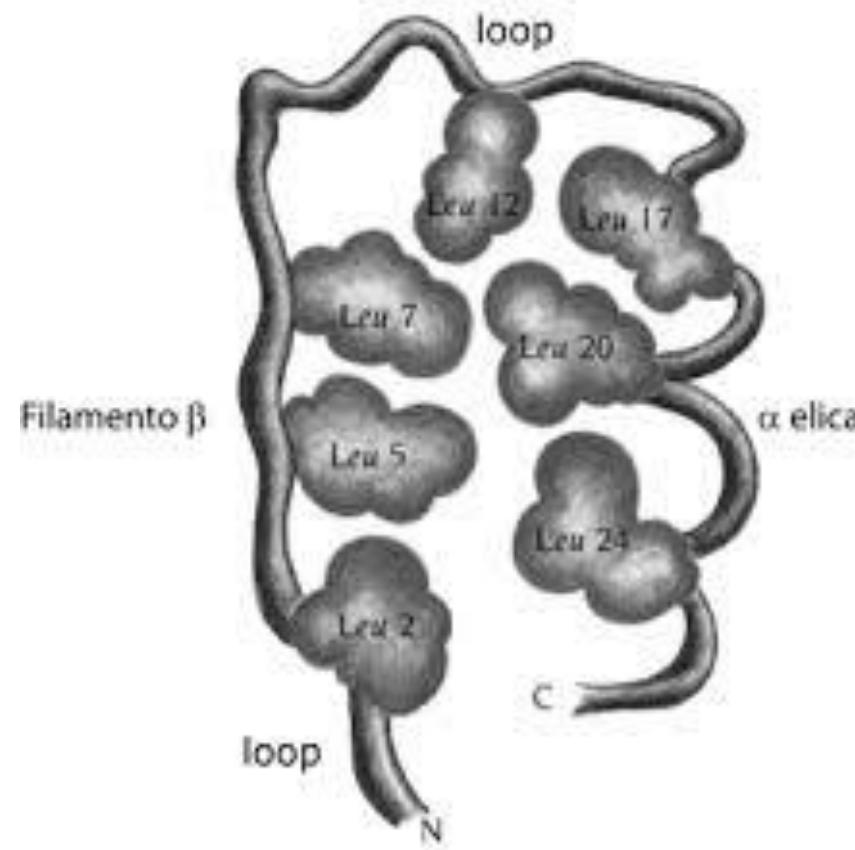
Proteine con motivi ricchi di leucina (ripiegamento a ferro di cavallo)

A

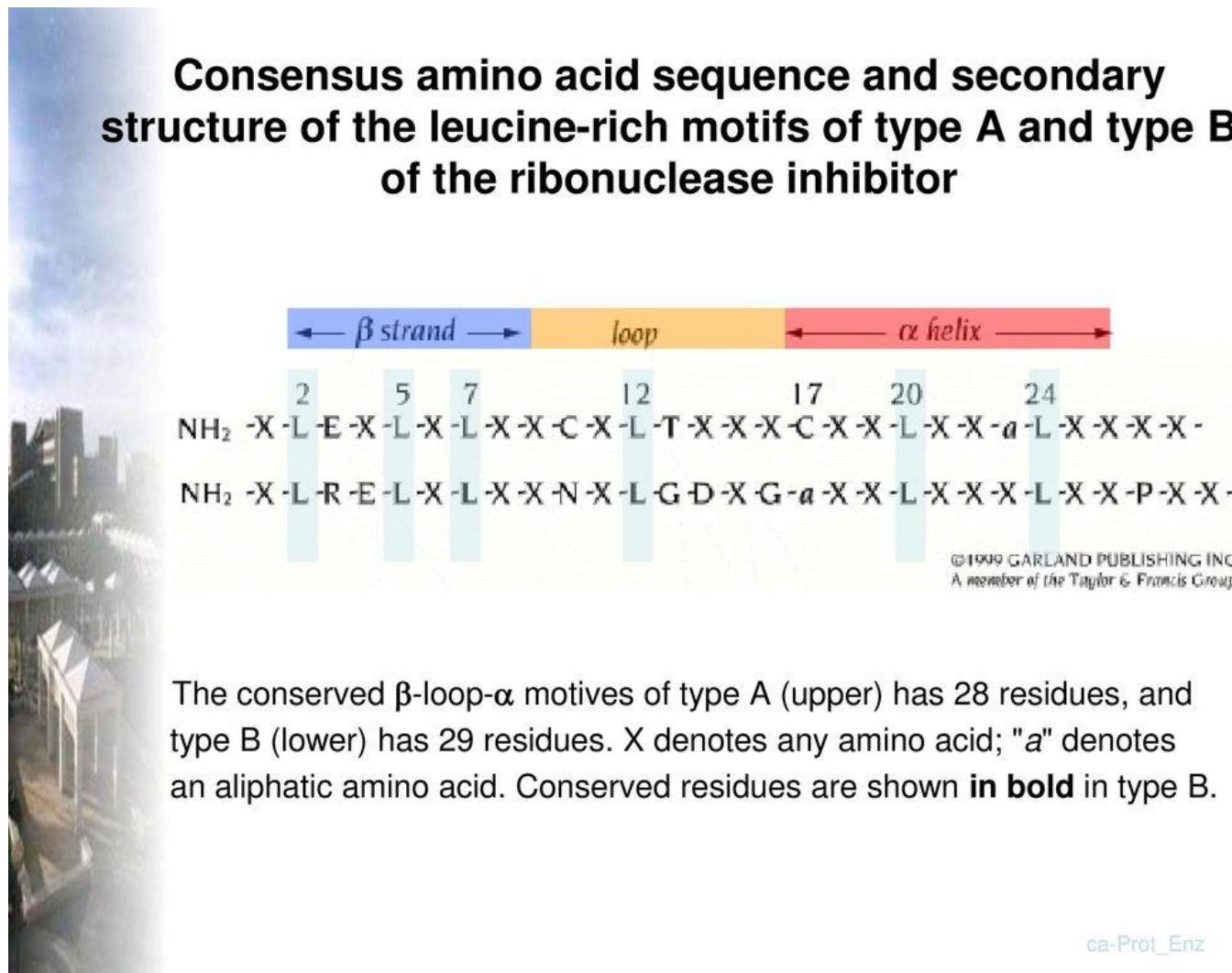
	consensus sequence
L X X L X X N X L X X L	53-74
F Q N V R L L C L R N N L L K K L E N F E P	76-97
S Q T L E D L D V Y D N Q I T K I E N L E C	98-119
L I K L A N L D L S F N R I K R I E N L E N	120-141
L S N L R K L Y F V N N H I S K I E N L S N	142-163
L K D L E M L E L G S N K I R K L E N L D E	164-185
L E K L T Q L Y C G K N K I P A I E N L D N	186-207
L T N L T I L S I Q G N R L T K I N G L A S	208-229
L V N L E Q L Y L S E N G I T E I E G L E T	230-251
L S K L L Q I L D L A Y N F I S Q I Q N M S N	252-273
L V N L E E F W C N D N K I S D W E Q L G K	277-300
D S N Y R R K I L L S L P N L Q Q L D	301-319
	LRR cap

B**C**

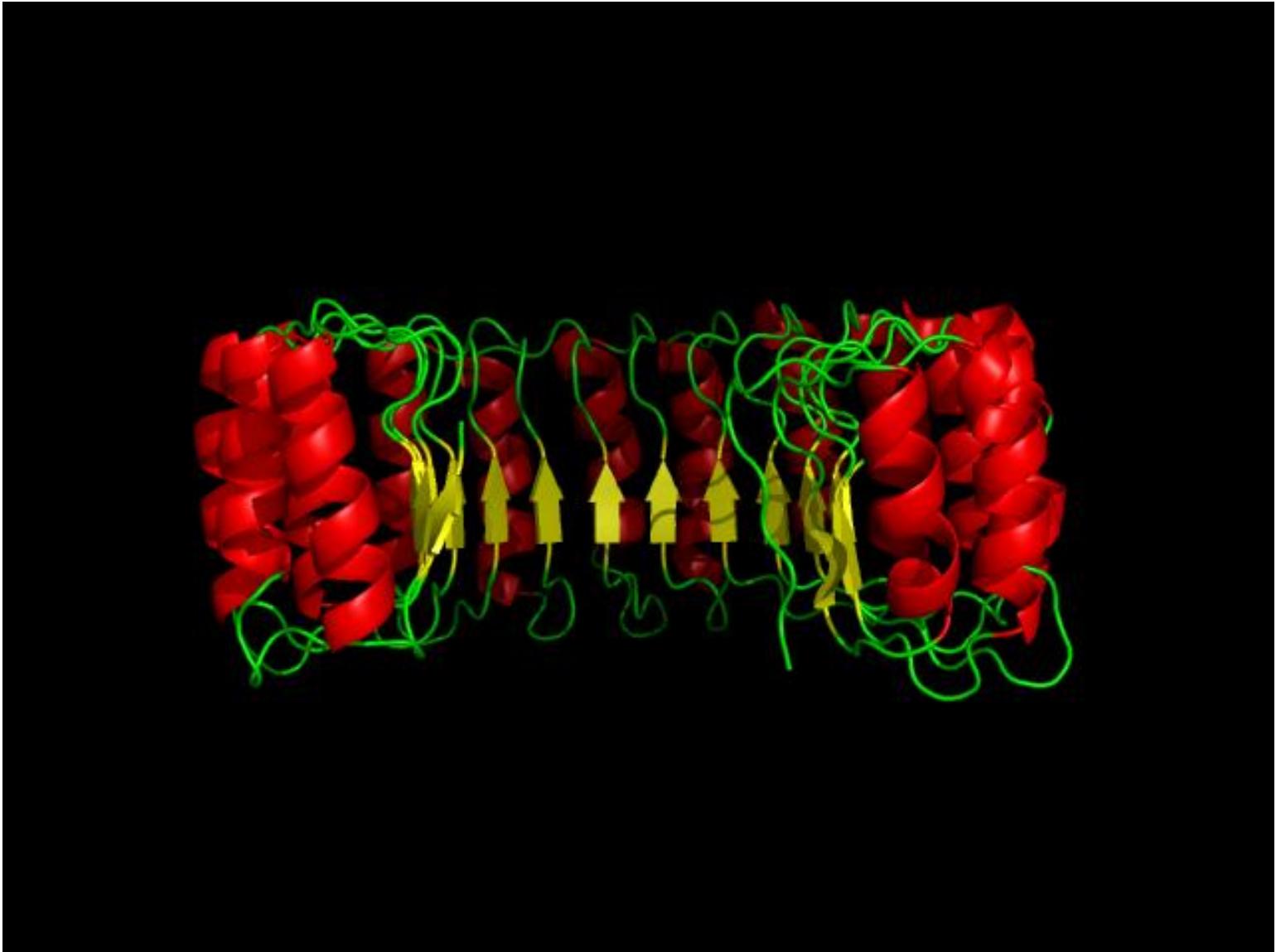
Proteine a β foglietto chiuse formate da filamenti antiparalleli



Proteine a β foglietto chiuse formate da filamenti antiparalleli



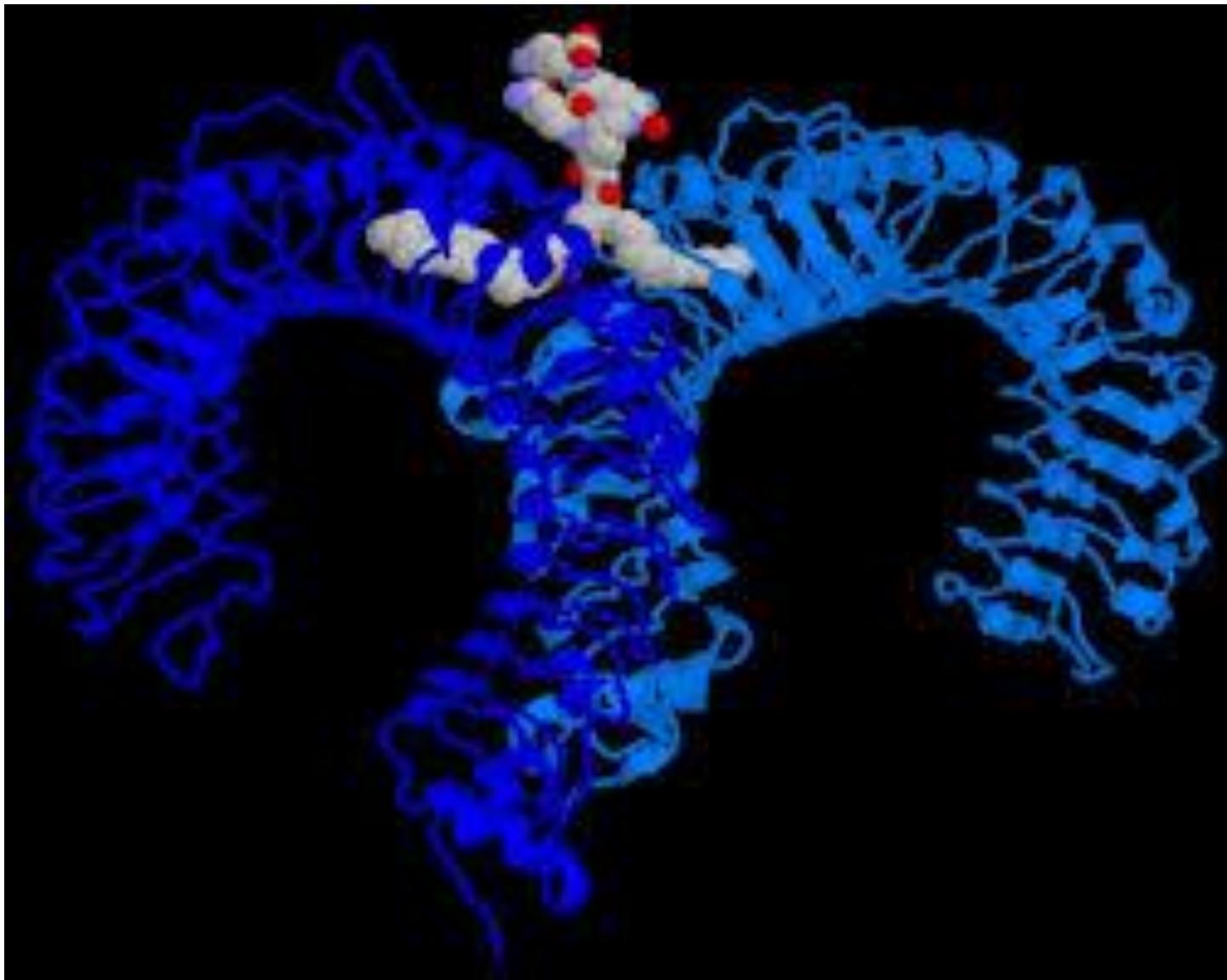
 Una proteina con motivi ricchi di leucina, l'inibitore della ribonucleasi



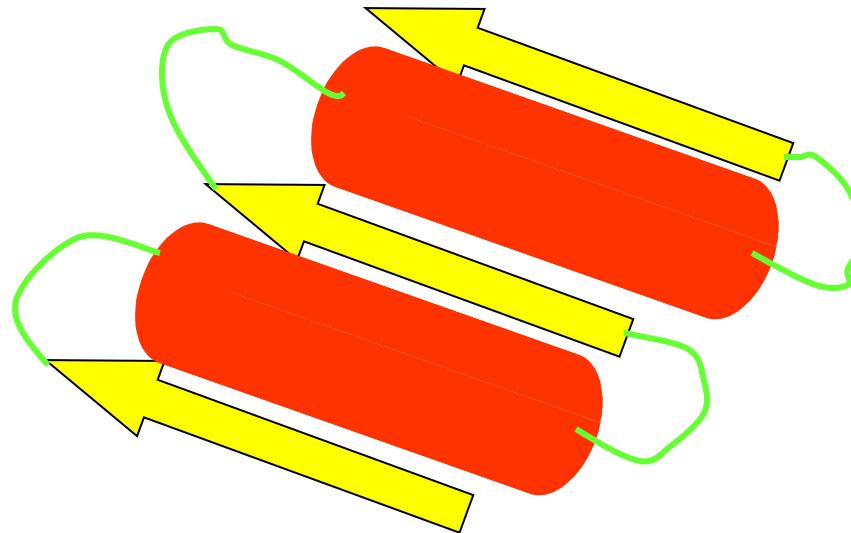
Una proteina con motivi ricchi di leucina, l'inibitore della ribonucleasi



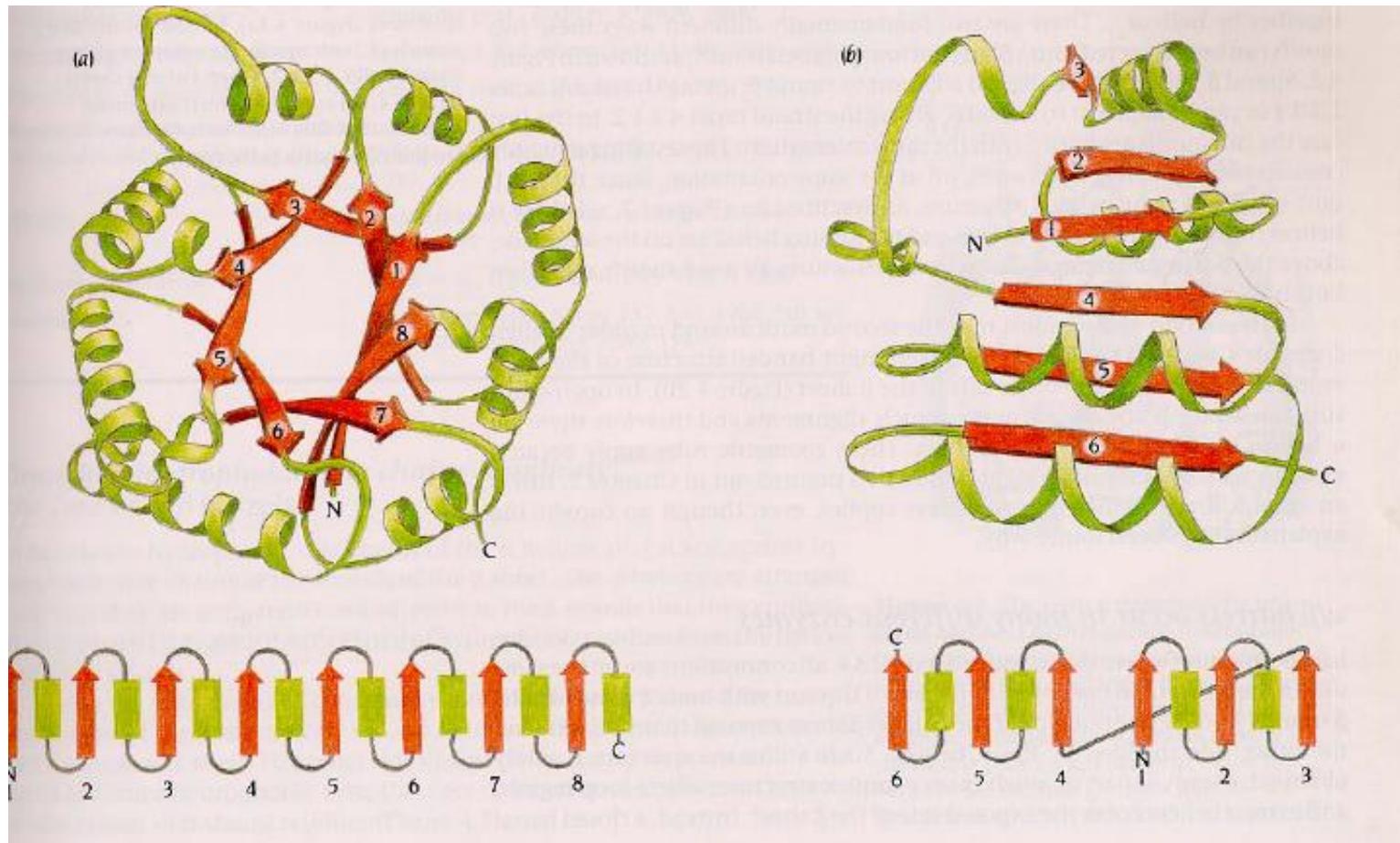
Una proteina con motivi ricchi di leucina, i recettori
Toll-like nella risposta immunitaria



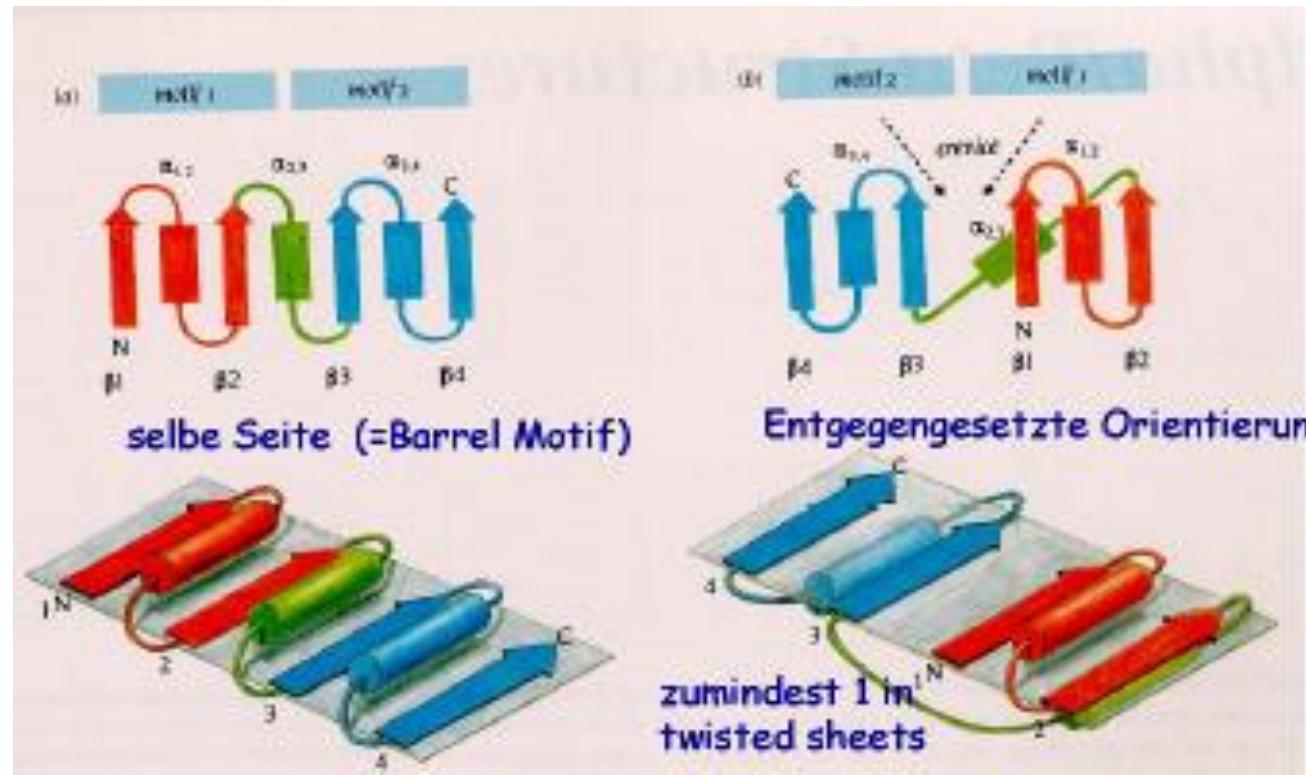
Il ripiegamento di Rossmann è l'unità strutturale delle proteine a foglietto aperto



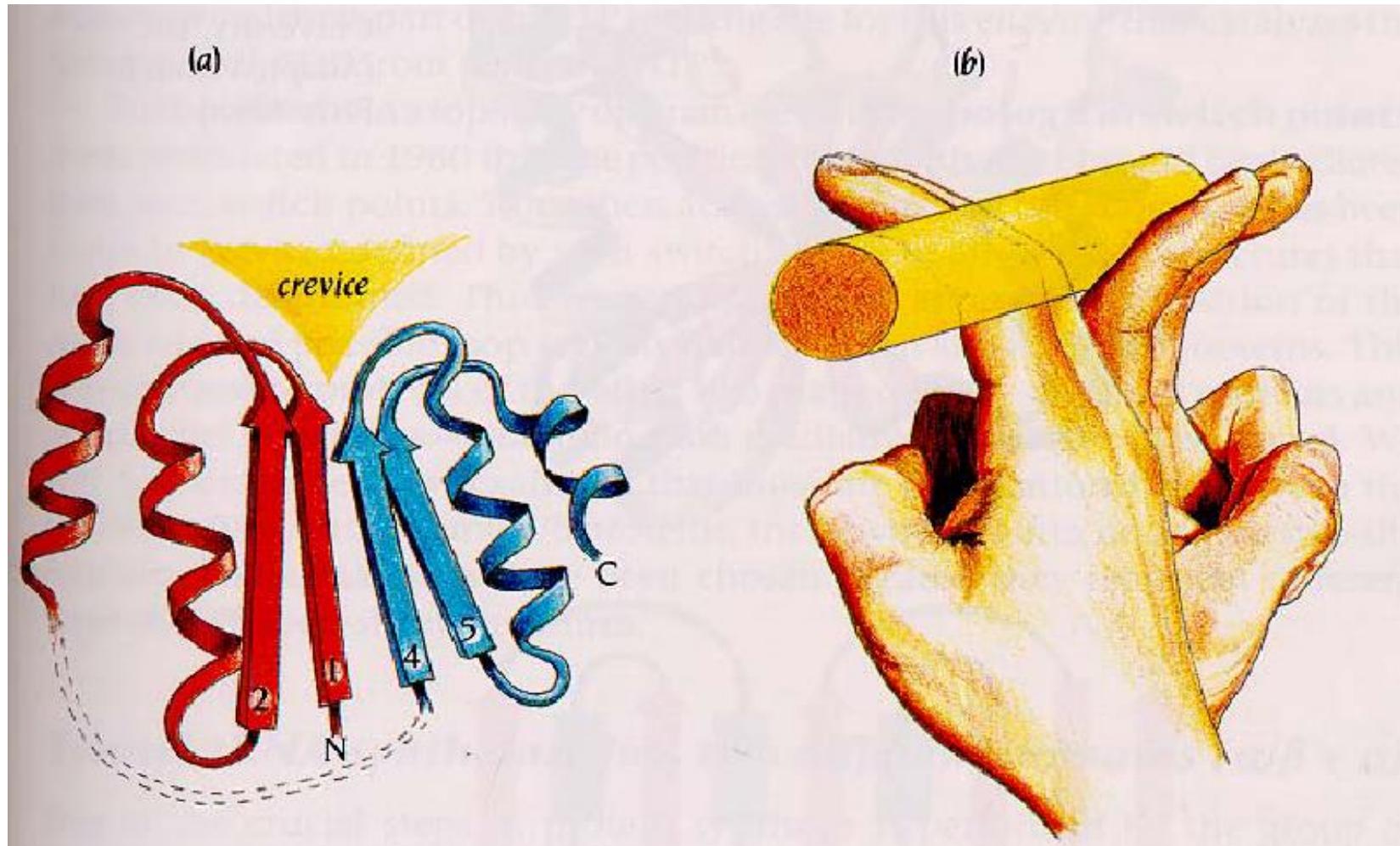
Proteine a botte TIM e a foglietto aperto



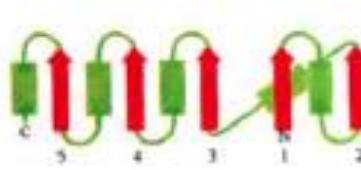
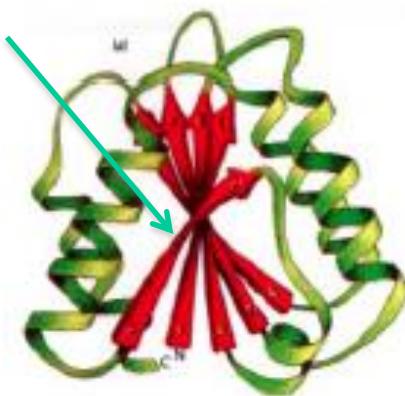
I motivi α/β sono strutture ad andamento destroso



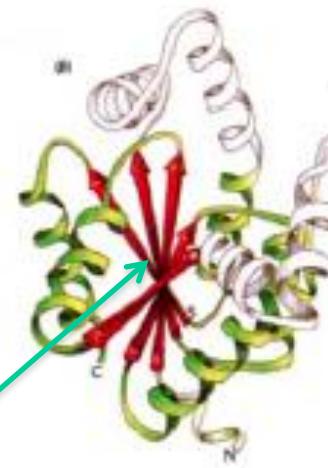
Proteine α/β a foglietto aperto



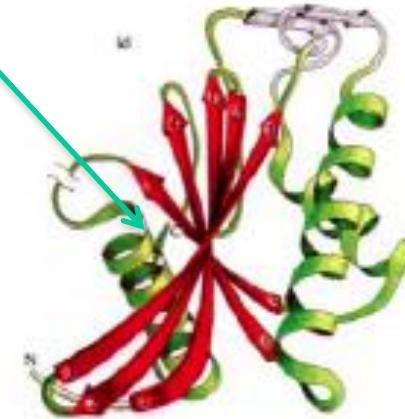
Proteine α/β a foglietto aperto



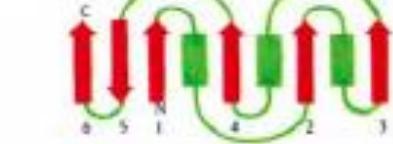
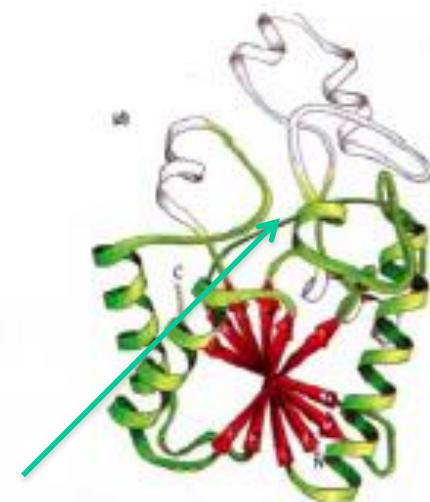
Flavodoxin



Adenylaktinase

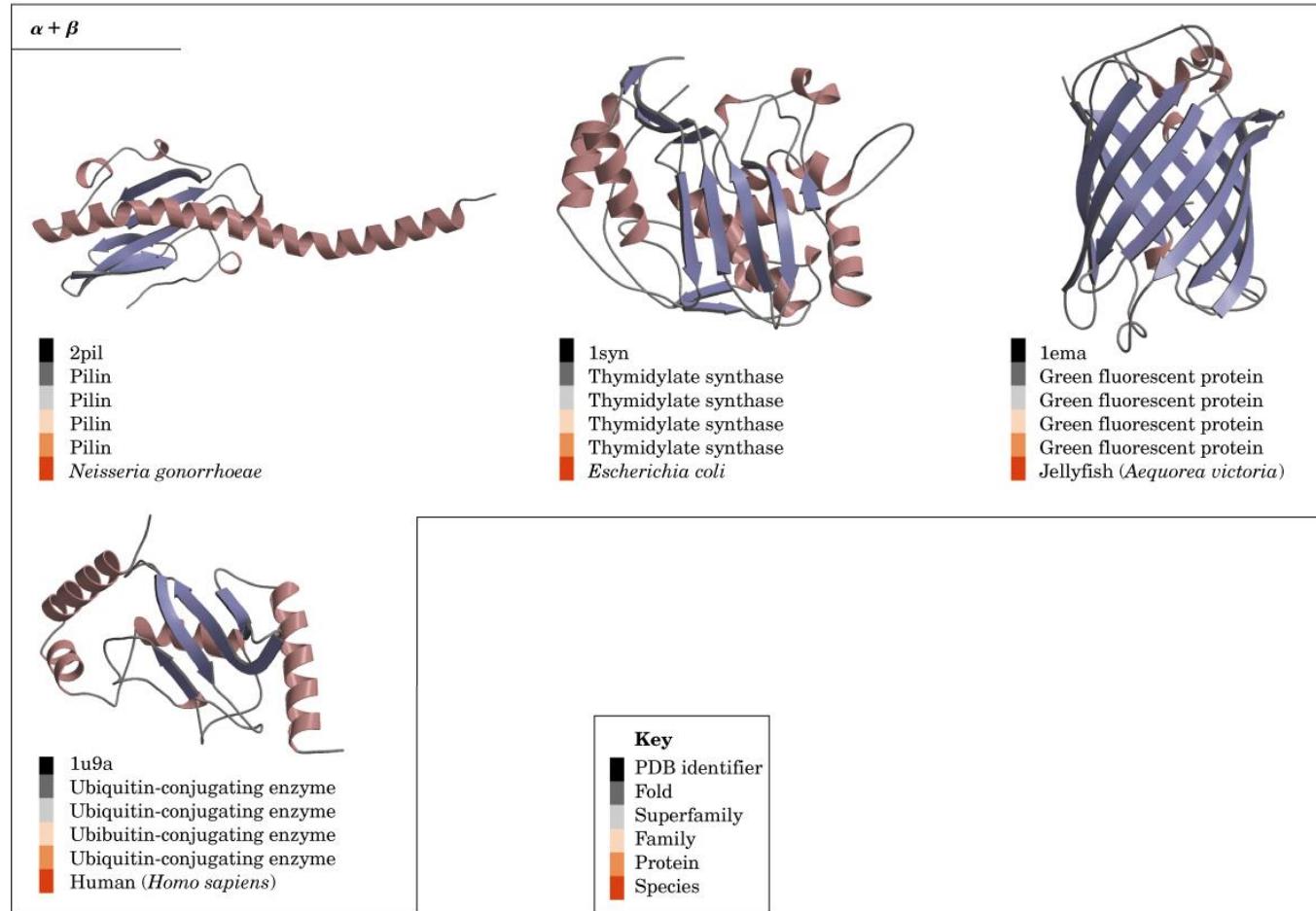


Hexokinase

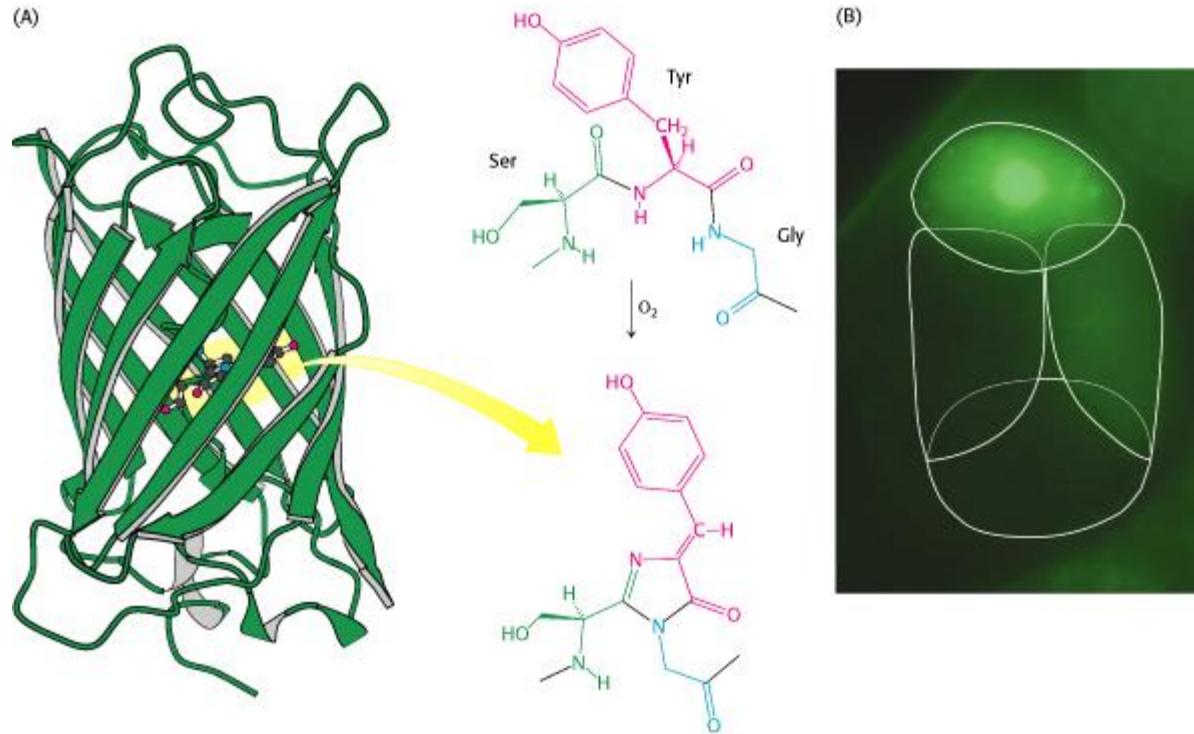


**Phosphoglycerat-
mutase**

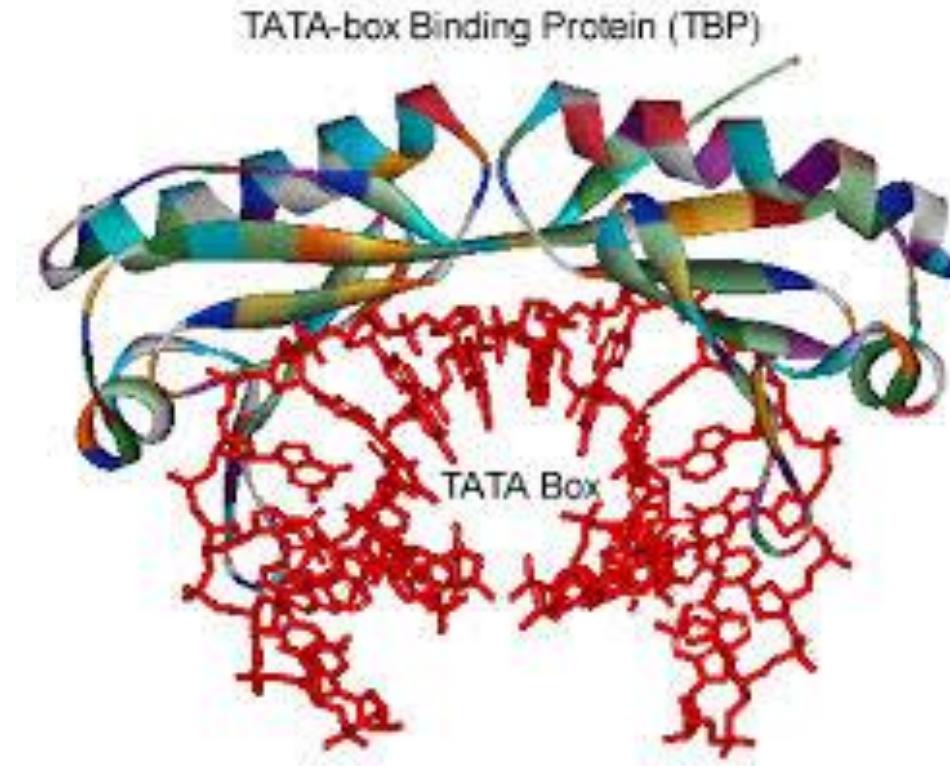
Proteine a motivi $\alpha+\beta$



Un esempio di proteina a motivi $\alpha+\beta$: la proteina GFP (green fluorescent protein)



Un esempio di proteina a motivi $\alpha+\beta$: la proteina TATA binding protein



Un esempio di proteina a motivi $\alpha+\beta$: la proteina TATA binding protein

