Ankara University, Faculty of Agriculture , Department of Fisheries and Aquaculture, Programme of Fisheries and Aquaculture

AQS104: Biochemistry

Reference: Nelson, D. L., Lehninger, A. L., & Cox, M. M. (2008). ***Lehninger Principles of Biochemistry (5th edition)***. Macmillan.

AQS104 BIOCHEMISTRY: Weekly Programme	
1. Week: • The foundations of biochemistry • Water	**8. Week:** Principles of metabolic regulation The citric acid cycle
2. Week: • Amino acids, peptides, and proteins • The three-dimensional structure of proteins	**9. Week:** Fatty acid catabolism Aino acid oxidation and the production of urea
3. Week: • Protein function • Enzymes	**10. Week:** Oxidative phosphorylation and photophosphorylation Carbohydrate biosynthesis in plants and bacteria
4. Week: • Carbohydrates and Glycobiology • Nucleotides and Nucleic Acids	**11. Week:** Lipid biosynthesis Biosynthesis of amino acids, nucleotides, and related molecules
5. Week: • DNA-based information technologies • Lipids	**12. Week:** Hormonal regulation and integration of mammalian metabolism Genes and chromosomes
6. Week: Biological membranes and transport Biosignaling	**13. Week:** DNA metabolism RNA metabolism
7. Week: Bioenergetics and biochemical reaction types Glycolysis, gluconeogenesis, and the pentose phosphate pathway	**14. Week:** Protein metabolism Regulation of gene expression

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2. Week:

Amino Acids, Peptides, and Proteins

The Three-Dimensional Structure of Proteins

Reference: Nelson, D. L., Lehninger, A. L., & Cox, M. M. (2008). ***Lehninger Principles of Biochemistry (5th edition)***. Macmillan.

Amino acid	Abbreviation/ symbol	M_r*	pK_a values: pK_1 (—COOH)	pK_2 ($—NH_3^+$)	pK_R (R group)	pI	Hydropathy index†	Occurrence in proteins (%)‡
Nonpolar, aliphatic R groups								
Glycine	Gly G	75	2.34	9.60		5.97	−0.4	7.2
Alanine	Ala A	89	2.34	9.69		6.01	1.8	7.8
Proline	Pro P	115	1.99	10.96		6.48	1.6	5.2
Valine	Val V	117	2.32	9.62		5.97	4.2	6.6
Leucine	Leu L	131	2.36	9.60		5.98	3.8	9.1
Isoleucine	Ile I	131	2.36	9.68		6.02	4.5	5.3
Methionine	Met M	149	2.28	9.21		5.74	1.9	2.3
Aromatic R groups								
Phenylalanine	Phe F	165	1.83	9.13		5.48	2.8	3.9
Tyrosine	Tyr Y	181	2.20	9.11	10.07	5.66	−1.3	3.2
Tryptophan	Trp W	204	2.38	9.39		5.89	−0.9	1.4
Polar, uncharged R groups								
Serine	Ser S	105	2.21	9.15		5.68	−0.8	6.8
Threonine	Thr T	119	2.11	9.62		5.87	−0.7	5.9
Cysteine§	Cys C	121	1.96	10.28	8.18	5.07	2.5	1.9
Asparagine	Asn N	132	2.02	8.80		5.41	−3.5	4.3
Glutamine	Gln Q	146	2.17	9.13		5.65	−3.5	4.2
Positively charged R groups								
Lysine	Lys K	146	2.18	8.95	10.53	9.74	−3.9	5.9
Histidine	His H	155	1.82	9.17	6.00	7.59	−3.2	2.3
Arginine	Arg R	174	2.17	9.04	12.48	10.76	−4.5	5.1
Negatively charged R groups								
Aspartate	Asp D	133	1.88	9.60	3.65	2.77	−3.5	5.3
Glutamate	Glu E	147	2.19	9.67	4.25	3.22	−3.5	6.3

*M_r values reflect the structures as shown in Figure 3–5. The elements of water (M_r 18) are deleted when the amino acid is incorporated into a polypeptide.

†A scale combining hydrophobicity and hydrophilicity of R groups. The values reflect the free energy (ΔG) of transfer of the amino acid side chain from a hydrophobic solvent to water. This transfer is favorable ($\Delta G < 0$; negative value in the index) for charged or polar amino acid side chains, and unfavorable ($\Delta G > 0$; positive value in the index) for amino acids with nonpolar or more hydrophobic side chains. See Chapter 11. From Kyte, J. & Doolittle, R.F. (1982) A simple method for displaying the hydropathic character of a protein. *J. Mol. Biol.* **157,** 105–132.

‡Average occurrence in more than 1,150 proteins. From Doolittle, R.F. (1989) Redundancies in protein sequences. In *Prediction of Protein Structure and the Principles of Protein Conformation* (Fasman, G.D., ed.), pp. 599–623, Plenum Press, New York.

§Cysteine is generally classified as polar despite having a positive hydropathy index. This reflects the ability of the sulfhydryl group to act as a weak acid and to form a weak hydrogen bond with oxygen or nitrogen.

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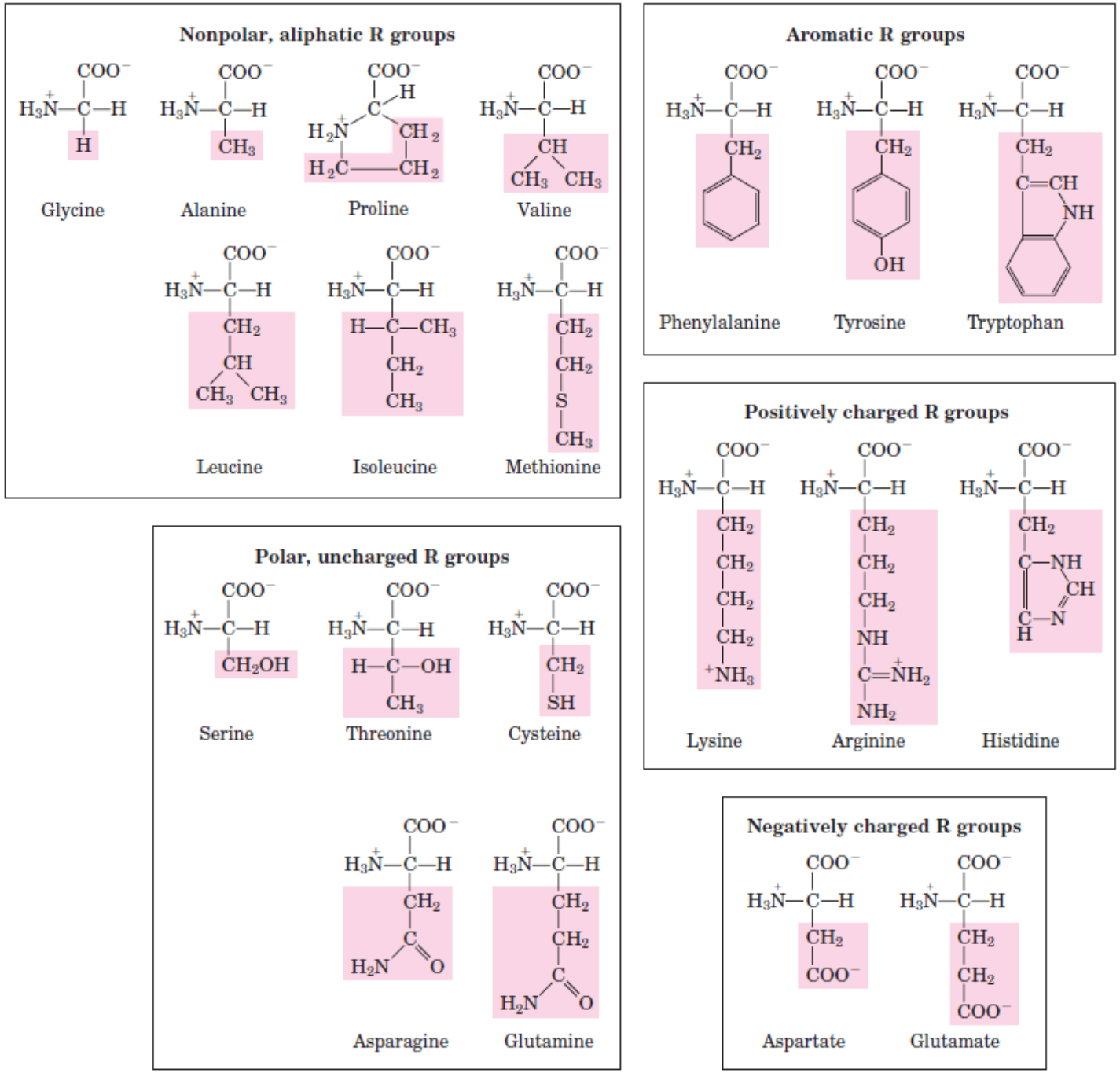

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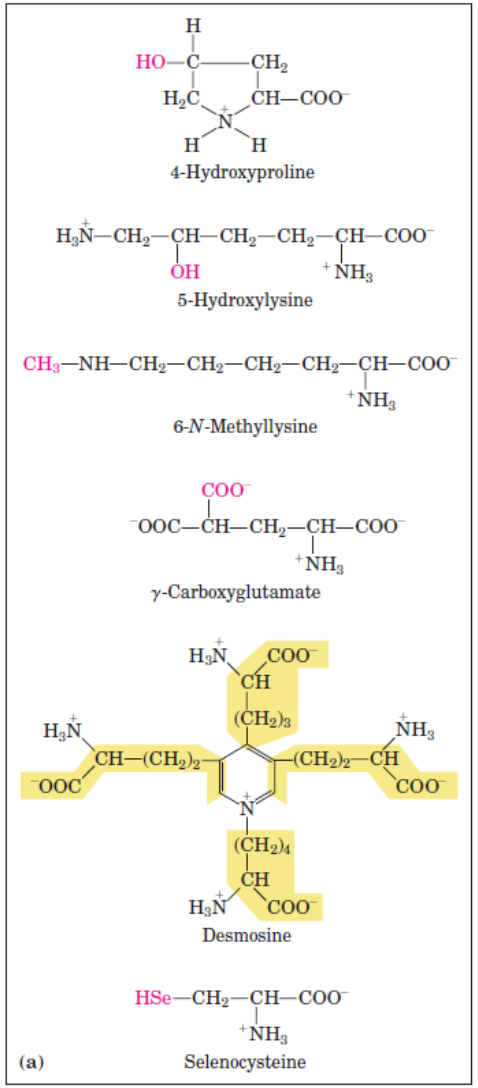

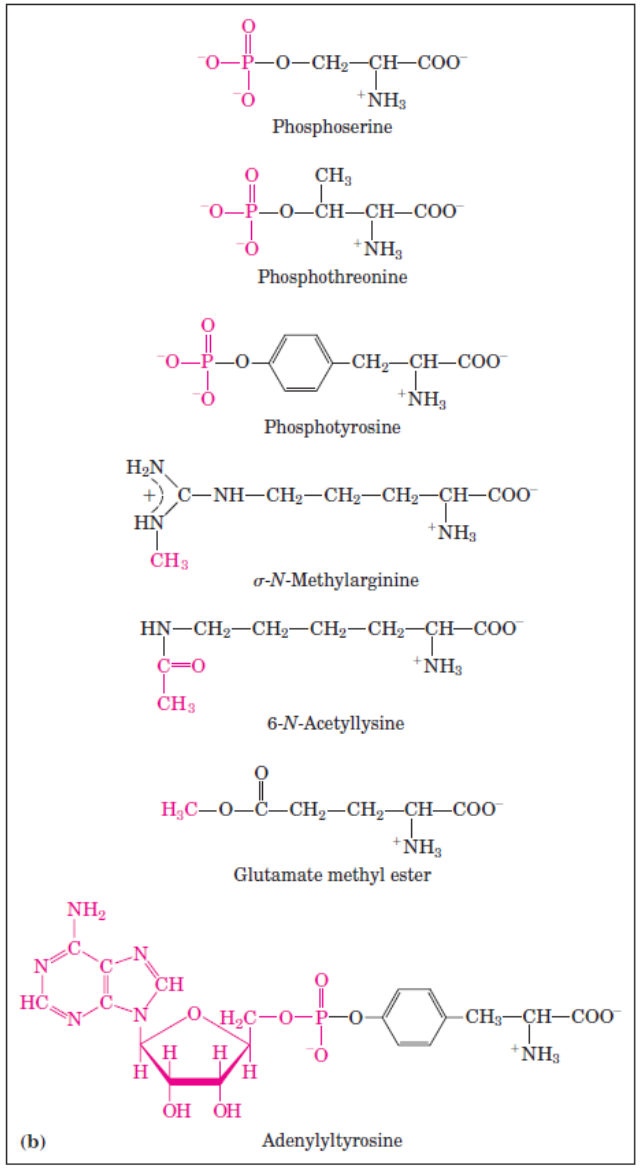

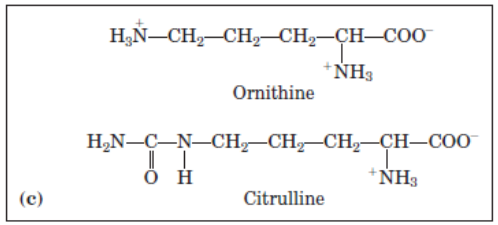

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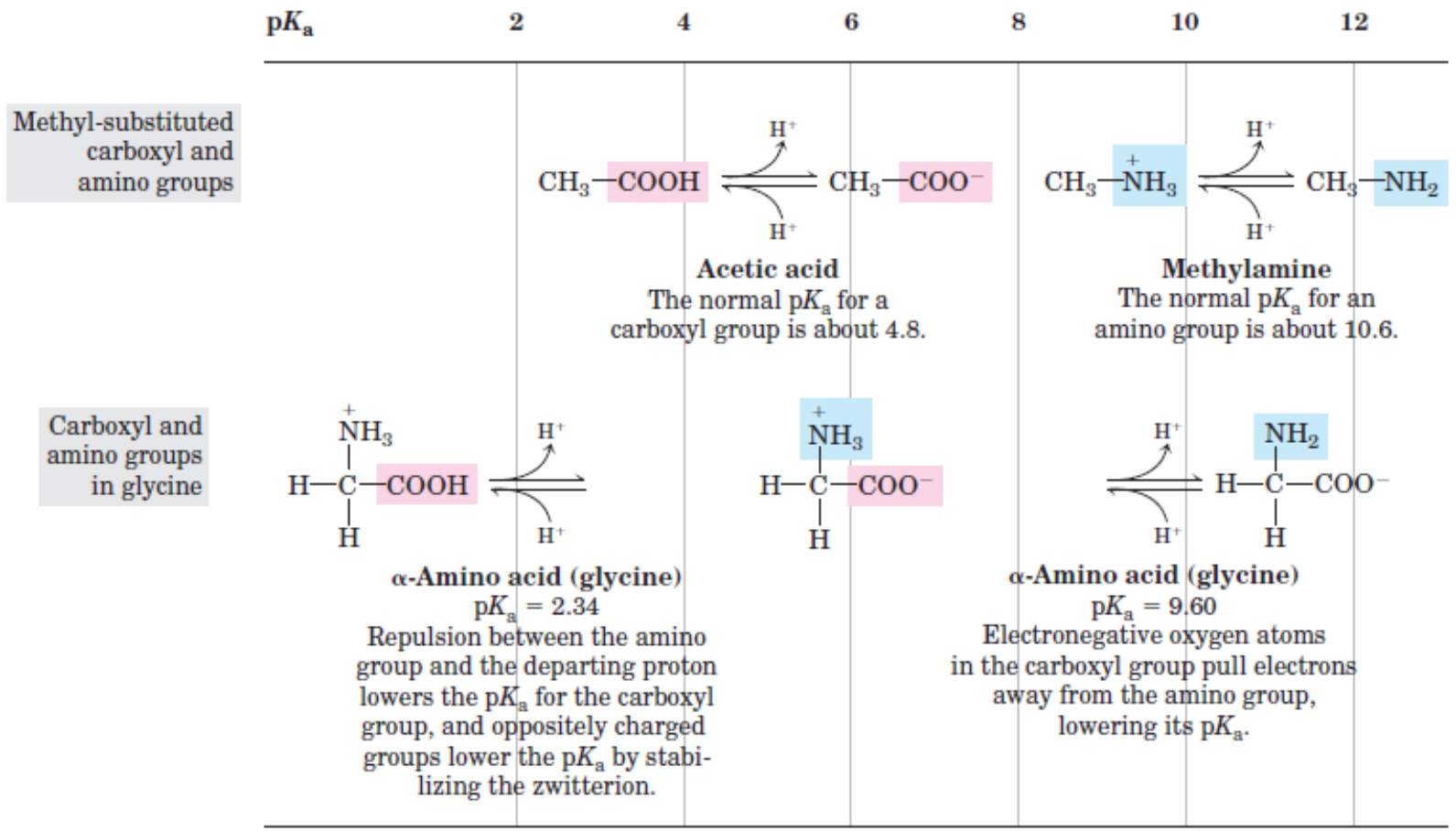

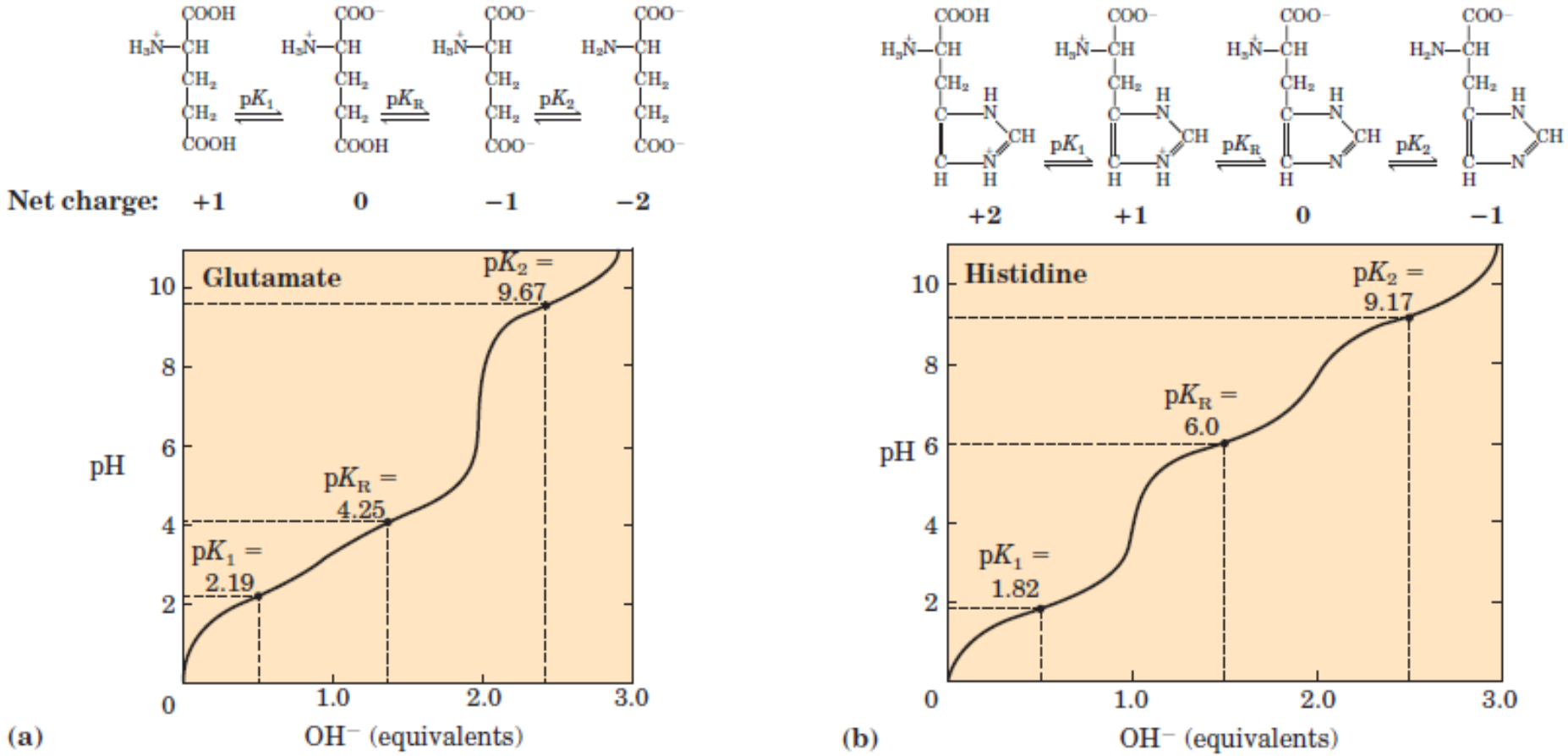

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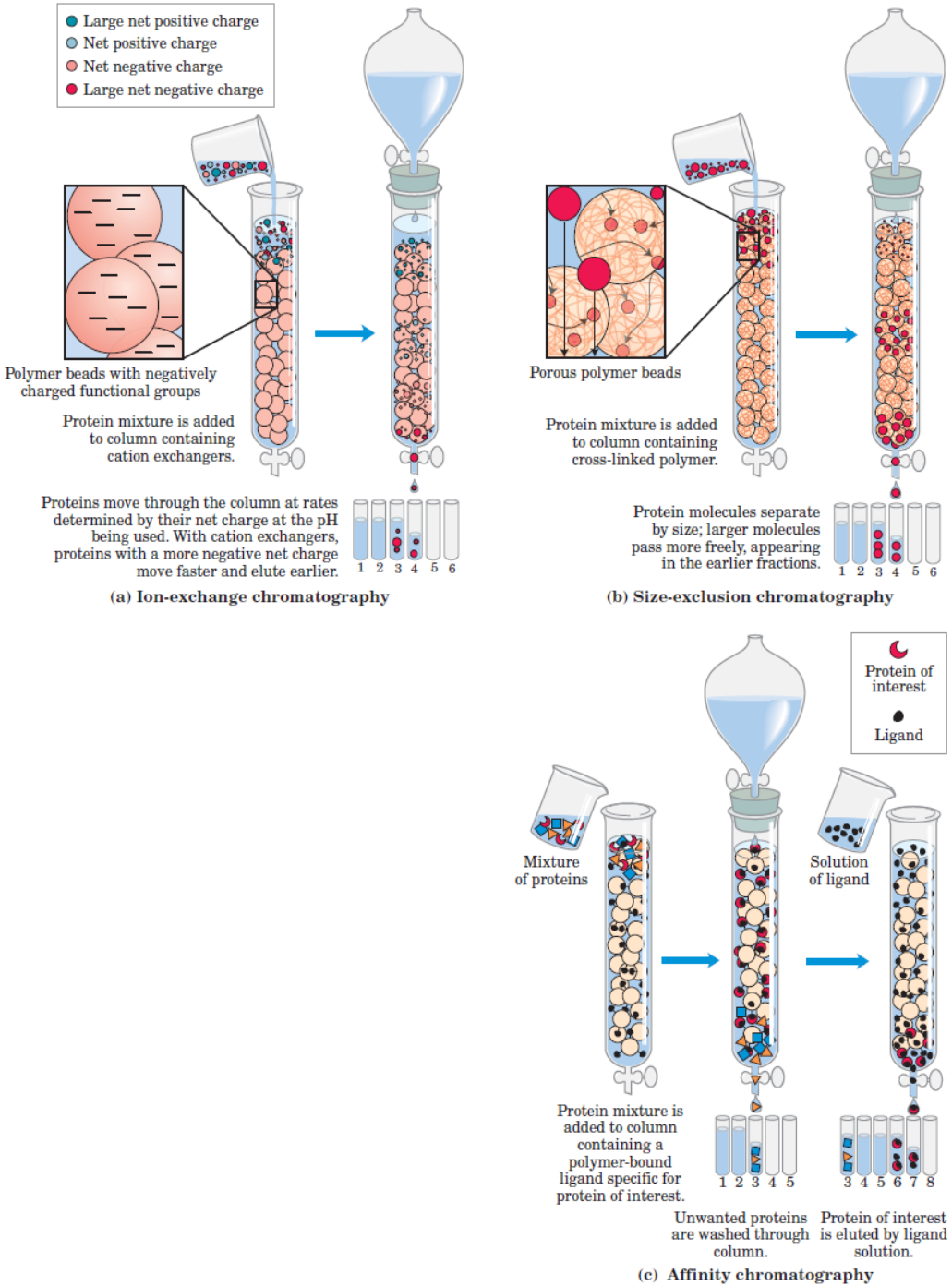

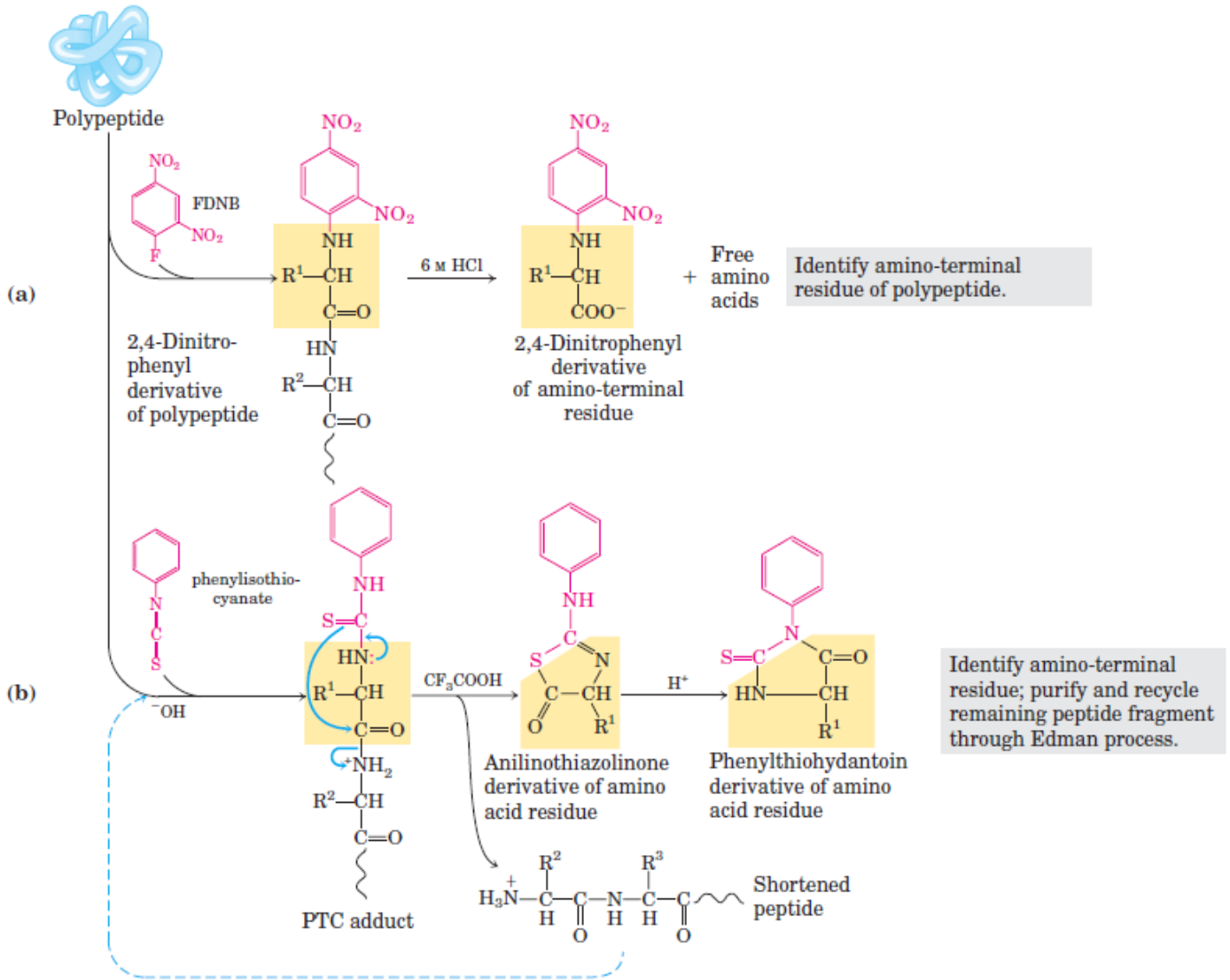

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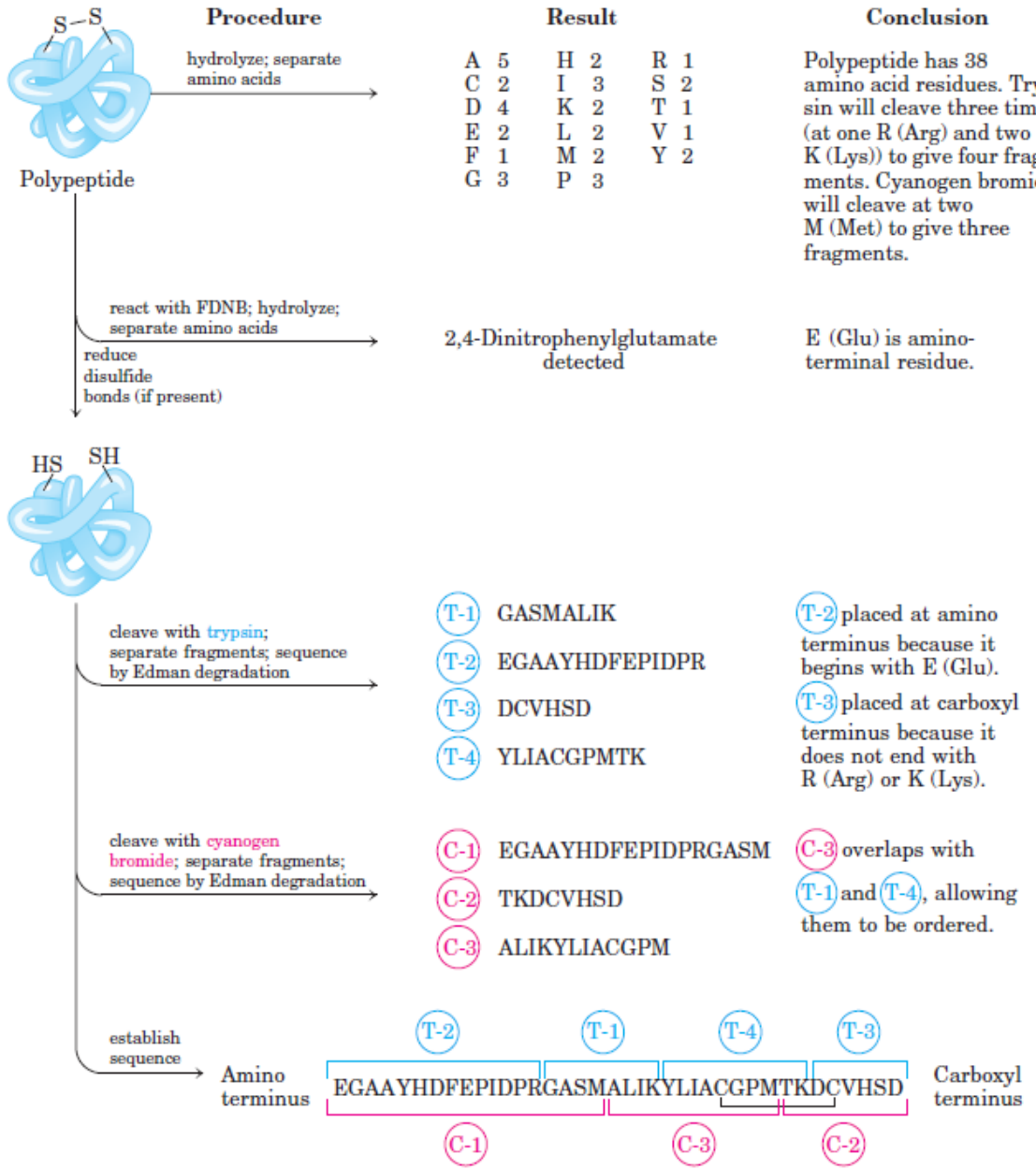

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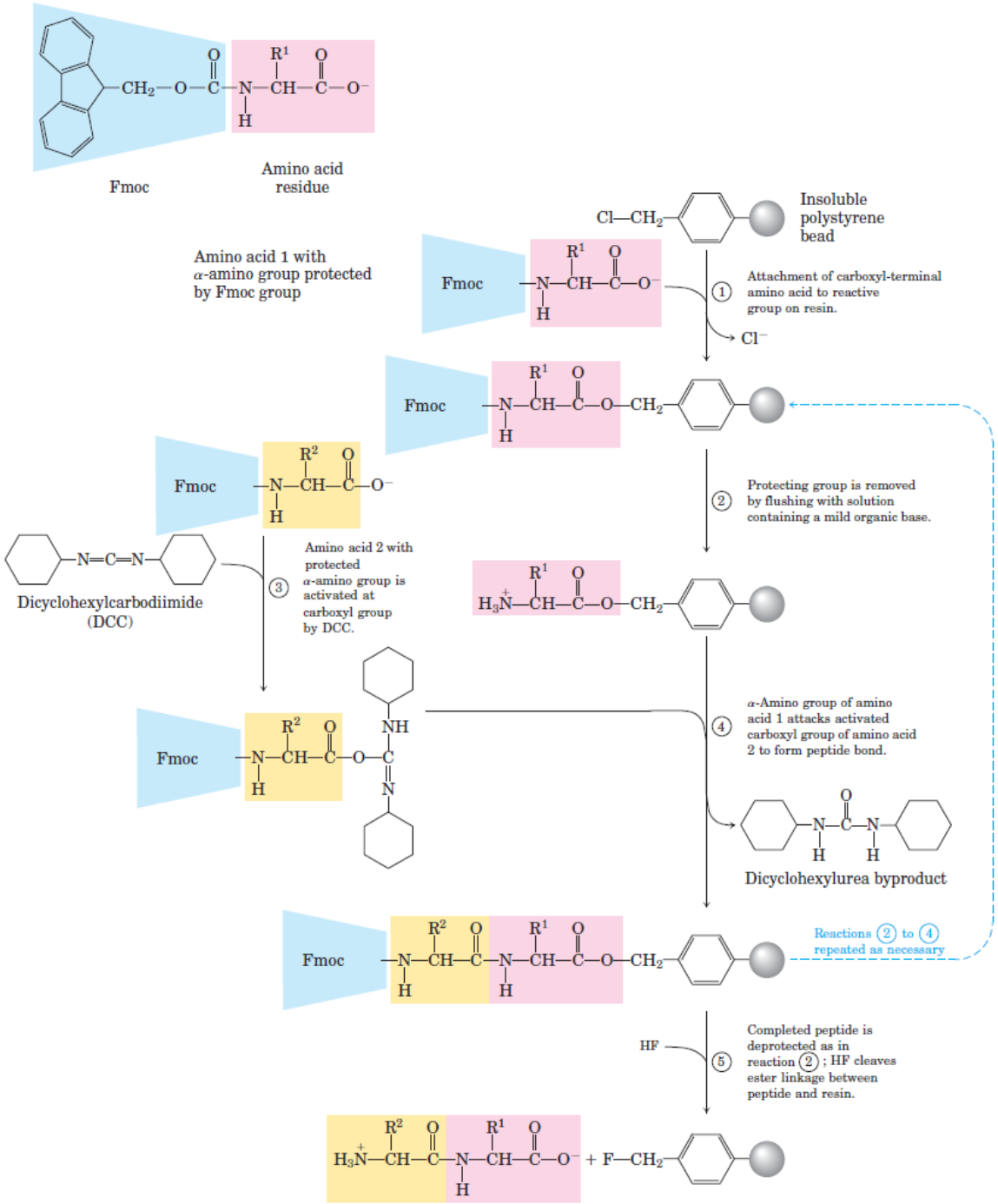

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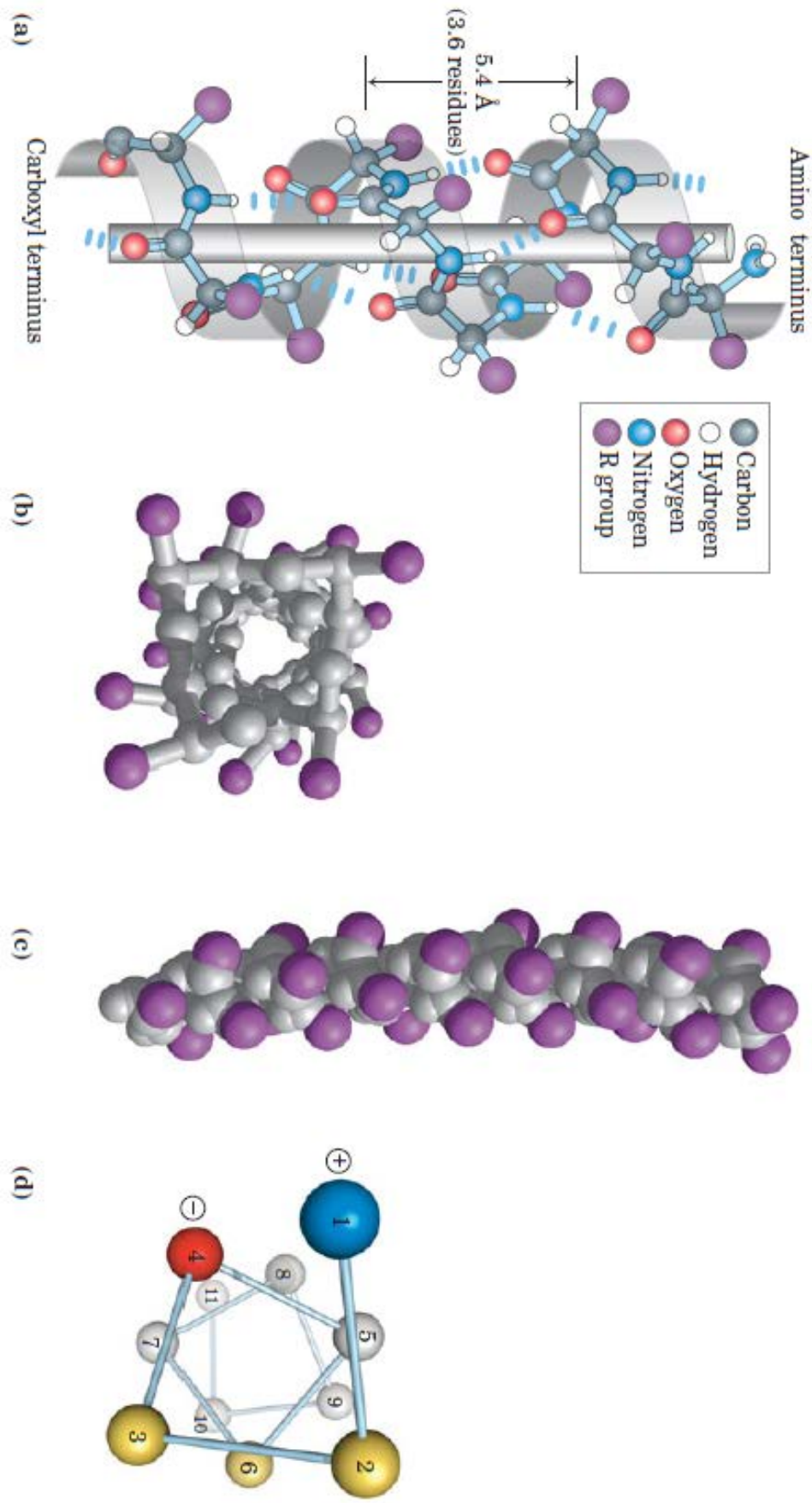

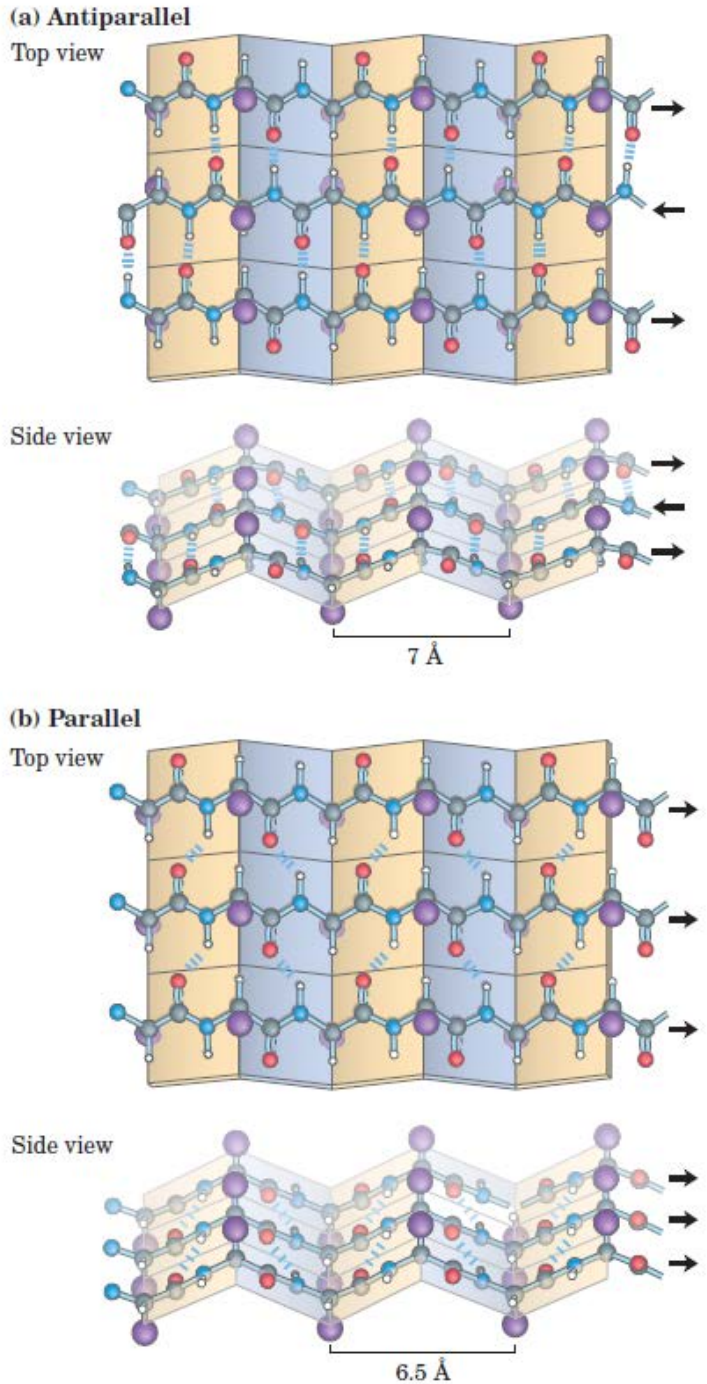

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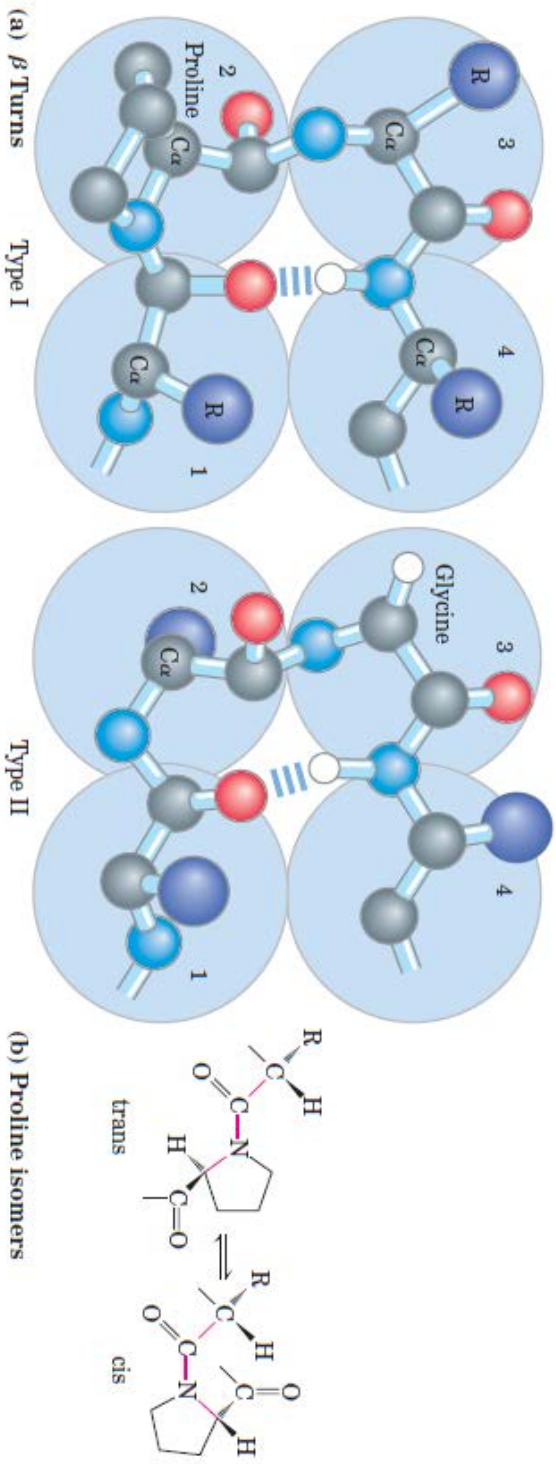

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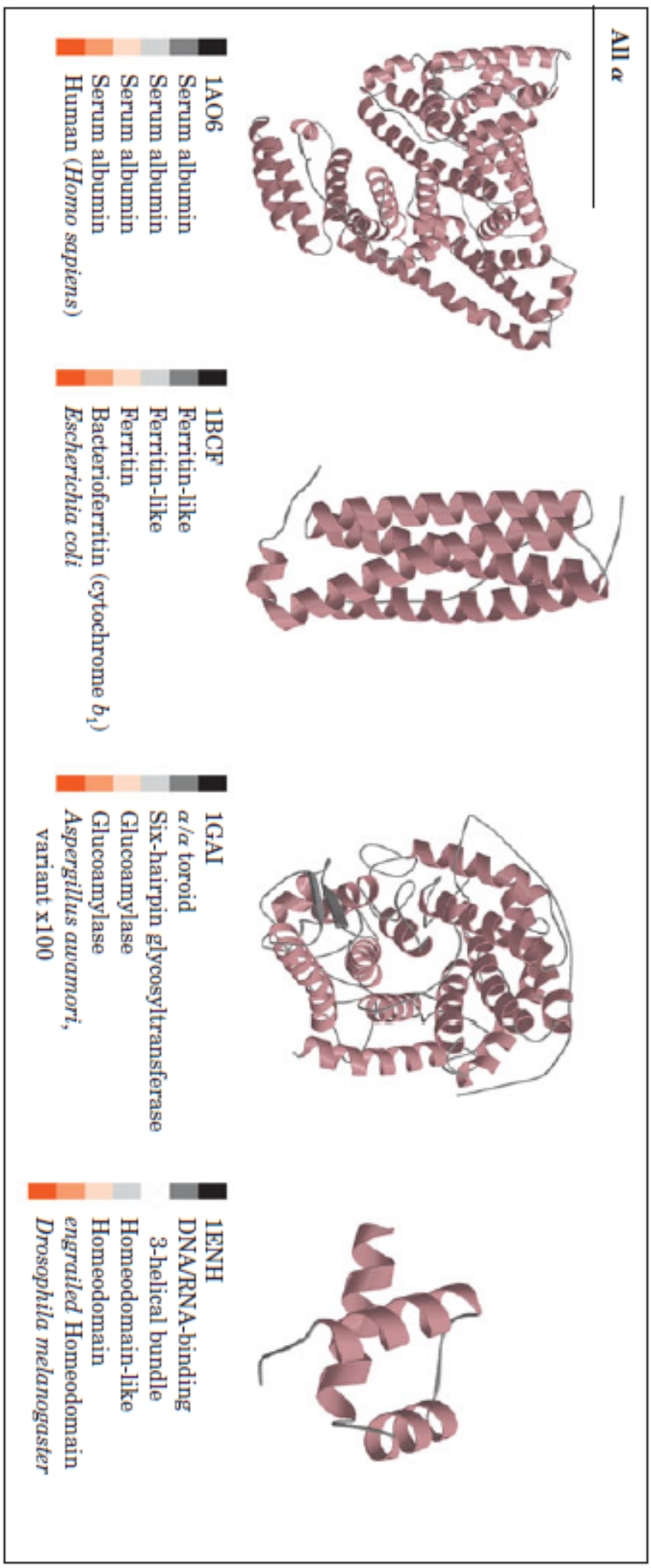

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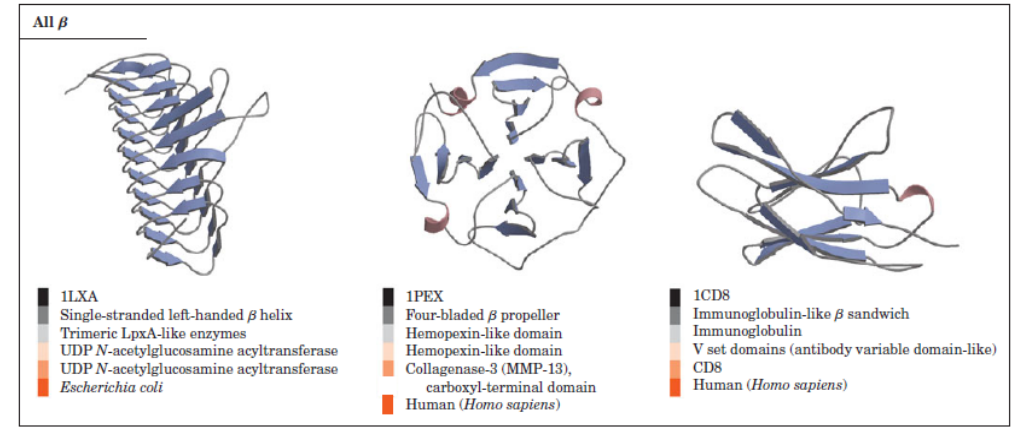
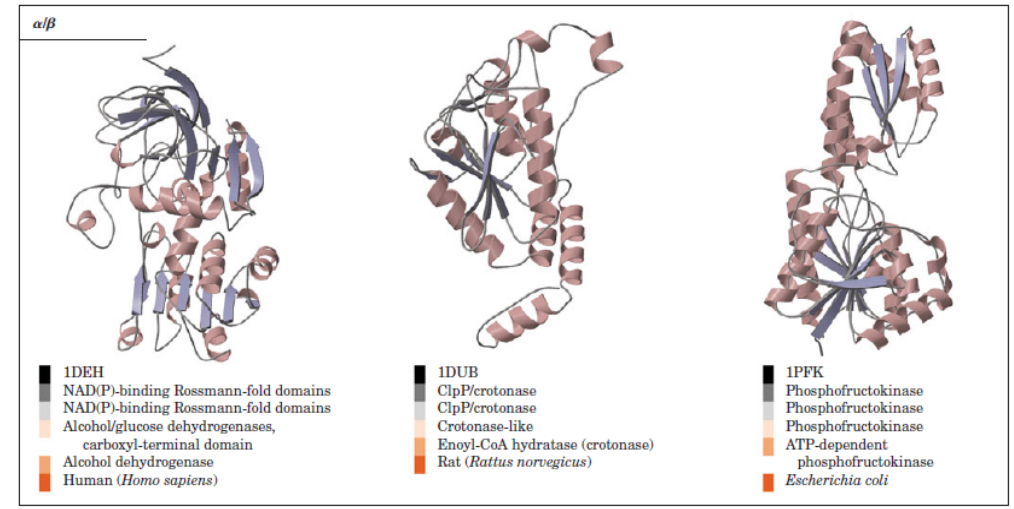
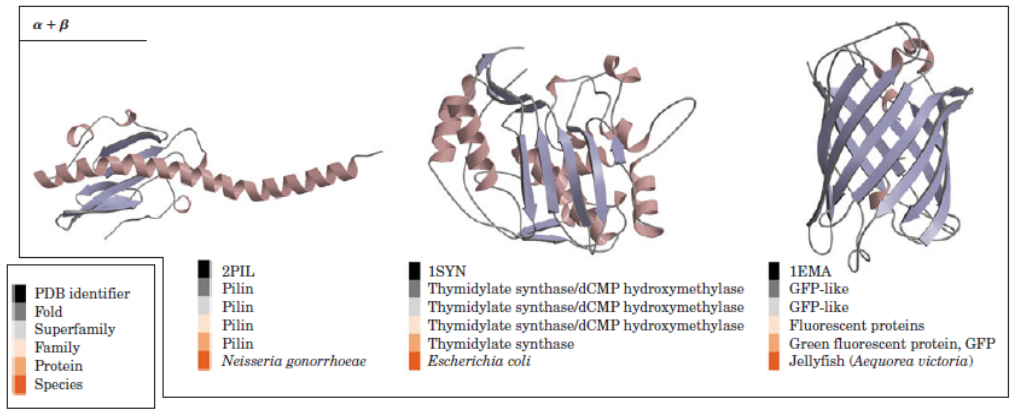
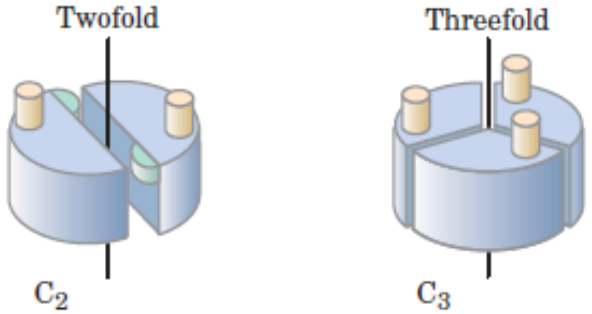
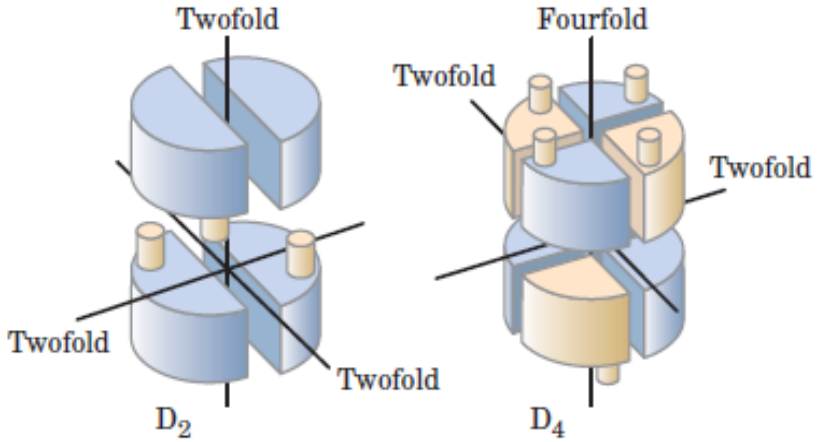








Two types of cyclic symmetry
(a)



Two types of dihedral symmetry
(b)

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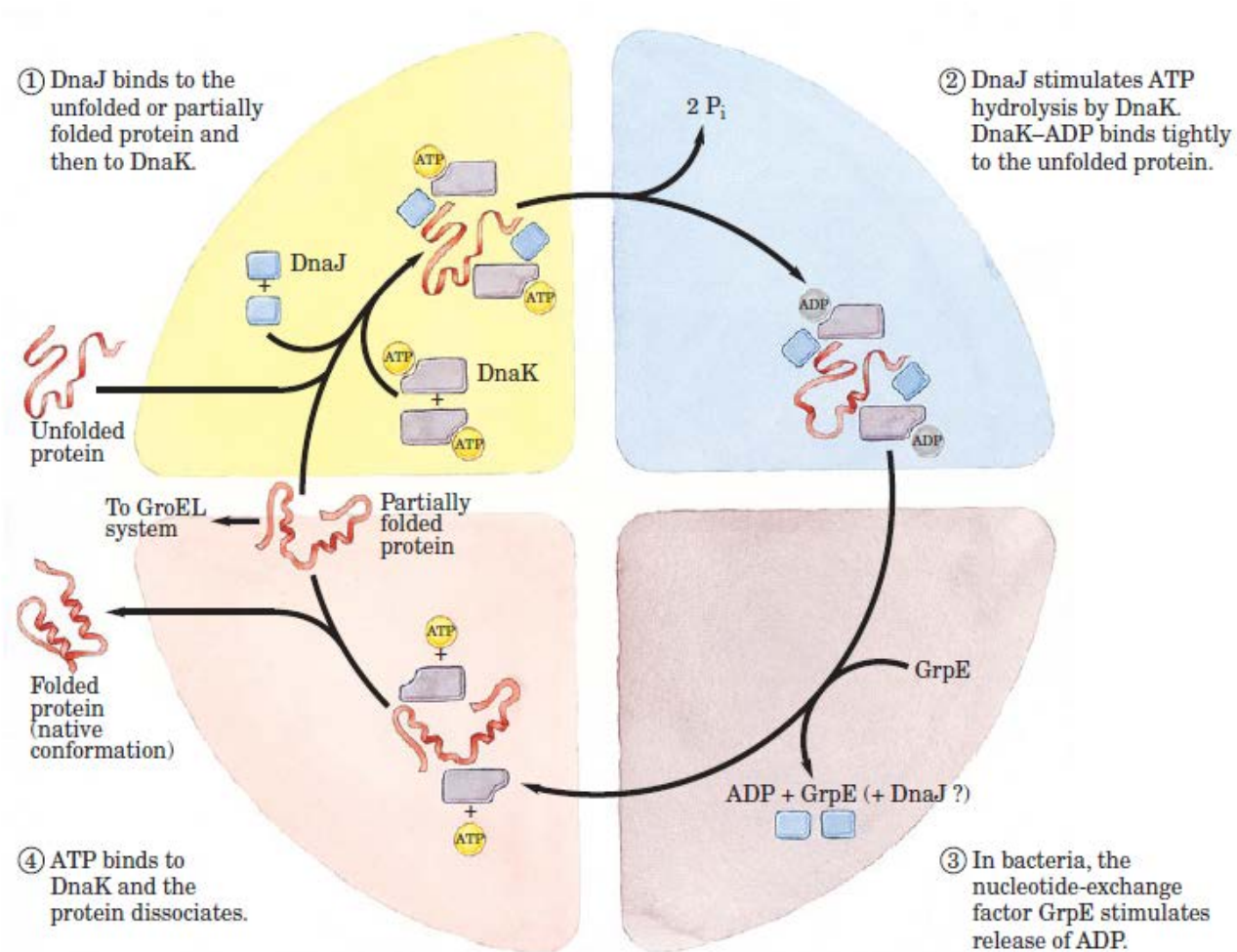

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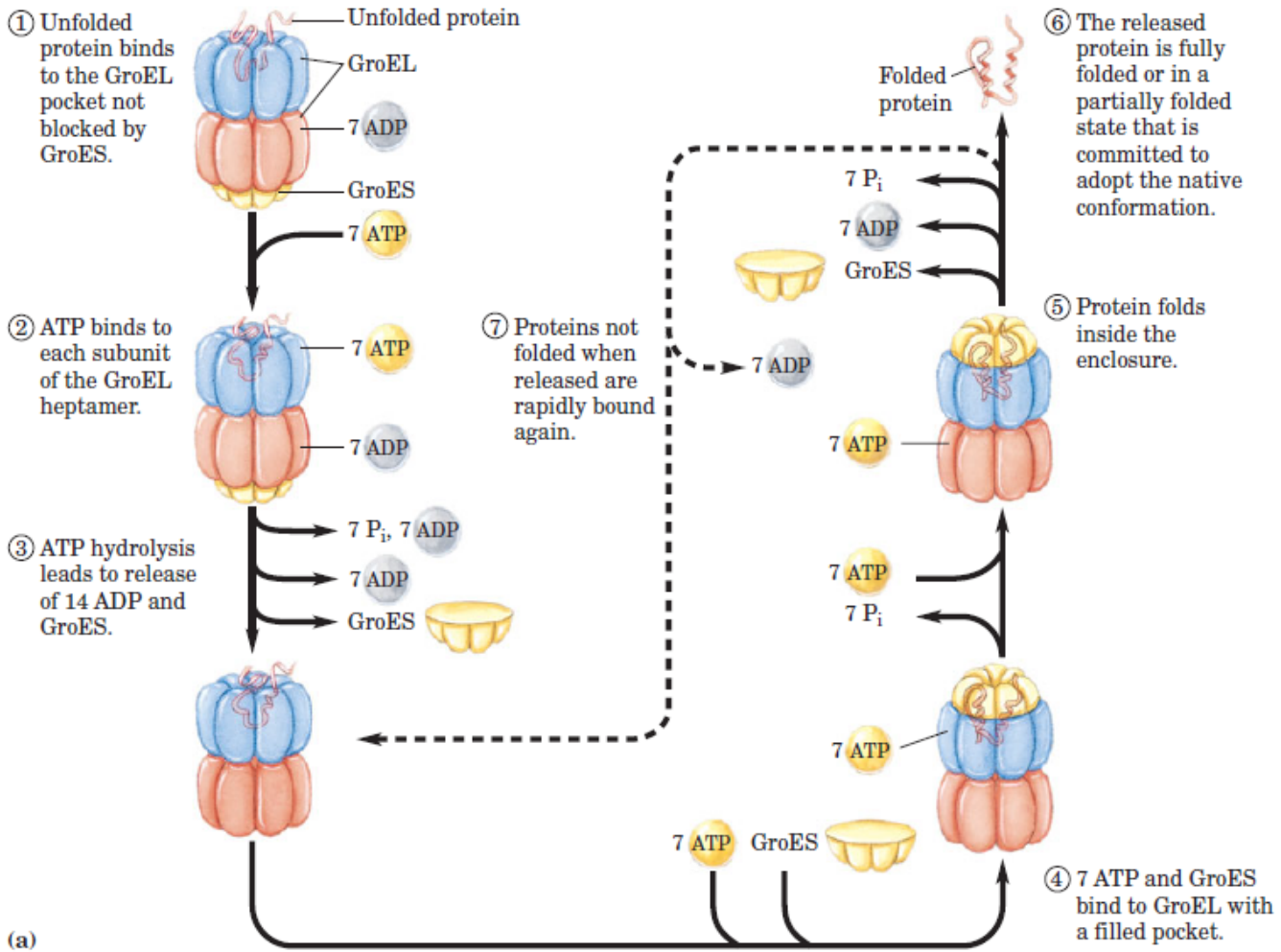

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