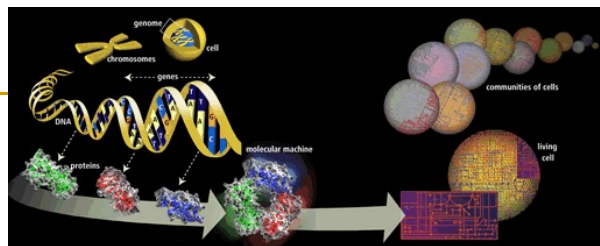
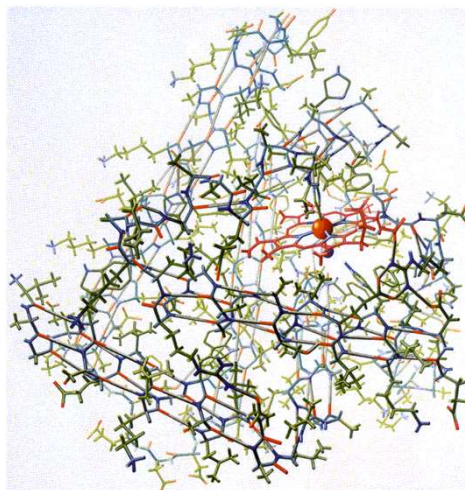


A Brief Introduction to Protein



3-D Structure of Myoglobin

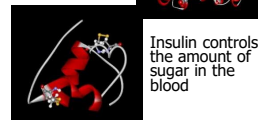
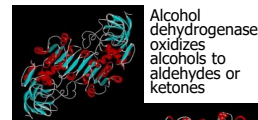


Protein Structure and Functions Part 1

Protein Structure and Functions Part 2

Proteins play key roles in a living system

- Beside the structural components of cell, here are three examples of protein functions
- Catalysis:** Almost all chemical reactions in a living cell are catalyzed by protein enzymes.
- Carrier and transport:** Some proteins transports various substances, such as oxygen, ions, and so on.
- Regulatory:** If/when a cell divides, which genes are expressed, etc



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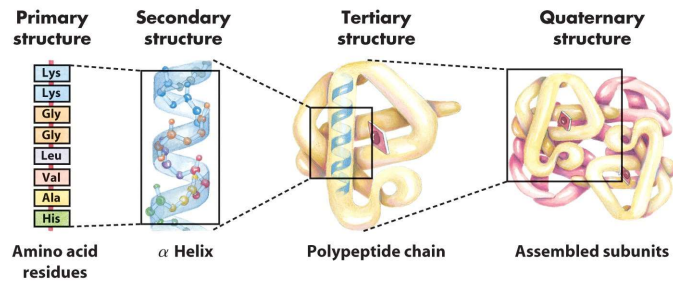
Levels of Protein Structure

- Primary Structure** - amino acid sequence in a polypeptide
- Secondary Structure** - local spatial arrangement of a polypeptide's backbone atoms (without regard to side chain conformation)
- Tertiary Structure** - three-dimensional structure of entire polypeptide
- Quaternary Structure** - spatial arrangement of subunits of proteins composed of multiple polypeptides (protein complexes)

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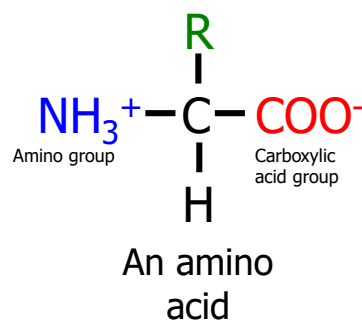
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Amino acid: Basic unit of protein

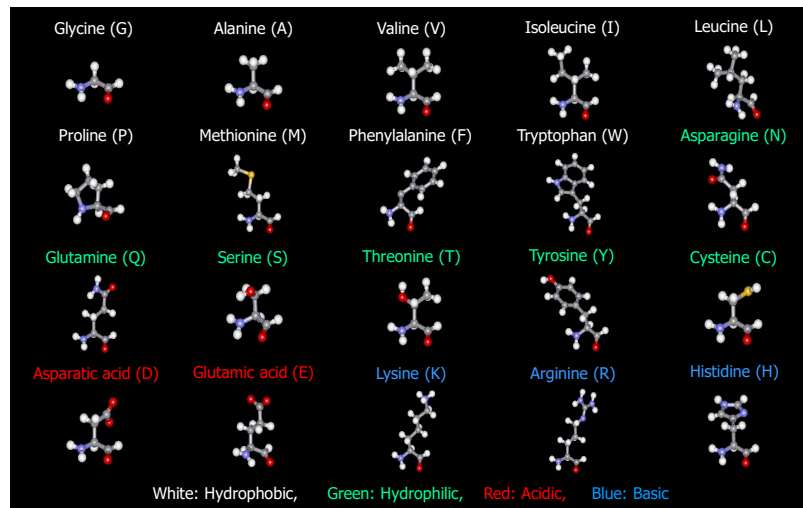


Different side chains, **R**, determine the properties of 20 amino acids.

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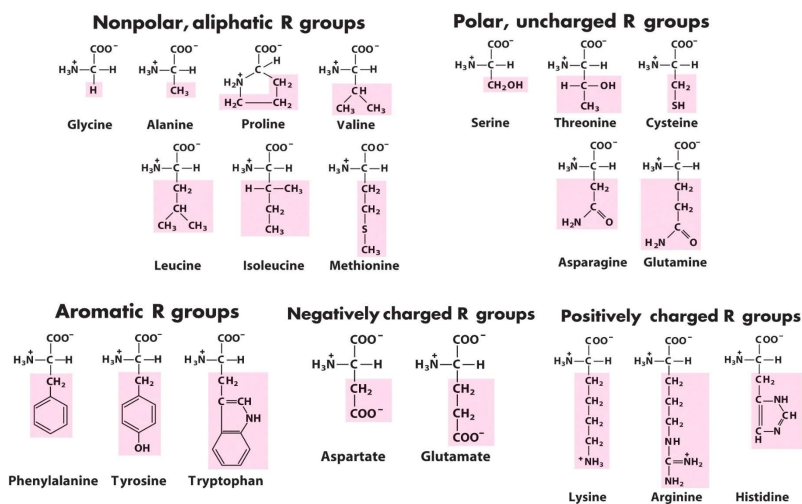
20 Amino acids



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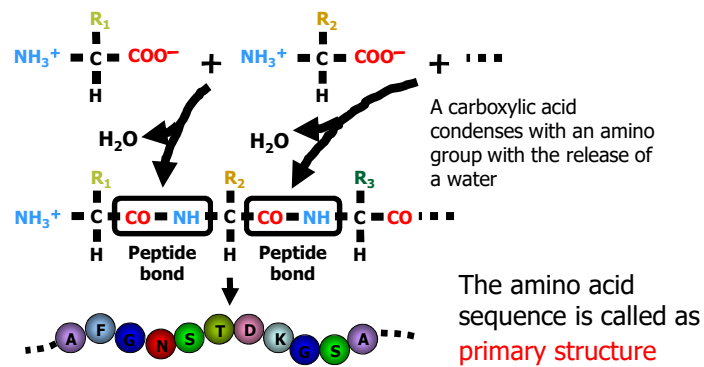
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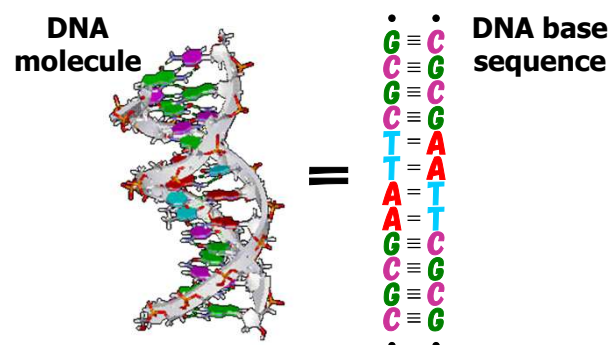
Proteins are linear polymers of amino acids



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Amino acid sequence is encoded by DNA base sequence in a gene



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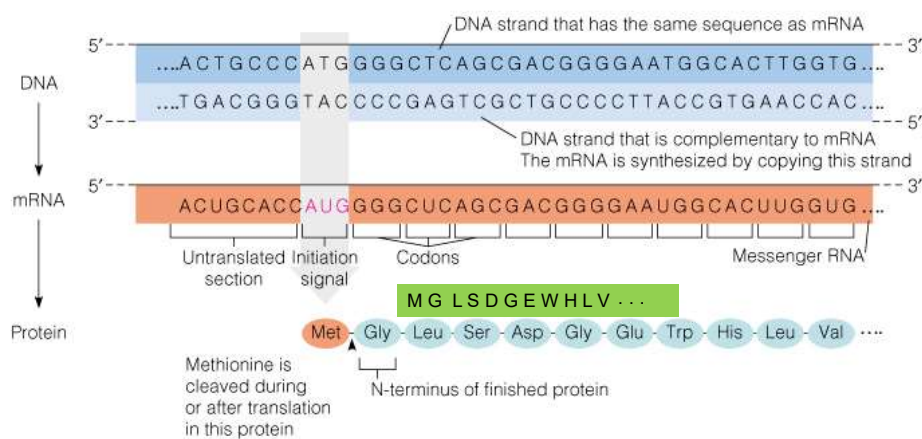
Amino acid sequence is encoded by DNA base sequence in a gene

		Second letter								
		T		C		A		G		
First letter	T	TTT	Phe (F)	TCT	Ser (S)	TAT	Tyr (Y)	TGT	Cys (C)	T
		TTC		TCC		TAC		TGC		C
		TTA	Leu (L)	TCA		TAA	Stop	TGA	Stop	A
		TTG		TCG		TAG		TGG	Trp (W)	G
	C	CTT	Leu (L)	CCT	Pro (P)	CAT	His (H)	CGT	Arg (R)	T
		CTC		CCC		CAC		CGC		C
		CTA		CCA		CAA	Gln (Q)	CGA		A
		CTG		CCG		CAG		CGG		G
	A	ATT	Ile (I)	ACT	Thr (T)	AAT	Asn (N)	AGT	Ser (S)	T
		ATC		ACC		AAC		AGC		C
		ATA		ACA		AAA	Lys (K)	AGA	Arg (R)	A
		ATG	Met (M)	ACG		AAG		AGG		G
	G	GTT	Val (V)	GCT	Ala (A)	GAT	Asp (D)	GGT	Gly (G)	T
		GTC		GCC		GAC		GGC		C
		GTA		GCA		GAA	Glu (E)	GGA		A
		GTG		GCG		GAG		GGG		G
		Third letter								

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DNA → RNA → Protein

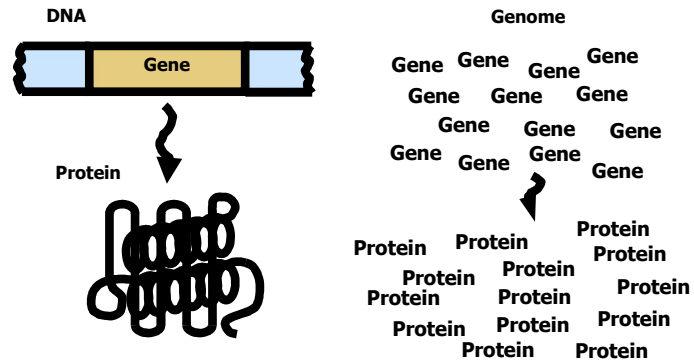


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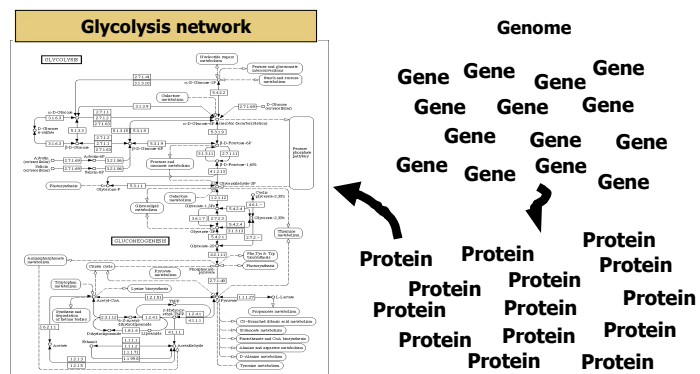
Gene is protein's blueprint, genome is life's blueprint



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Gene is protein's blueprint, genome is life's blueprint



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In 2003, Human genome sequence was deciphered!

- Genome is the complete set of genes of a living thing.
- In 2003, the human genome sequencing was completed.
- The human genome contains about 3 billion base pairs.
- The number of genes is estimated to be between 20,000 to 25,000.
- The difference between the genome of human and that of chimpanzee is only 1.23%!

3 billion base pair => 6 G letters
&
1 letter => 1 byte
The whole genome can be recorded in
just 10 CD-ROMs!



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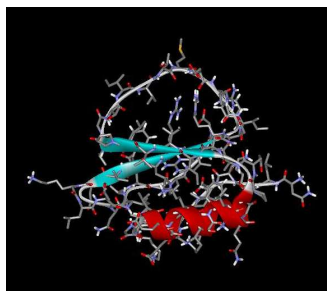
Each Protein has a unique structure

Amino acid sequence

NLKTEWPELVGKSVEE
AKKVILQDKPEAQIIVL
PVGITVTMEYRIDRVR
LFVDKLDNIAEVPRVG



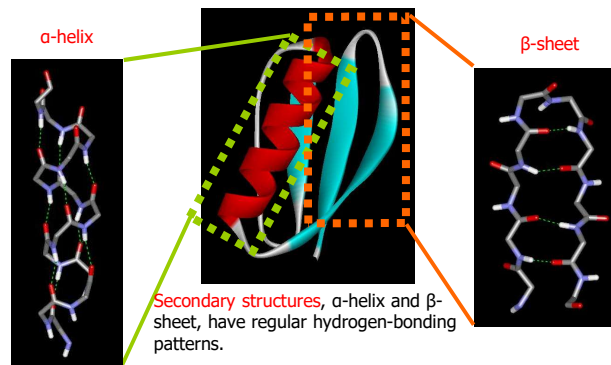
Folding!



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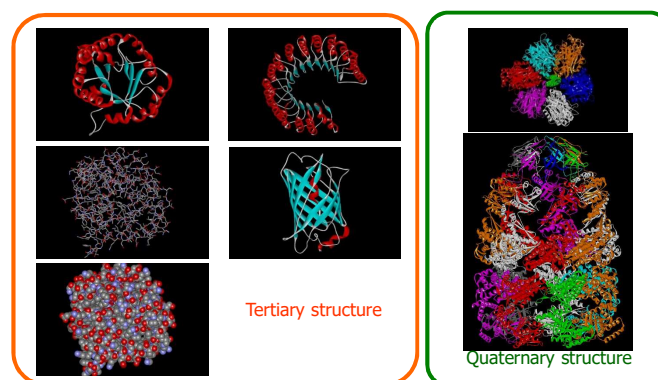
Basic structural units of proteins: Secondary structure



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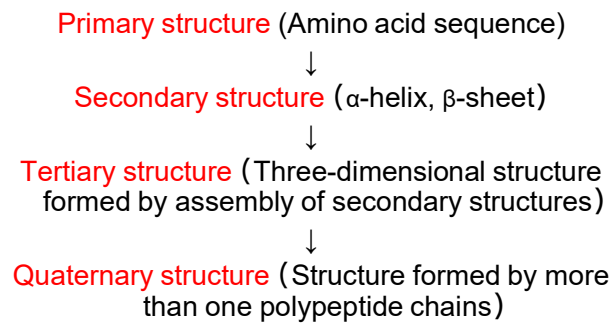
Three-dimensional structure of proteins



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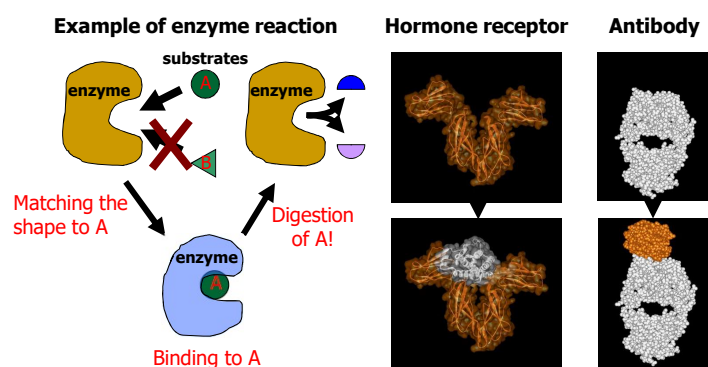
Hierarchical nature of protein structure



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Close relationship between protein structure and its function



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Summary

How are Proteins Made – Transcription and Translation

- Proteins are key players in our living systems.
- Proteins are polymers consisting of 20 kinds of amino acids.
- Each protein folds into a unique three-dimensional structure defined by its amino acid sequence.
- Protein structure has a hierarchical nature.
- Protein structure is closely related to its function.
- Protein structure prediction is a grand challenge of computational biology.