



Molecular and Cellular Biology

Lecture – 2

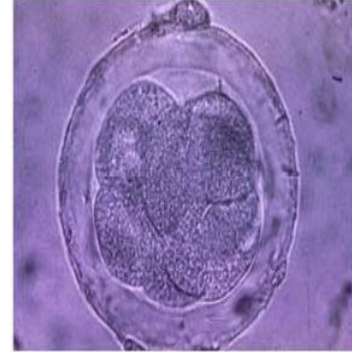
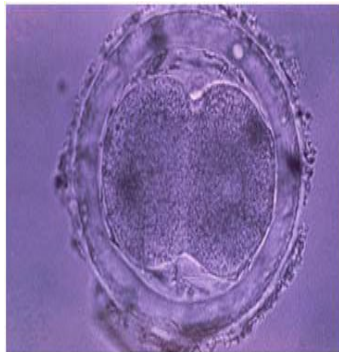
Department of CSE, DIU



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What is Life made of?





1. Cell

Let's learn about Eukaryotes and Prokaryotes

Cells

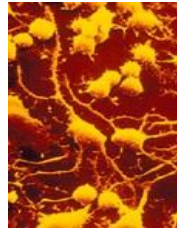
- Fundamental working units of every living system.
- Cell specialization in multicellular organism.
- Tissues are groups of cells for a particular function.
 - Fourteen major tissue types
 - Bone, muscle, nerve etc.
- Organs are formed
- More than 200 different cell types
 - With lots of variety in every sense
 - But the genetic code is same



Blood



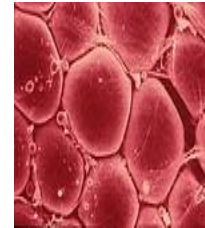
Bone



Nerve



Muscle



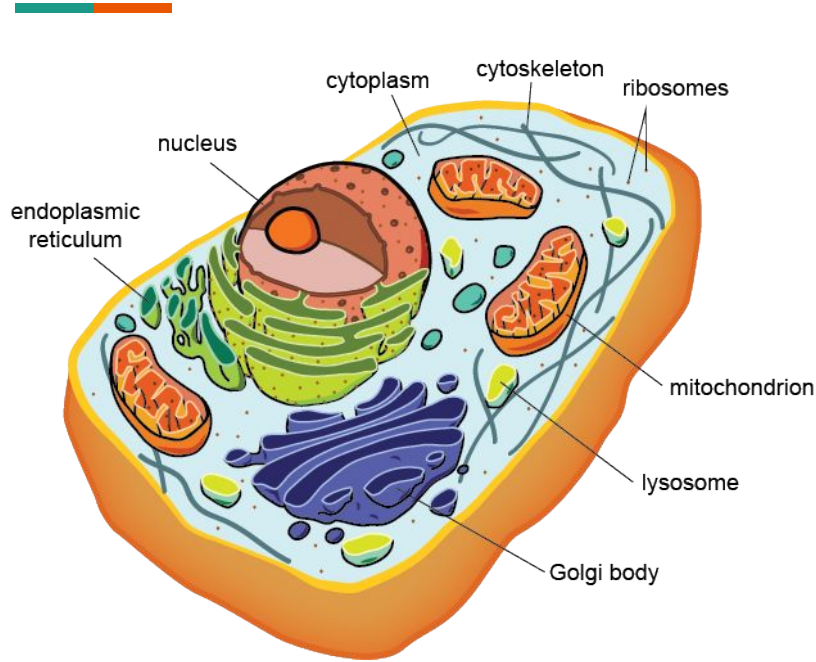
Fat

2 types of Cells



1. Eukaryotic Cells
2. Prokaryotic Cells

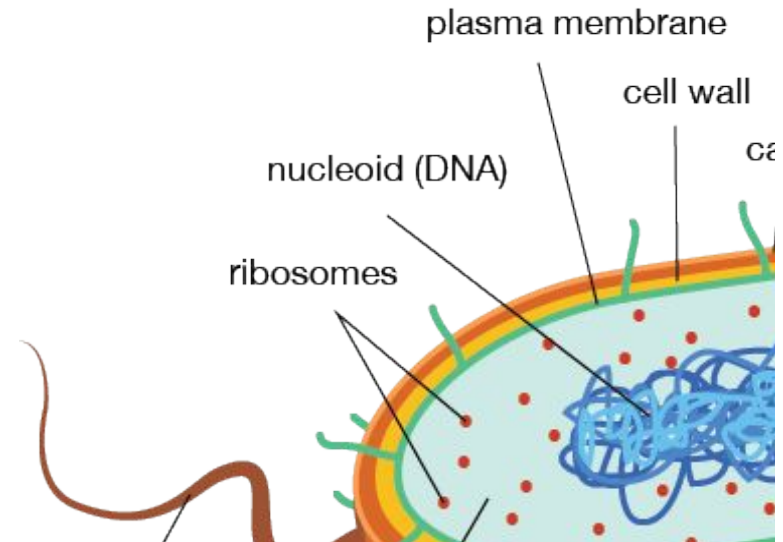
Eukaryotic



- Single or Multi Cell
- Are called Eukaryotes
- Have Nucleus
- Have membrane bounded organelles
- Have chromosomes inside Nucleus
- Seen in most of the life forms

Prokaryotic Cells


- ▷ Single Cell organism
- ▷ Are called Prokaryotes
- ▷ No Nucleus
- ▷ No other membrane bounded organelles
- ▷ One piece of rolled up DNA floating in cellular fluid
- ▷ Mostly some forms of very ancient Bacteria





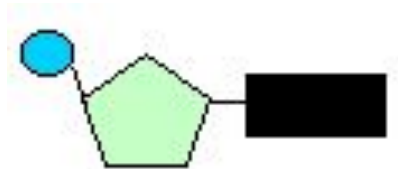
3. Nucleic Acid

All Life depends on 3 critical molecules

- 
- DNAs
 - Hold information on how cell works
 - RNAs
 - Act to transfer short pieces of information to different parts of cell
 - Provide templates to synthesize into protein
 - Proteins
 - Form enzymes that send signals to other cells and regulate gene activity
 - Form body's major components (e.g. hair, skin, etc.)
 - Are life's laborers!

Building Blocks of Nucleic acids

- DNA/RNA are polymeric chain on nucleotides
- Three parts of Nucleotides
 - a nitrogenous base,
 - a five-carbon-atom sugar and
 - a phosphate group



■ Phosphate Molecule

■ Deoxyribose Sugar


■ Base

Adenine, Cytosine, Guanine and Thymine



Nucleic acids Bases

- Adenine (A),
- Guanine (G)
- Cytosine (C)
- Thymine (T)
- Uracil (U)



3.1 DeoxyriboNucleic Acid (DNA)

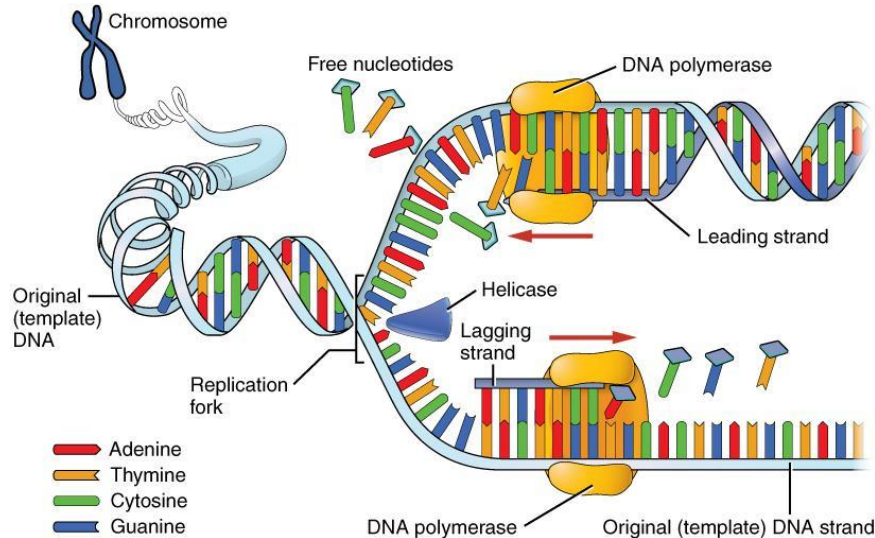
Carrier of genetic instructions

➤ Double Helix Structure (Watson and Crick, Nature 1953)

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- The diagram illustrates the structure of DNA. On the left, a 3D model of a DNA double helix is shown, with a yellow ribbon representing the sugar-phosphate backbone and colored rungs representing the nitrogen-containing bases. A bracket at the top indicates a 'base pair'. A dashed box highlights a section of the helix, which is expanded into a detailed 2D schematic on the right.
- The detailed schematic shows the sugar-phosphate backbone as two vertical yellow columns. The left column contains phosphate groups (P) and deoxyribose sugars (d). The right column contains deoxyribose sugars (d) and phosphate groups (P). The bases are connected by hydrogen bonds, indicated by dashed lines. The bases are color-coded: Thymine (T, red), Adenine (A, blue), Guanine (G, green), and Cytosine (C, purple). The bases are connected to the sugar-phosphate backbone via phosphodiester bonds. The bases are also connected to each other via hydrogen bonds. The bases are connected to the sugar-phosphate backbone via phosphodiester bonds. The bases are also connected to each other via hydrogen bonds.
- Labels in the diagram include:
- base pairs
 - nucleotide
 - sugar-phosphate backbone
 - hydrogen bonds
 - phosphate (P)
 - sugar (d)
 - nitrogen-containing bases (T, A, G, C)

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DNA Replication



► Initiation

- Helicase enzyme unwinds DNA strands
- Replication fork is created
- RNA Primer is created by Primase enzyme
- Primer is starting point of elongation

► Elongation

- New DNA Strand grows 1 base at a time as complimentary of leading strand (5' to 3')
- DNA Polymerase enzyme controls it
- Complimentary strand of lagging strand is created in small fragments called Okazaki Fragments (3' to 5')

► Termination

- Exonuclease enzyme removes all the primer sequences from new strands
- Again, DNA Polymerase fills the gaps
- DNA Ligase enzyme seals all the gaps

*** DNA Replication is Semi-Conservative, because, in new sets of DNA, one strand is newly created but the other strand comes from the ancestor.**

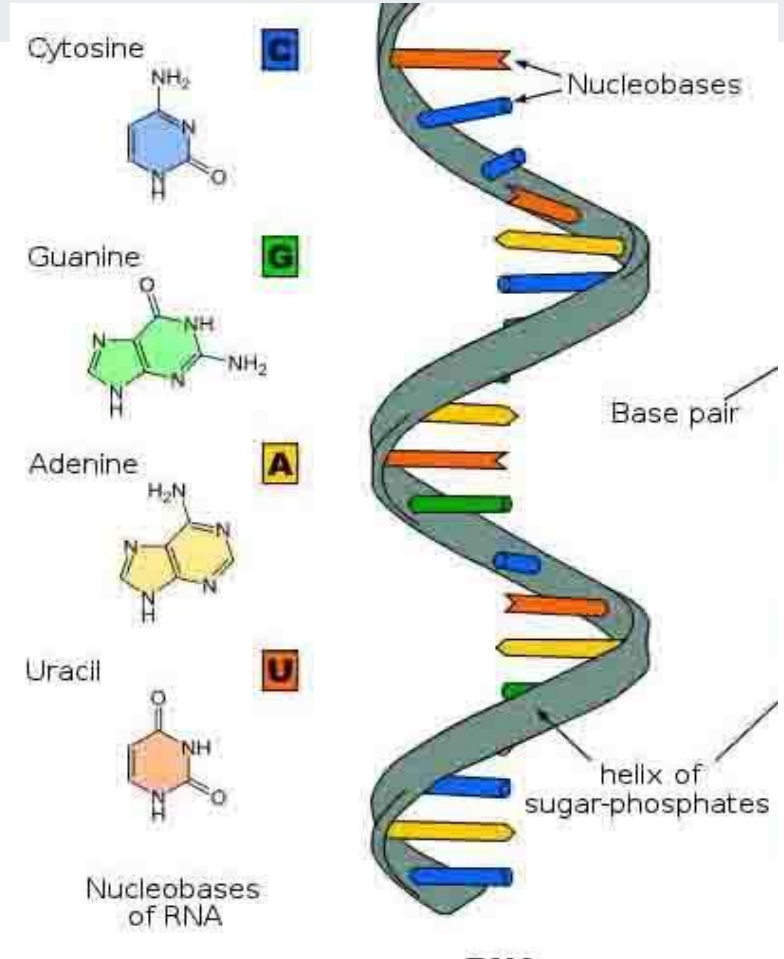


3.2 Ribonucleic Acid (RNA)

Protein Coding and Carrier

RNA Structure

- ▷ Single Helix Structure
- ▷ Single Strand which generally runs from 5' to 3'
- ▷ 3 major parts – Nitrogenous Base, 5-Carbon Ribose Sugar and Phosphate Group
- ▷ Four nitrogenous bases – Adenine (A), Cytosine (C), Guanine (G), Uracil (U)
- ▷ A-U is Double Hydrogen Bond and G-C is Triple Hydrogen Bond
- ▷ RNA is less stable than DNA due to its Ribose Sugar's structure



RNA Types

Messenger RNA (mRNA)

Carries a genes coding message for protein from Nucleus to Ribosome

Transfer RNA (tRNA)

Transfers specific amino acid sequence to ribosome to form Protein

Ribosomal RNA (rRNA)

Protein and rRNA combinedly forms ribosome

Non-Coding RNA

Not translated into protein. Ex – tRNA, rRNA

Catalytic RNA

Catalyze chemical reaction.

Double Stranded RNA

Contains complementary strands like DNA. Induces gene expression.



Reference Video

<https://youtu.be/C1CRrtkWwu0>

<https://youtu.be/TNKWgcFPHqw>

**Thank
You**

