

Introduction to Biology

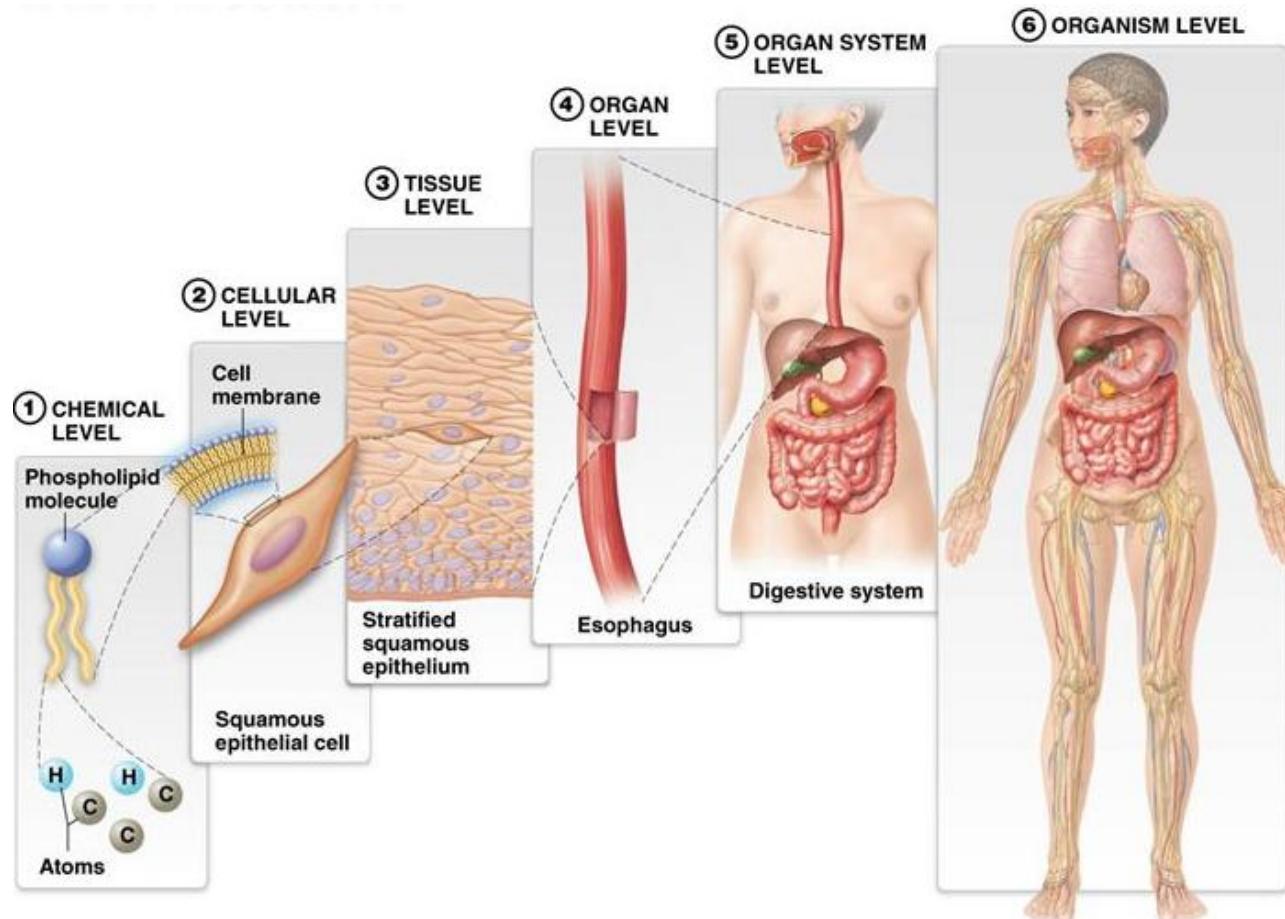


INDRAPRASTHA INSTITUTE of
INFORMATION TECHNOLOGY **DELHI**

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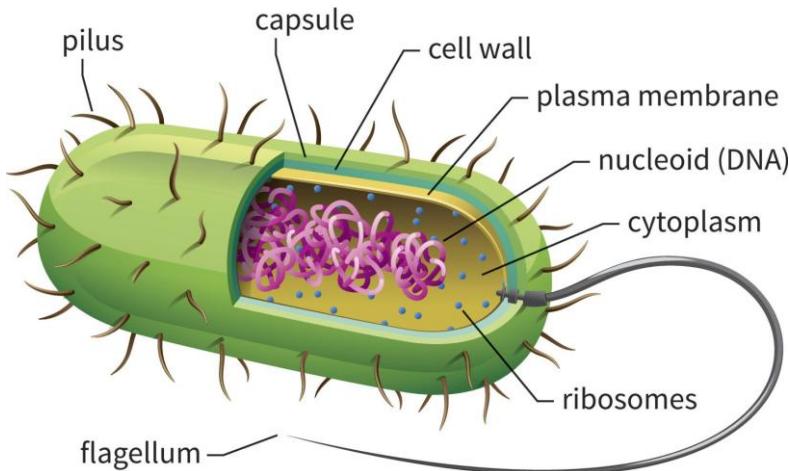
August 12, 2025

Structural organization of human body

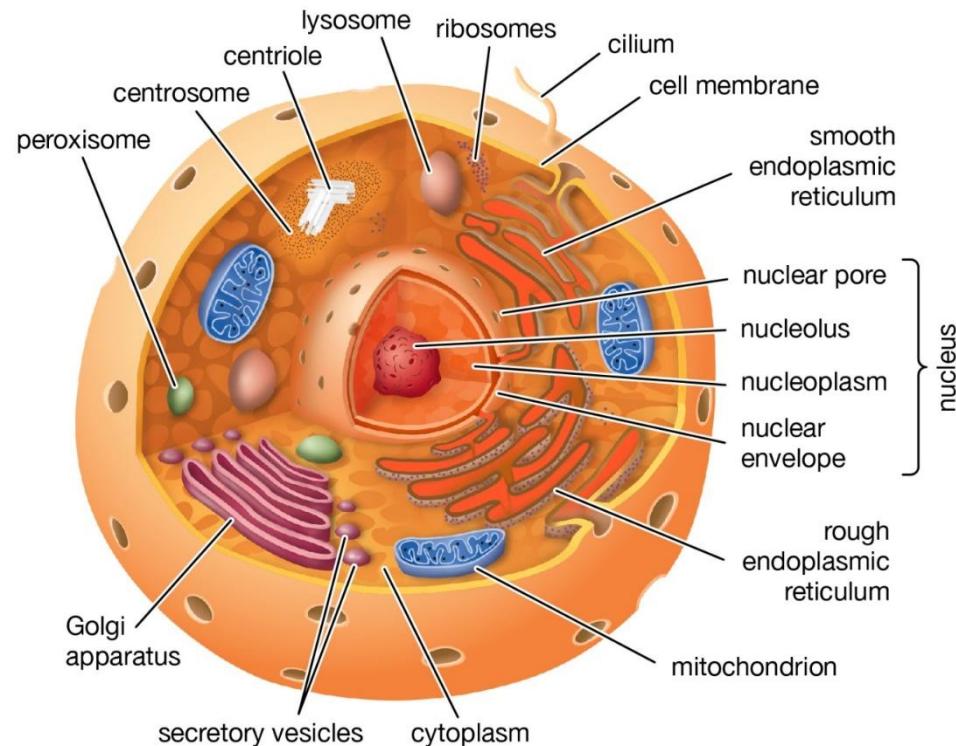


Types of cells

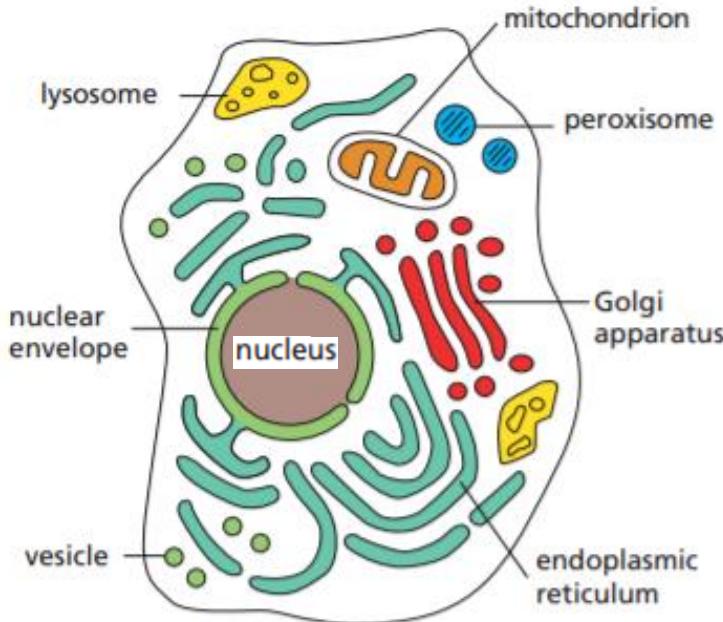
Prokaryotic cell



Eukaryotic cell



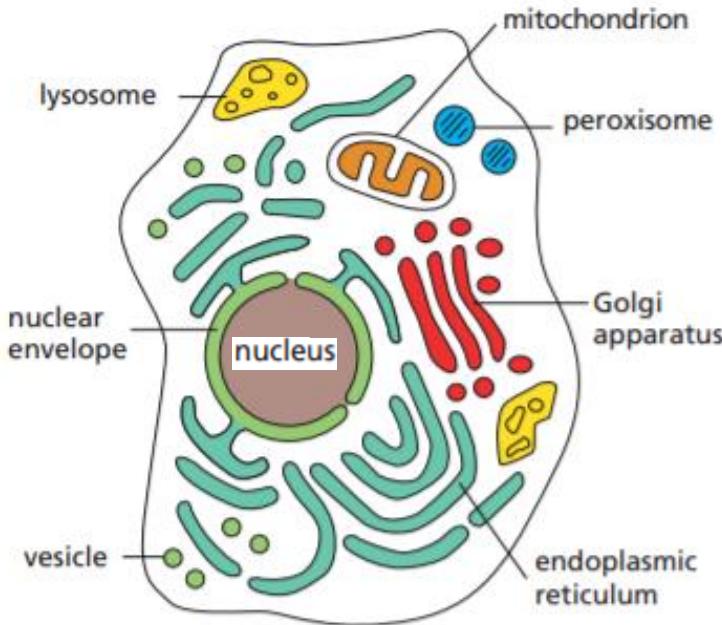
Cell structure



Nucleus

- Most prominent organelle in a eukaryotic cell
- Enclosed within nuclear envelope
- Contains DNA, the genetic information of the organism

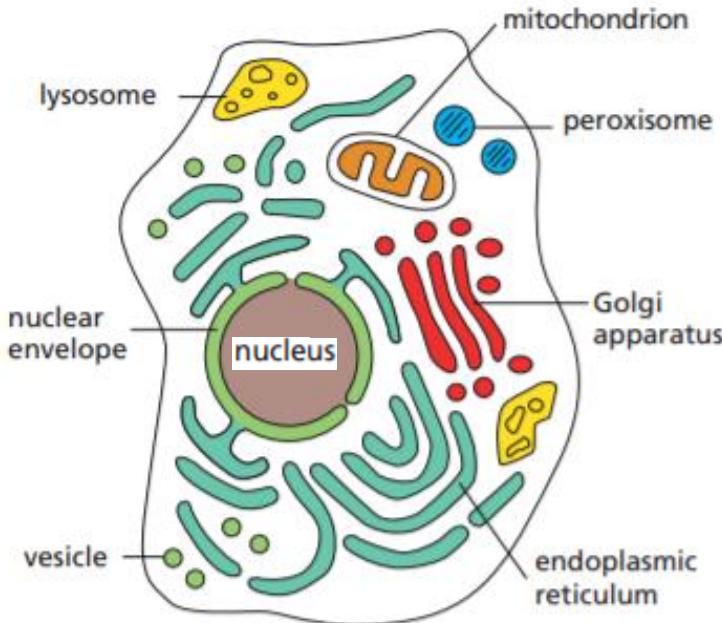
Cell structure



Mitochondria

- Double membraned organelle
- The inner membrane of the mitochondrion folds inwards, forming the cristae
- Generate chemical energy for the cell in the form of adenosine triphosphate, or ATP
- Consumes oxygen and releases carbon dioxide, therefore process is cellular respiration
- Contain their own DNA and reproduce by dividing in two

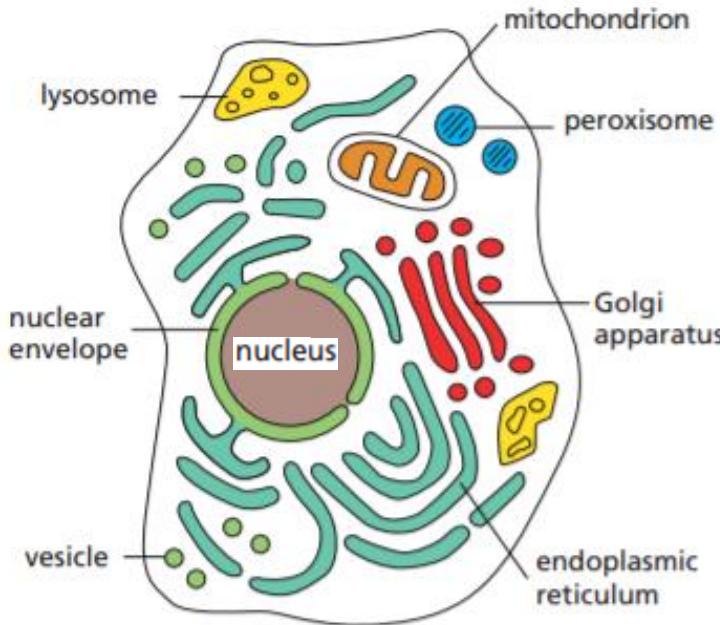
Cell structure



Endoplasmic reticulum

- It is an irregular maze of interconnected spaces enclosed by a membrane
- Enormously enlarged in cells
- Specialized for the secretion of proteins
- Site for preparation of cell-membrane components and other material for export

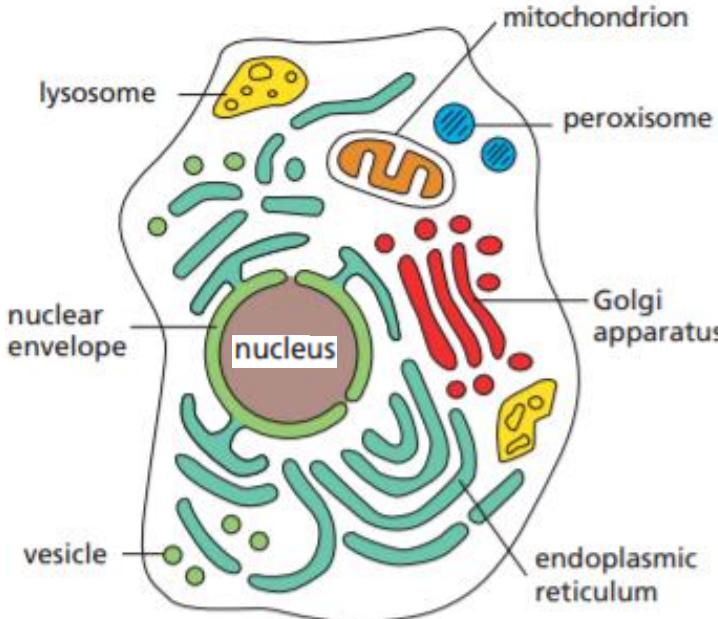
Cell structure



Golgi apparatus

- Stacks of flattened, membrane-enclosed sacs
- Modifies and packages molecules made in the endoplasmic reticulum that are destined to be either secreted from the cell or transported to another cell compartment

Cell structure



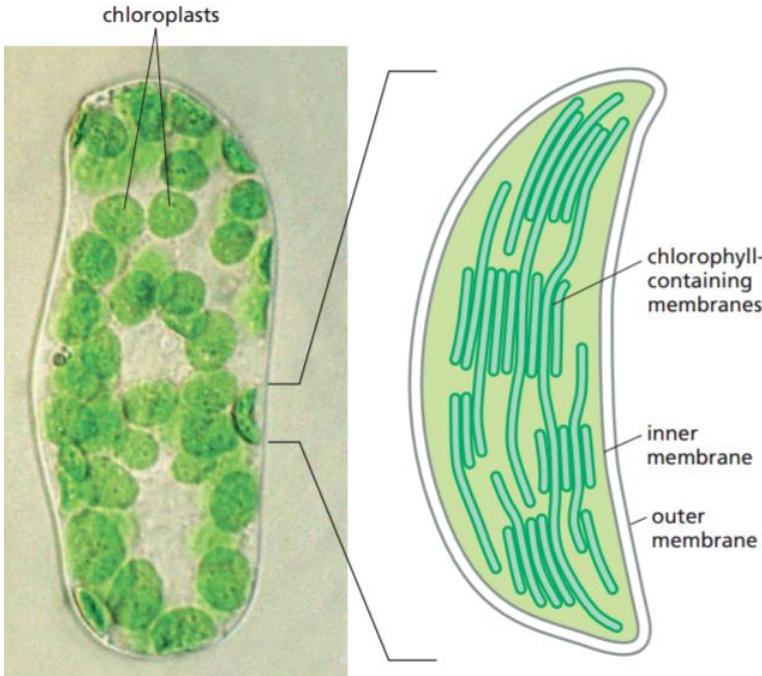
Lysosomes

- Small sac-like structures derived from Golgi complex
- Contains digestive enzymes to digest and destroy foreign particles
- May burst open digesting the contents of the cell
- Also called the 'suicide bag of the cell'

Peroxisomes

- Small, membrane-enclosed vesicles
- Provide a safe environment for a variety of reactions in which hydrogen peroxide is used to inactivate toxic molecules.

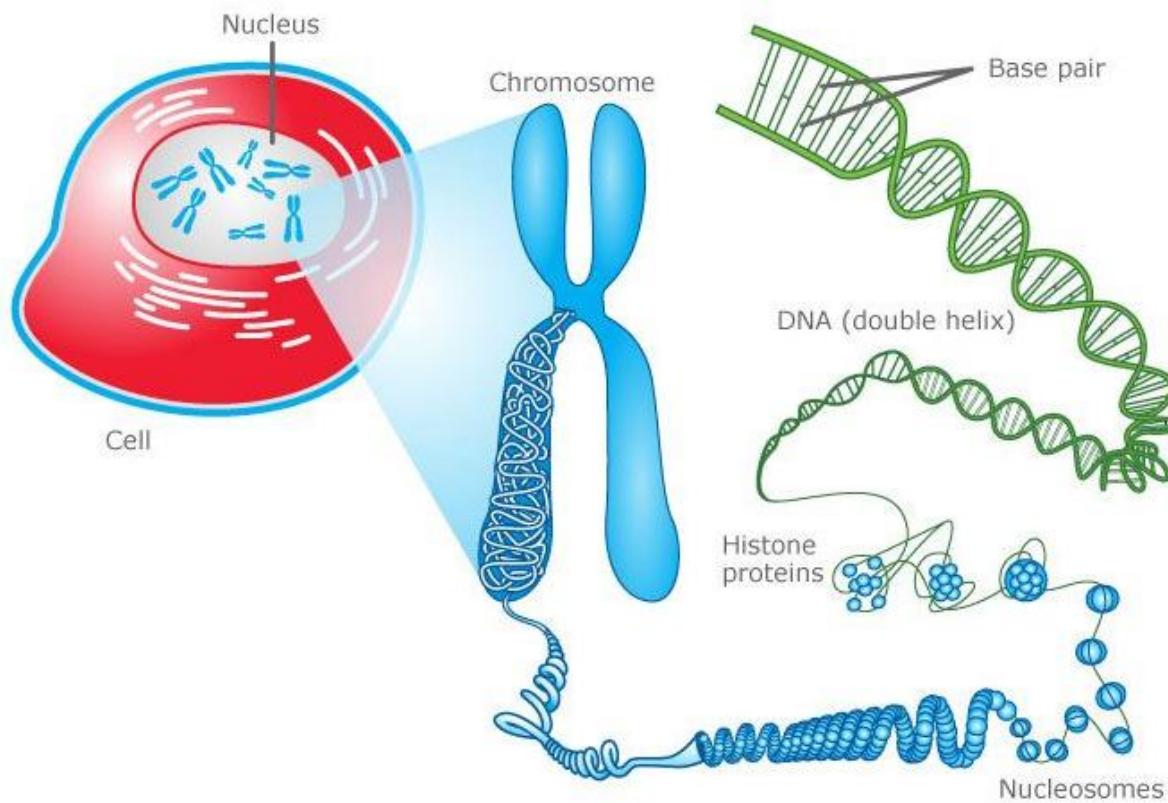
Cell structure



Chloroplast

- Large, green organelles found only in the cells of plants and algae, not in the cells of animals or fungi
- Double membraned organelle
- Possess internal stacks of membranes containing the green pigment chlorophyll, which helps in the process of photosynthesis
- Energy of sunlight is used to drive the manufacture of energy-rich sugar molecules, oxygen is released as a molecular by-product
- Oxidizing these sugars in mitochondria, plants can derive energy when needed
- Contain their own DNA and reproduce by dividing in two

The genome is our Genetic Blueprint



Nearly every human cell contains 23 pairs of chromosomes

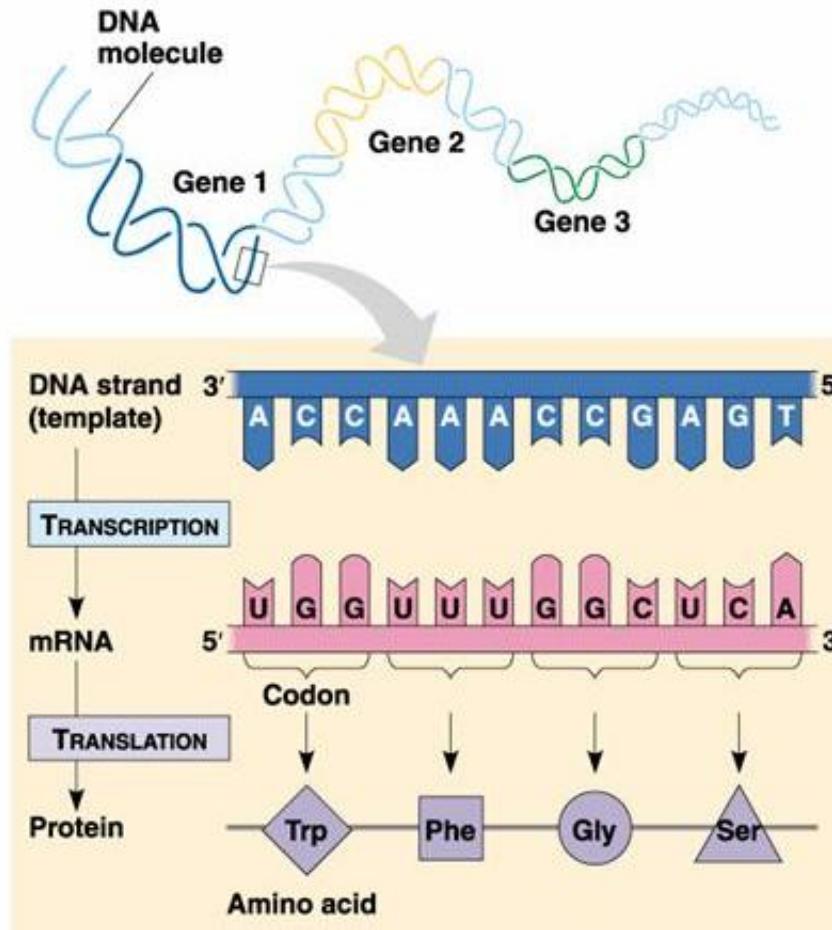
- 1 - 22 and XY or XX
- XY = Male
- XX = Female

Length of chr 1-22, X, Y together is ~3.2 billion bases (about 2 meters diploid)

Genome size of important species

<i>Organism</i>	<i>Chromosomes</i>	<i>base pairs</i>
Bacteriophage λ (virus)	1	5×10^4
<i>Escherichia Coli</i>	1	5×10^6
<i>Saccharomyces cerevisiae</i> (yeast)	32	1×10^7
<i>Caenorhabditis elegans</i> (worm)	12	5×10^8
<i>Drosophila melanogaster</i> (fruit fly)	8	2×10^8
<i>Homo sapiens</i> (human)	46	3×10^9

Major molecules: DNA, RNA, Proteins

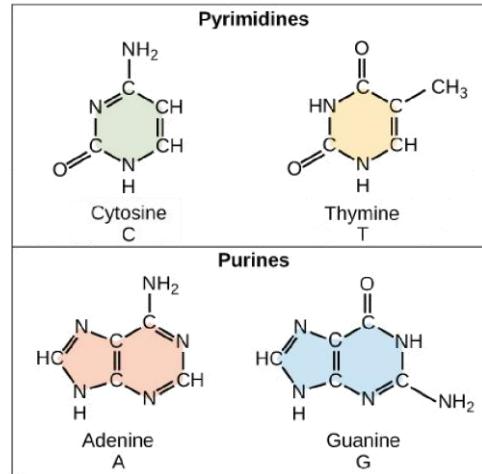


Central Dogma

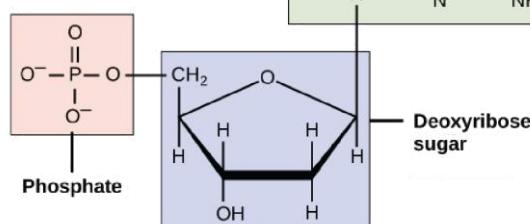
DNA → RNA → Protein

- Every cell contains the same DNA
- Cells differ in the DNA (gene) which is active at any one time
- Genes - DNA sequences that encode proteins or RNA

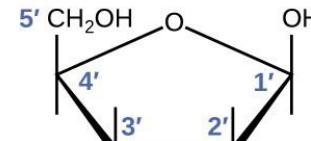
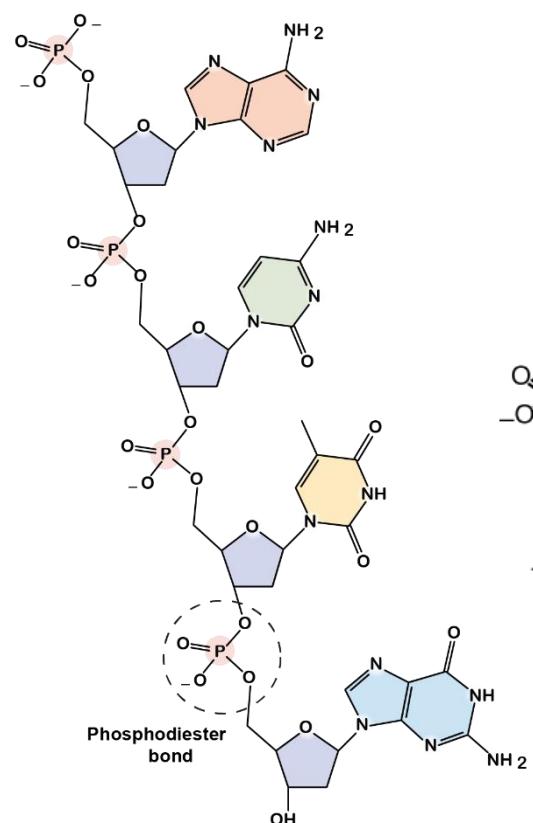
Nucleotides, the building blocks of DNA



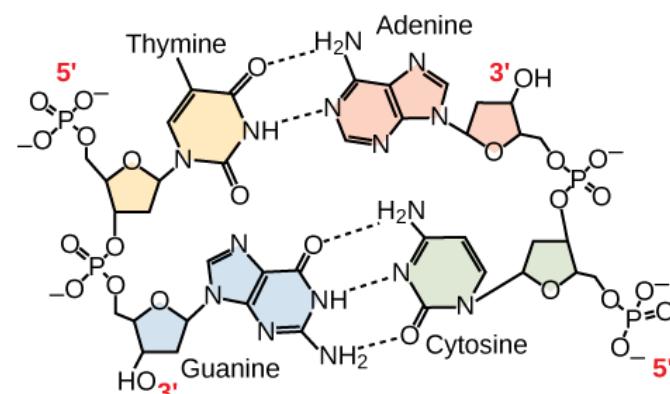
Nucleotide



Single strand of DNA



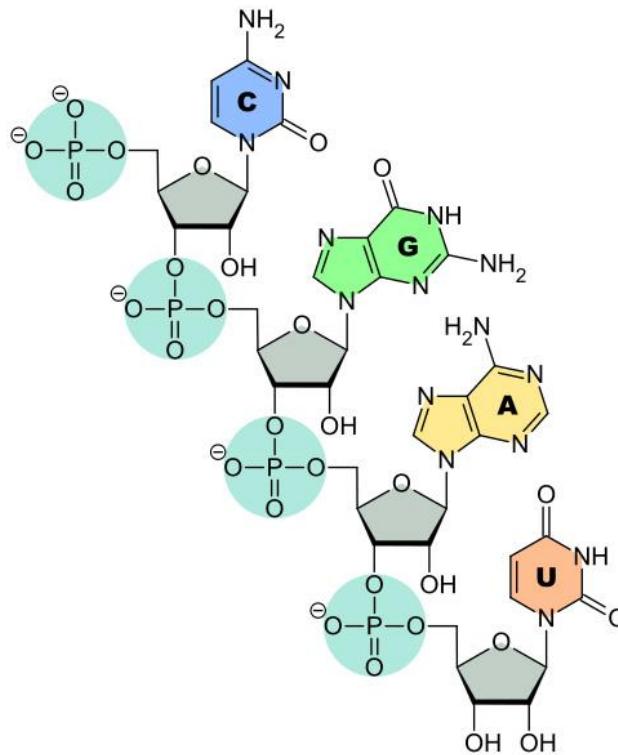
deoxyribose (in DNA)



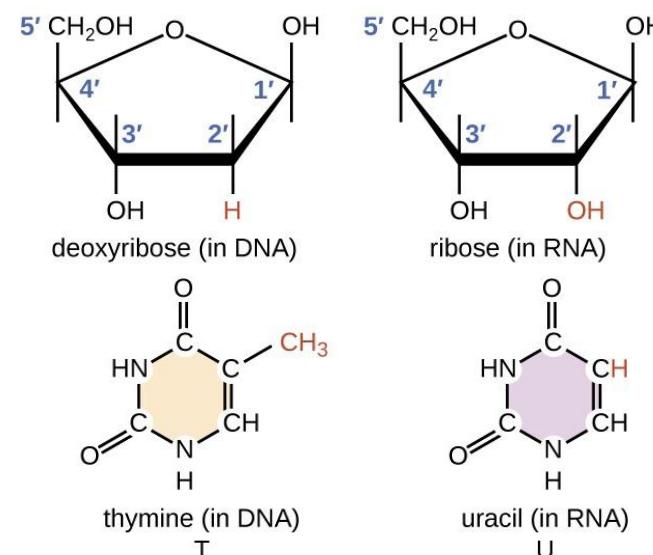
Double stranded DNA

Nucleotides, the building blocks of RNA

Structure of RNA



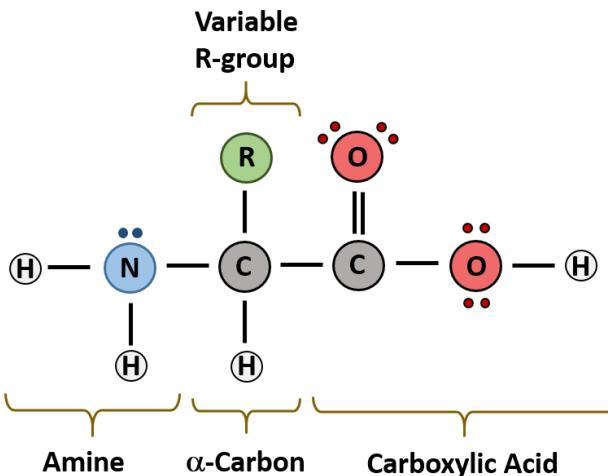
Differences between DNA and RNA



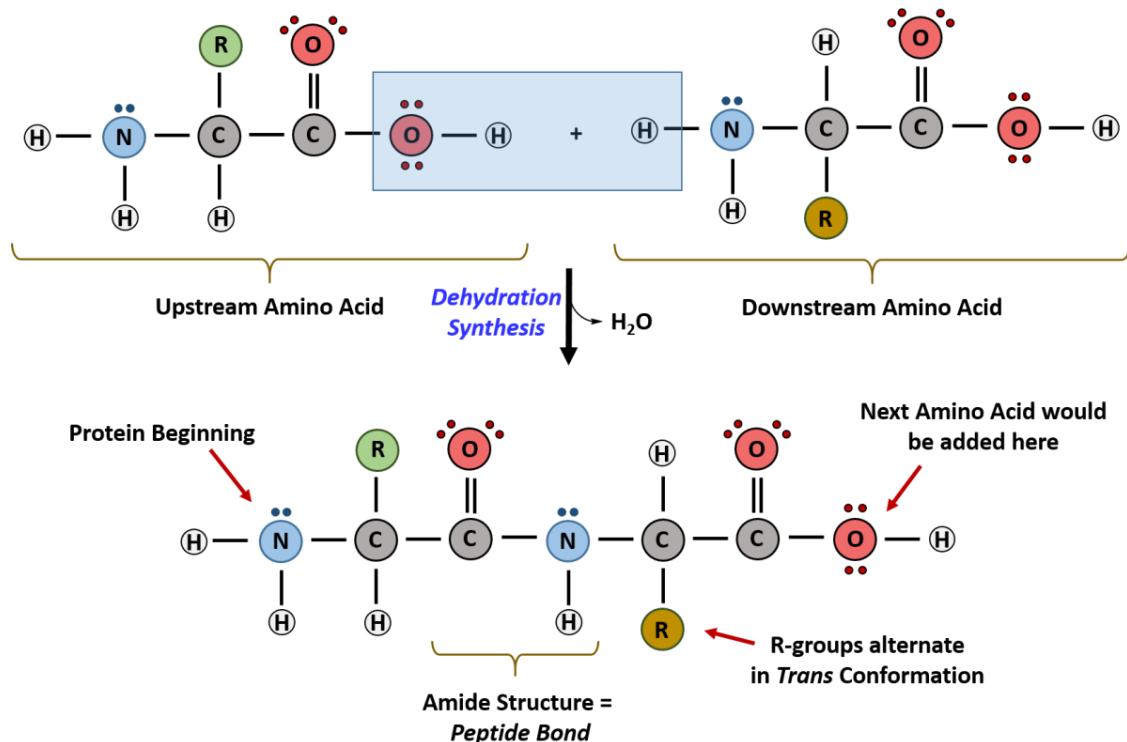
Major types of RNA:
messenger RNA (mRNA),
ribosomal RNA (rRNA), transfer RNA (tRNA),
regulatory RNAs (miRNA, siRNA)

Amino acids, the building blocks of protein

Basic structure of an amino acid

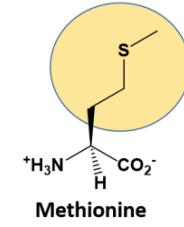
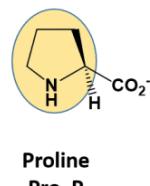
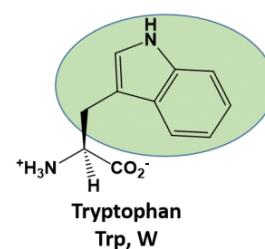
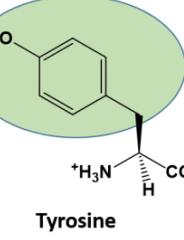
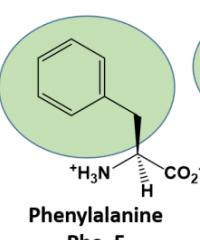
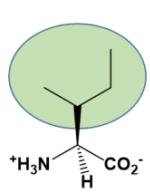
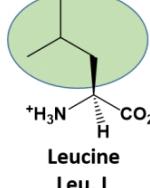
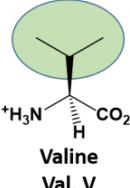
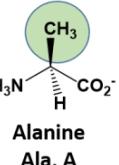
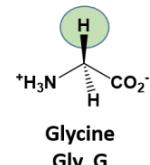


Formation of peptide bond

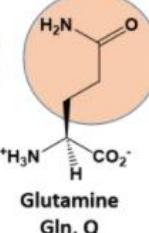
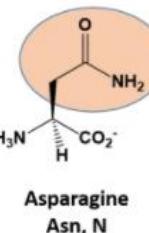
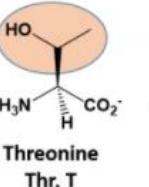
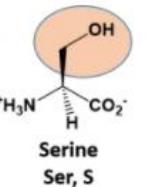
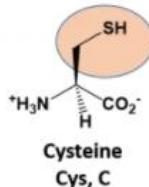


Different types of Amino acids

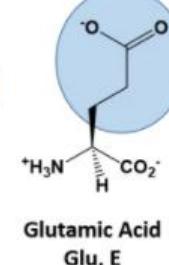
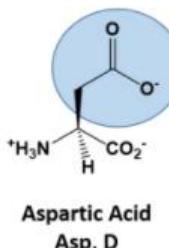
Nonpolar (Hydrophobic) Amino Acids



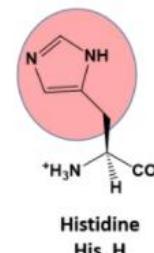
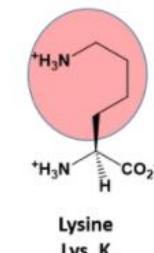
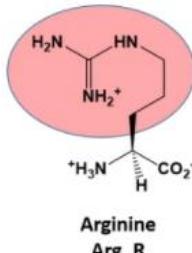
Polar (Hydrophilic) Amino Acids



Acidic Amino Acids

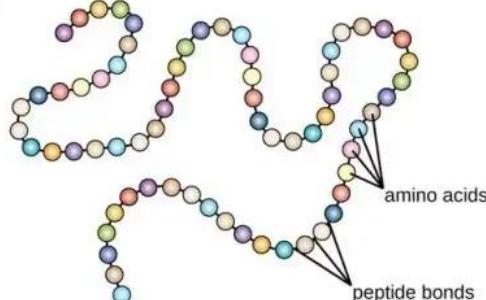


Basic Amino Acids

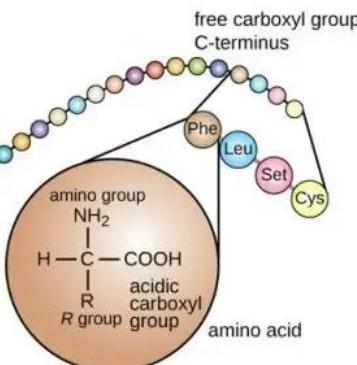


Structure of protein

free amino group,
N-terminus



The primary protein structure
is the chain of amino acids
that makes up the protein.

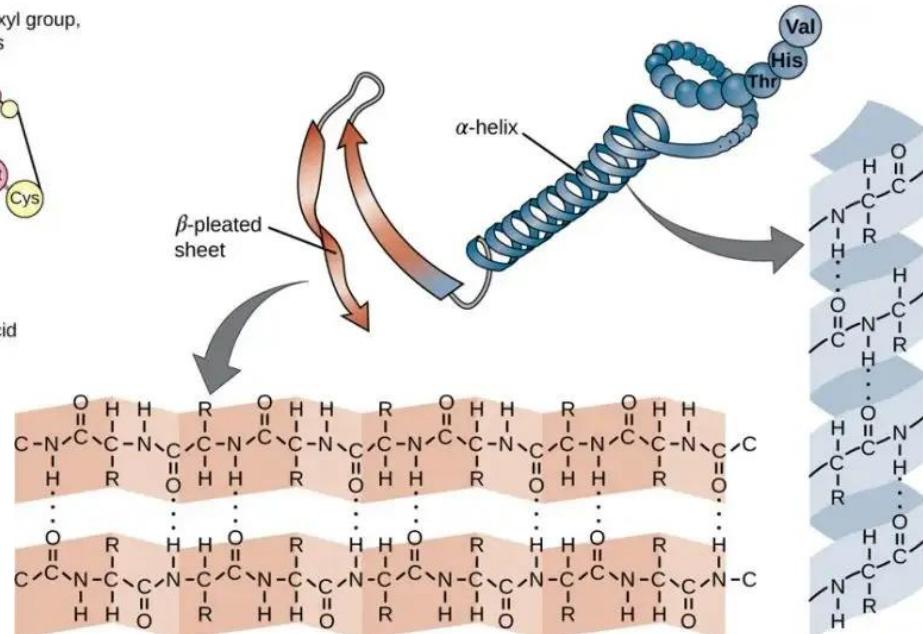


Primary structure of protein

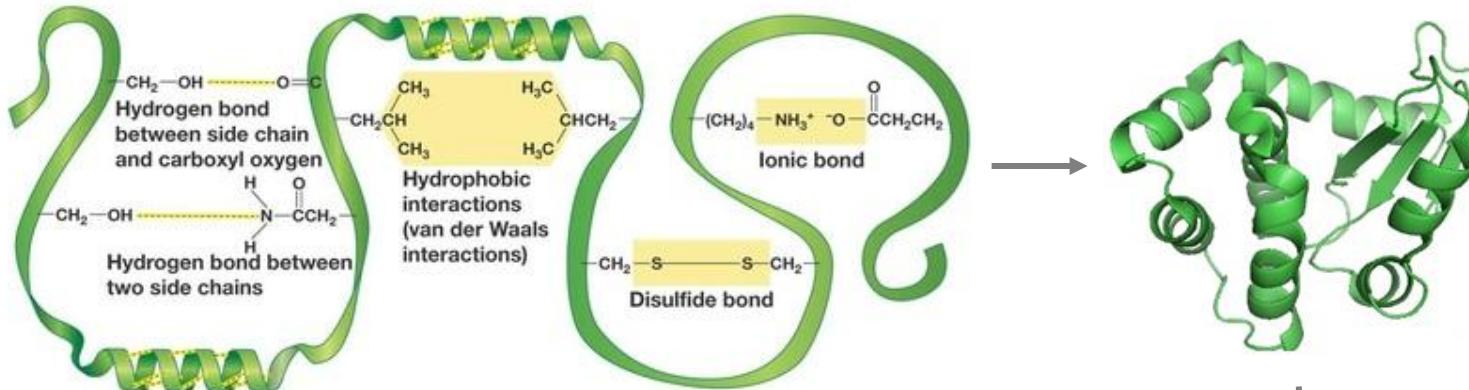
This level of structure is determined by the sequence
of amino acids that join to form a polypeptide.

Secondary structure of protein

Hydrogen bonding between amino acids cause the
polypeptide to form an alpha helix or a pleated sheet.



Structure of protein

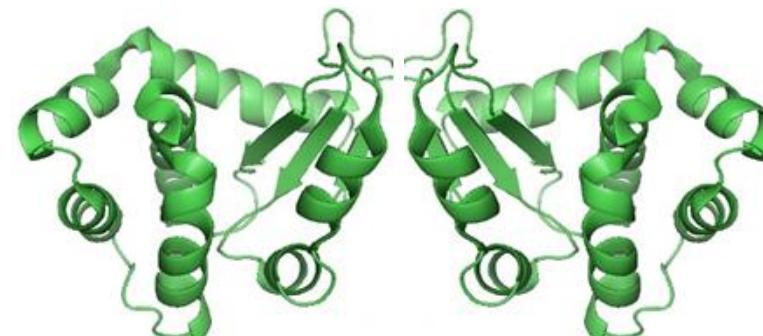


Tertiary structure of protein

This level of structure is determined by the sequence of amino acids that join to form a polypeptide.

Quaternary structure of protein

This level of structure forms when two or more tertiary structures combine to form a single protein



Genetic code

		Second letter						
		U	C	A	G			
First letter	U	UUU UUC UUA UUG	UCU UCC UCA UCG	UAU UAC UAA UAG	Tyr Stop Stop	UGU UGC UGA UGG	Cys Stop Trp	
	C	CUU CUC CUA CUG	CCU CCC CCA CCG	CAU CAC CAA CAG	His Pro	CGU CGC CGA CGG	Arg	
	A	AUU AUC AUA AUG	ACU ACC ACA ACG	AAU AAC AAA AAG	Ile Thr	AGU AGC AGA AGG	Ser Arg	
	G	GUU GUC GUA GUG	GCU GCC GCA GCG	GAU GAC GAA GAG	Ala	GGU GGC GGA GGG	Gly	
Third letter								