

# Molecular and Cellular Biology

## Lecture – 2

Department of CSE, DIU



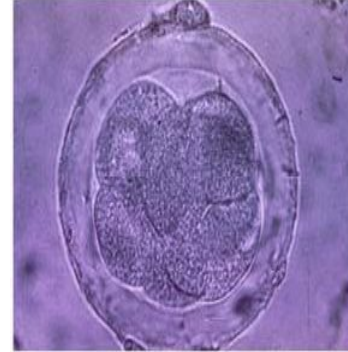
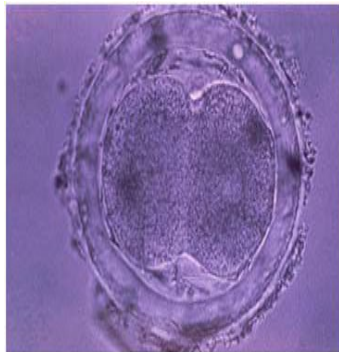
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# 1. Cell

Let's learn about Eukaryotes, Prokaryotes and Cell Division

# What is Life made of?



# Cells

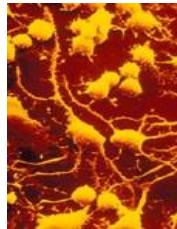
- **Fundamental working units** of every living system.
- Cell specialization in multi-cellular organism.
- **Tissues** are groups of cells for a particular function.
  - Fourteen major tissue types
    - Bone, muscle, nerve etc.
- **Organs** are formed
- More than 200 different cell types
  - With lots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



Blood



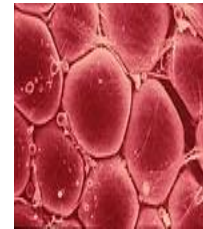
Bone



Nerve

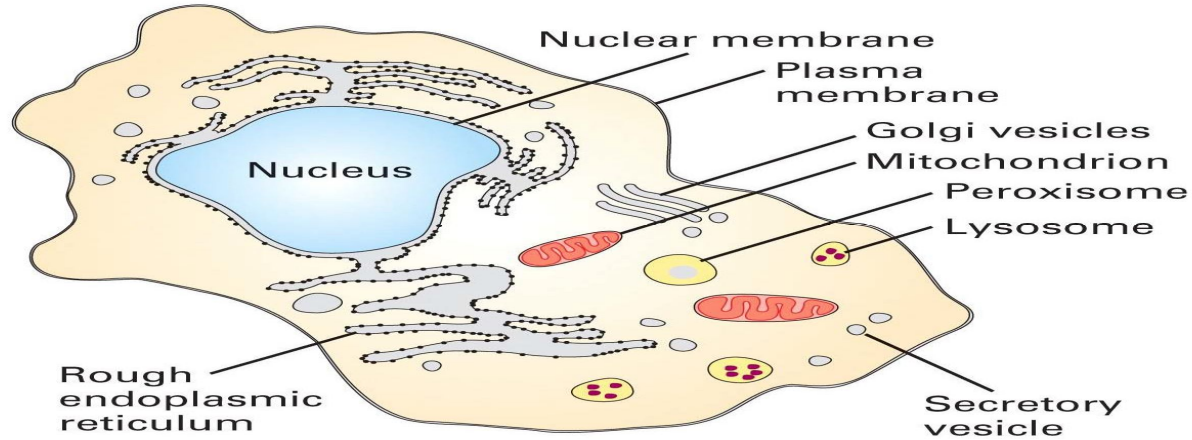


Muscle



Fat

# Life begins with Cell

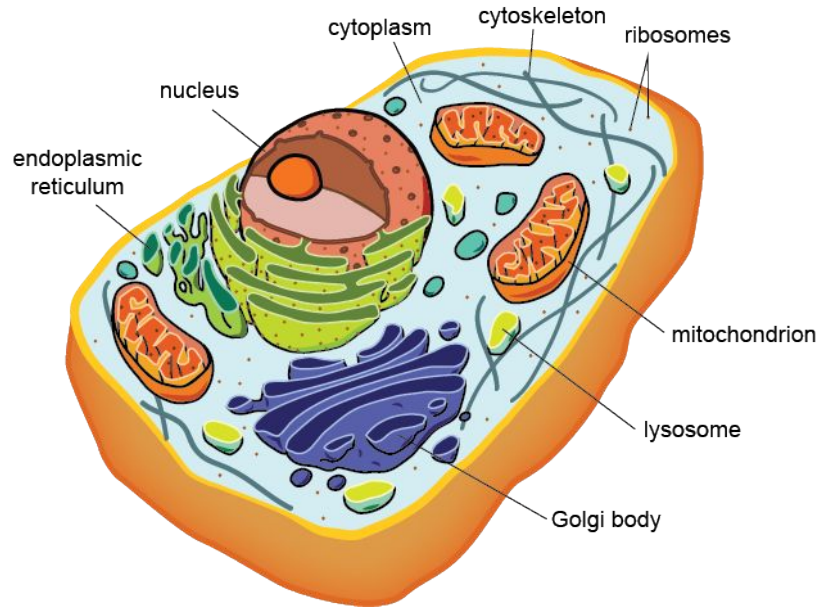


- A cell is the smallest structural unit of an organism that is capable of *sustained* independent functioning
- All cells have some common features

## 2 types of Cells

1. Eukaryotic Cells
2. Prokaryotic Cells

# Eukaryotic Cells

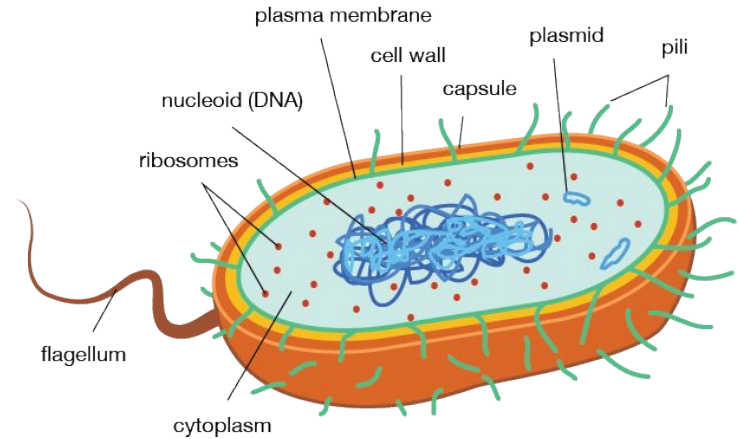


- Single or Multi Cell
- Are called Eukaryotes
- Have Nucleus
- Have membrane bounded organelles
- Have chromosomes inside Nucleus
- Seen in most of the life forms



# 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

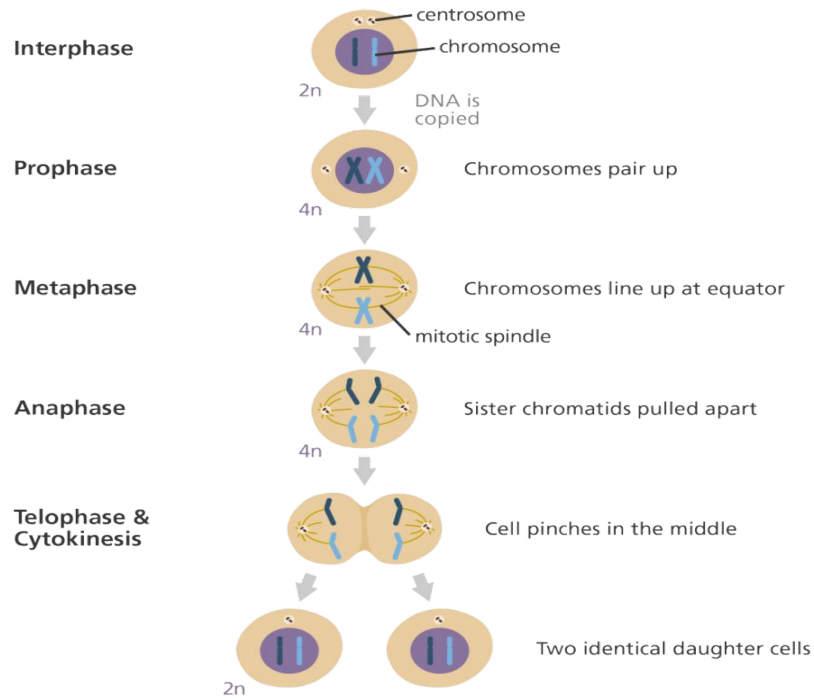


# 2. Cell Division

2 types of Cell Division

- Mitosis Cell Division
- Miosis Cell Division

# Mitosis Cell Division

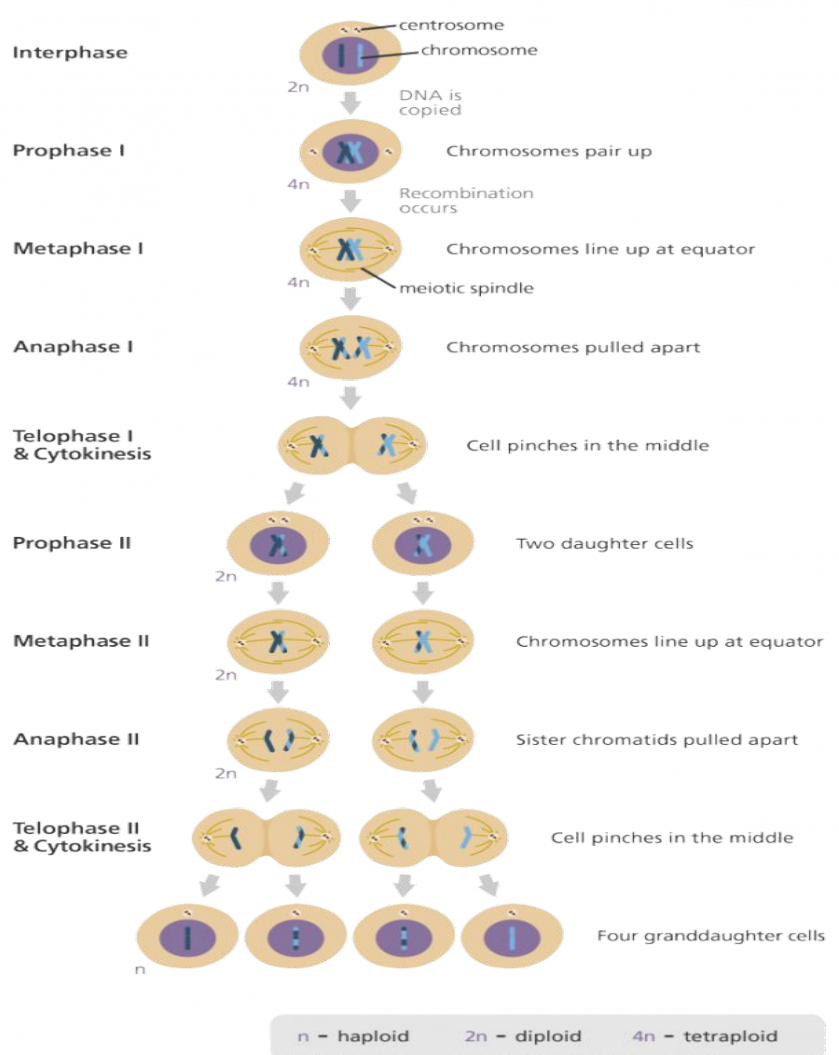


- Happens in Somatic Cells (general body cells)
- Cell and chromosome, both gets divided only once
- No cross over
- Takes part in healing and repair

$2n$  - diploid       $4n$  - tetraploid

# Meiosis Cell Division

- Happens in Germ Cells
- Cell is divided twice, but chromosome only once
- Cross over happens
- Takes part in formation of gametes and maintenance of chromosome number in the race



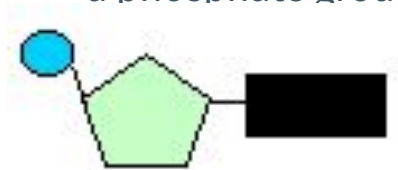
# 3. Nucleic Acid

# 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

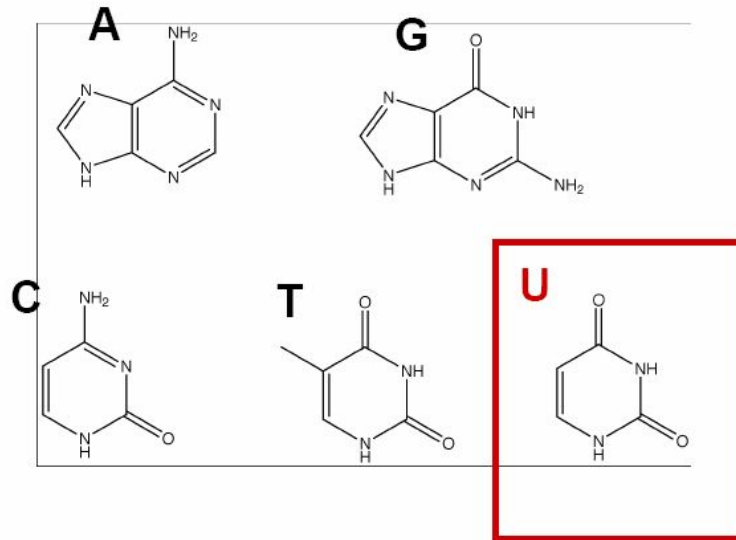
■ Deoxyribose Sugar

■ Base

Adenine, Cytosine, Guanine and Thymine

# Nucleic acids Bases

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



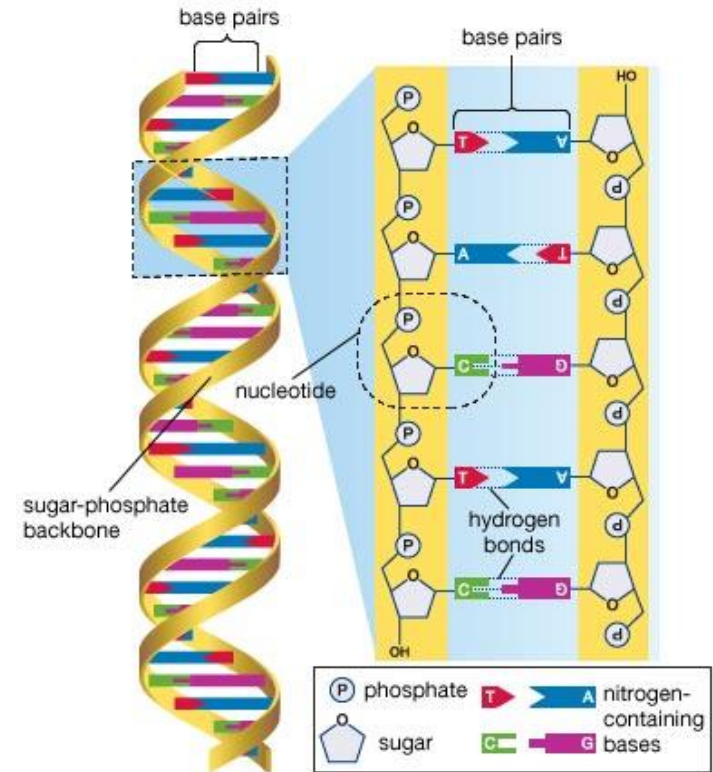


# 3.1 DeoxyriboNucleic Acid (DNA)

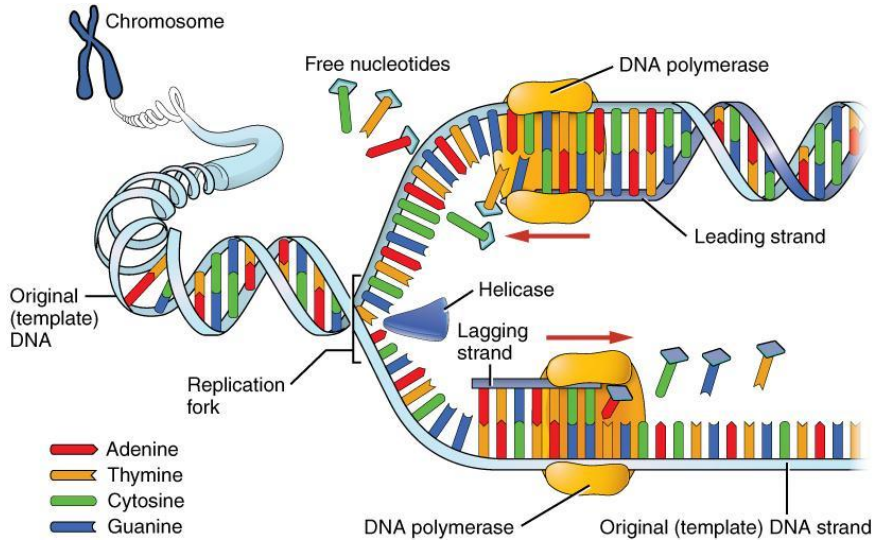
Carrier of genetic instructions

# DNA Structure

- ▶ Double Helix Structure (Watson and Crick, Nature 1953)
- ▶ Two complimentary antiparallel strands, one runs from 5' to 3' end and another runs from 3' to 5' end
- ▶ 3 major parts – Nitrogenous Base, 5-Carbon Deoxyribose Sugar and Phosphate Group
- ▶ Four nitrogenous bases – Adenine (A), Cytosine (C), Guanine (G), Thymine (T)
- ▶ A-T is Double Hydrogen Bond and G-C is Triple Hydrogen Bond
- ▶ DNA is more stable than RNA due to its Deoxyribose Sugar Structure



# 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

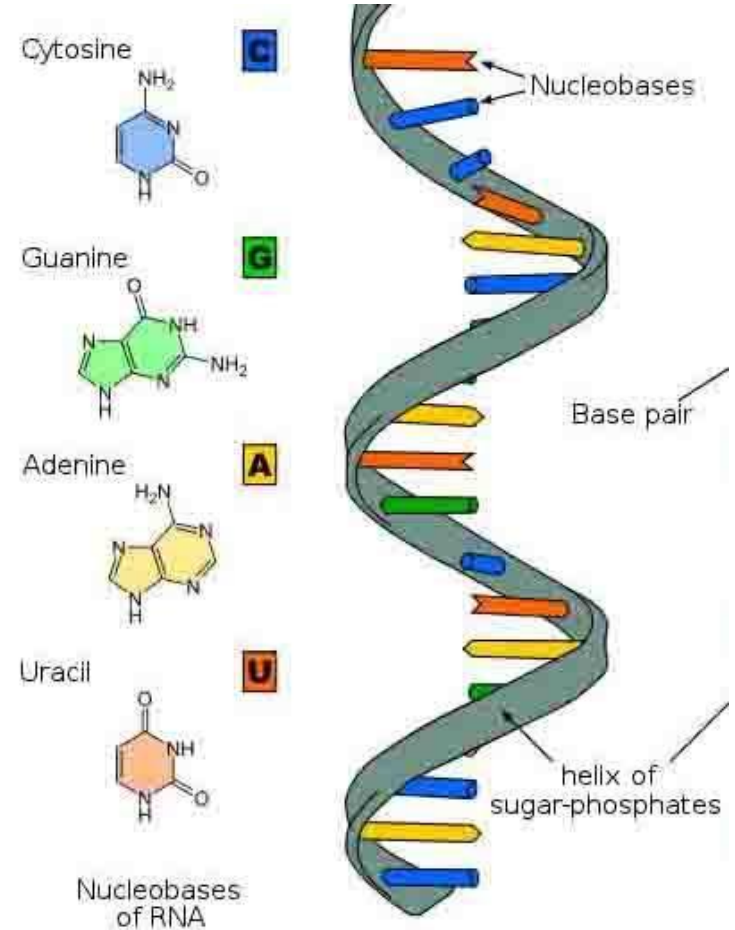
**\* DNA Replication is Semi-Conservative, because, in new sets of DNA, one strand is newly created but the other strand comes from the ancestor.**

# 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 exprression.

**Thank  
You**

