Molecular and Cellular Biology

Lecture – 2

Department of CSE, DIU

CONTENTS

What is Life made of?








1. Cell

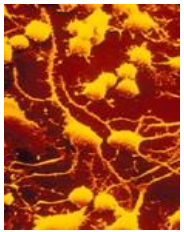
Let’s learn about Eukaryotes and Prokaryotes

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

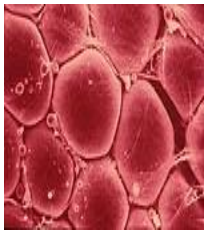
Blood

Bone



Nerve

Muscle

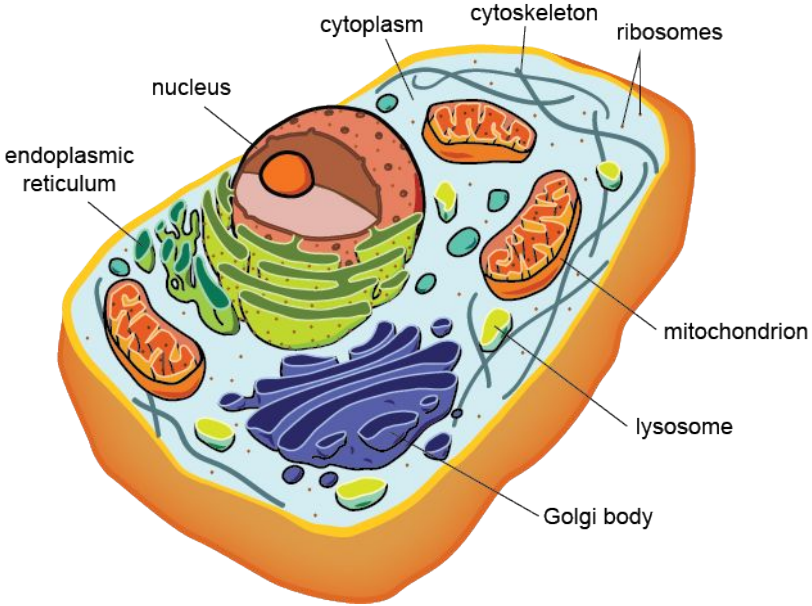


Fat

2 types of Cells

1. Eukaryotic Cells
2. Prokaryotic Cells

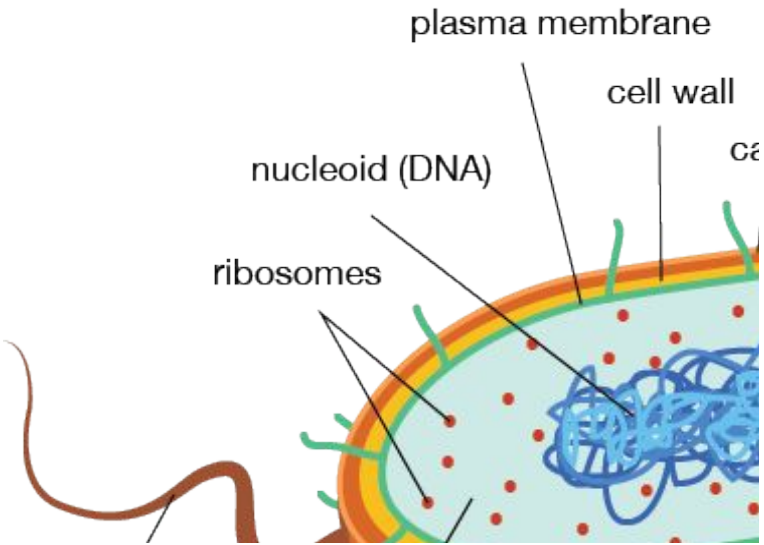
Eukaryotic



- 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



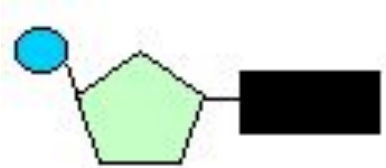
3. Nucleic Acid

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

DNA Structure

- **Double Helix Structure (Watson and Crick, Nature 1953)**

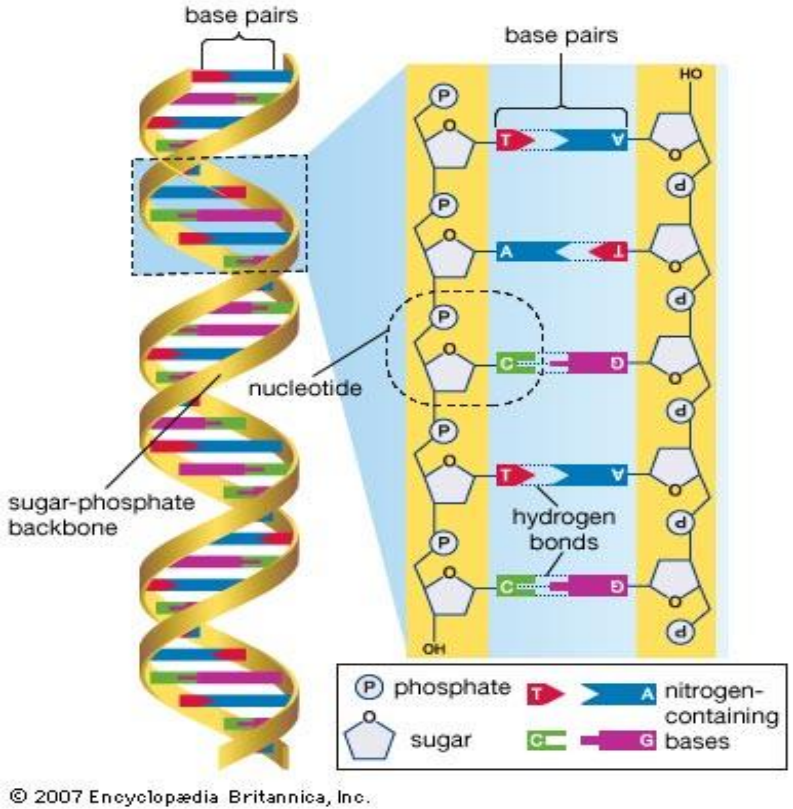
- Two complementary antiparallel strands, one runs from 5' to 3' end and another runs from 3' to 5' end

- 3 major parts – Nitrogenous Base, 5-Carbon Deoxyribose Sugar and Phosphate Group

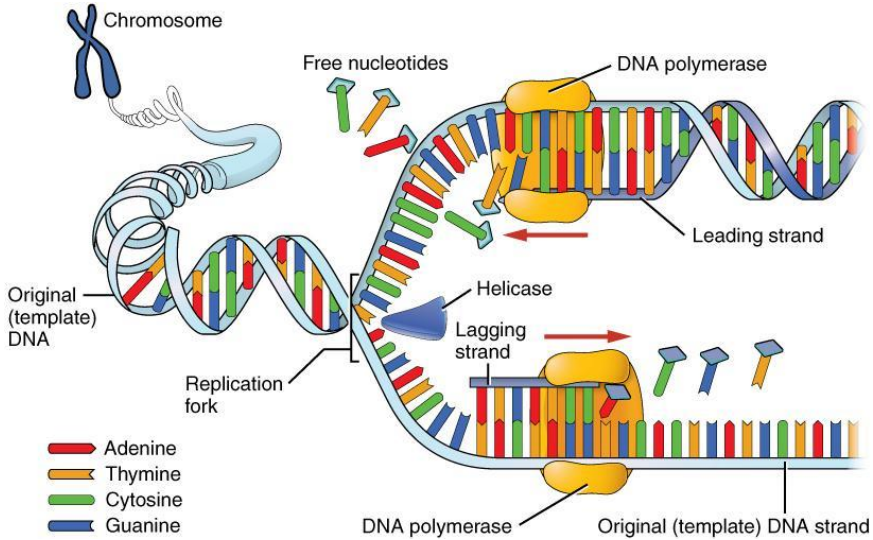
- Four nitrogenous bases – Adenine (A), Cytosine (C), Guanine (G), Thymine (T)

- 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

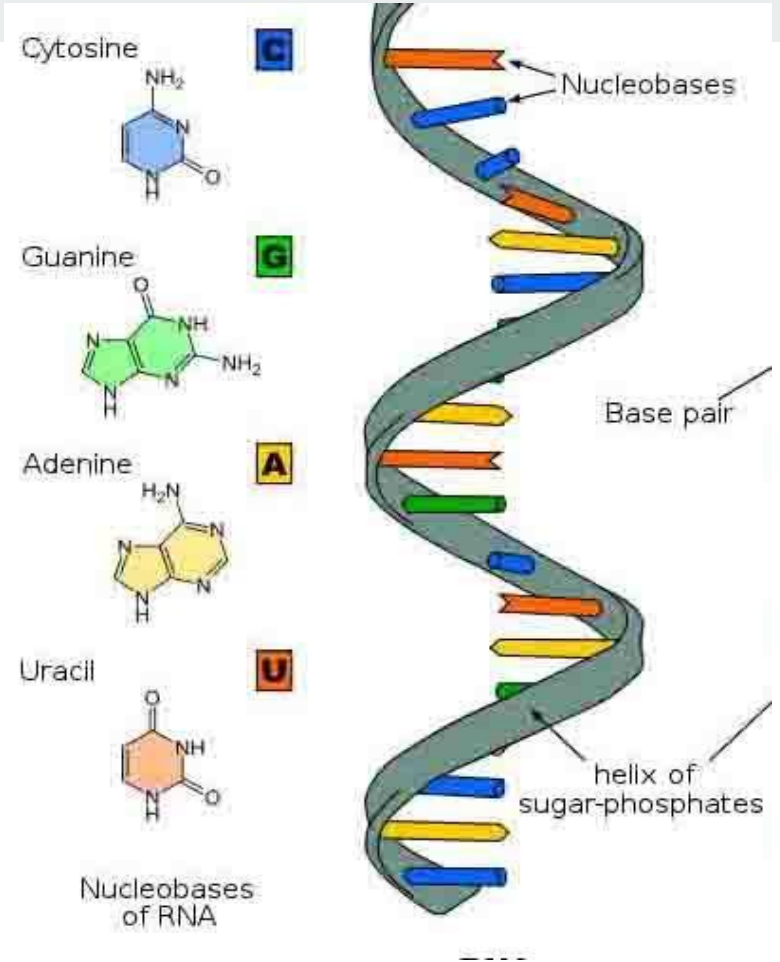
*** DNA Replication is Semi-Conservative, because, in new sets of DNA, one strand is newly created but the other strand comes from the ancestor.**

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 expression.

Reference Video

https://youtu.be/C1CRrtkWwu0
https://youtu.be/TNKWgcFPHqw


Thank
You