



MOLECULAR BIOLOGY

Introduction, scope & Importance

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What is Molecular Biology ?

- The branch of biology that deals with the structure, function, and manipulation of the macromolecules (e.g. proteins and nucleic acids) essential to life.
- The branch of biology that deals with the nature of biological phenomena at the molecular level through the study of DNA, RNA, proteins, and other macromolecules involved in genetic information and cell function.

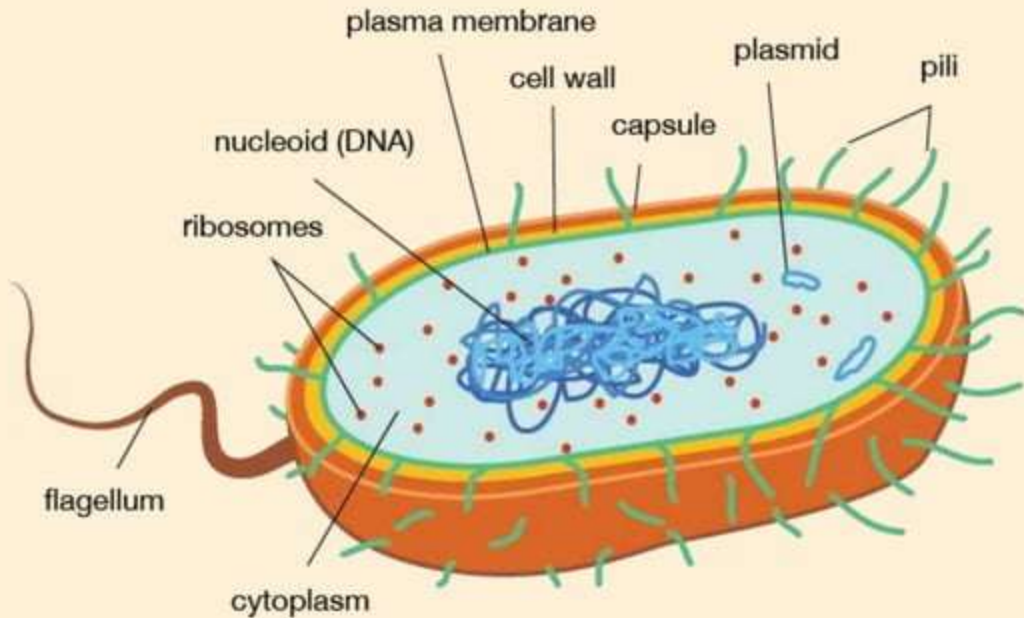
Three Domain of Life

Prokaryotic (Bacteria)

Eukaryotic

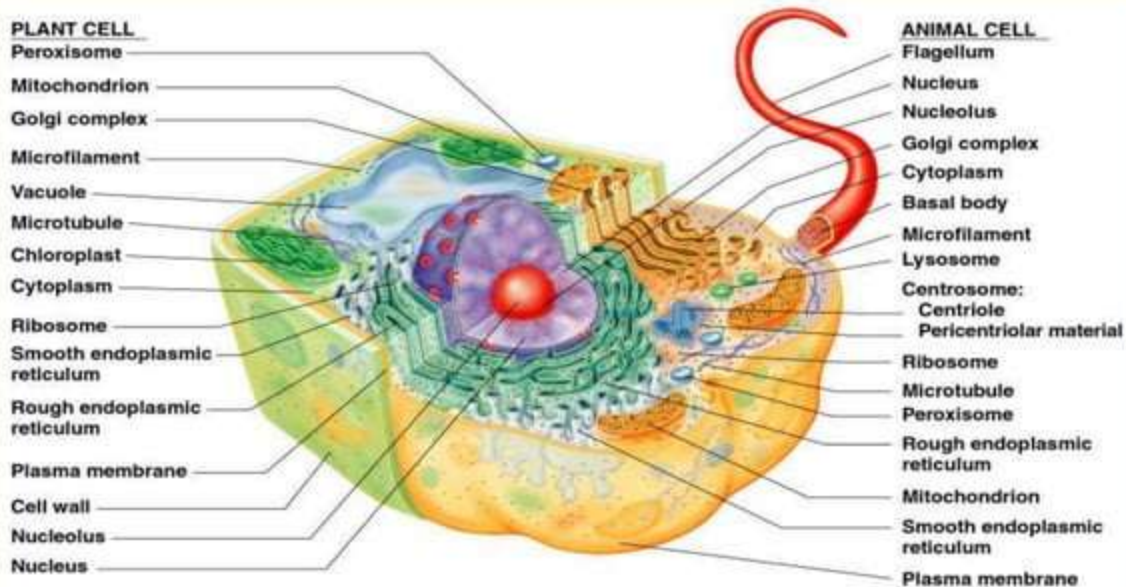
Archaea

Prokaryotic Cells



- Unicellular organisms, found in all environments. These include bacteria and archaea;
- Without a nucleus; no nuclear membrane (genetic material dispersed throughout cytoplasm);
- No membrane-bound organelles;
- Cell contains only one circular DNA molecule contained in the cytoplasm;
- DNA is naked (no histone);
- Simple internal structure; and
- Cell division by simple binary fission

Eukaryotic Cells

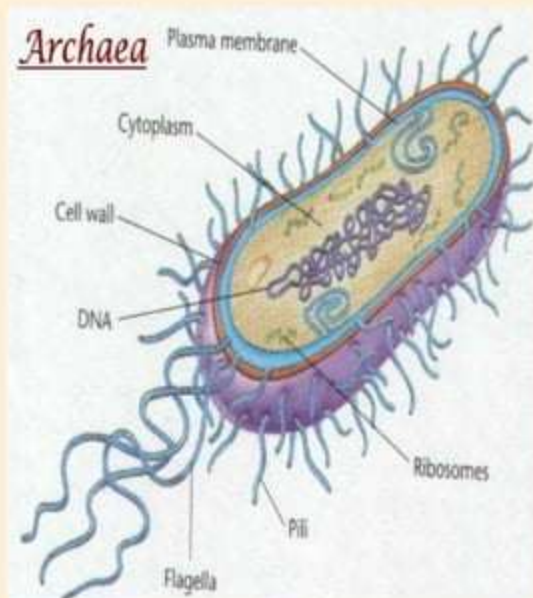


(a) Highly schematic diagram of a composite eukaryotic cell, half plant and half animal

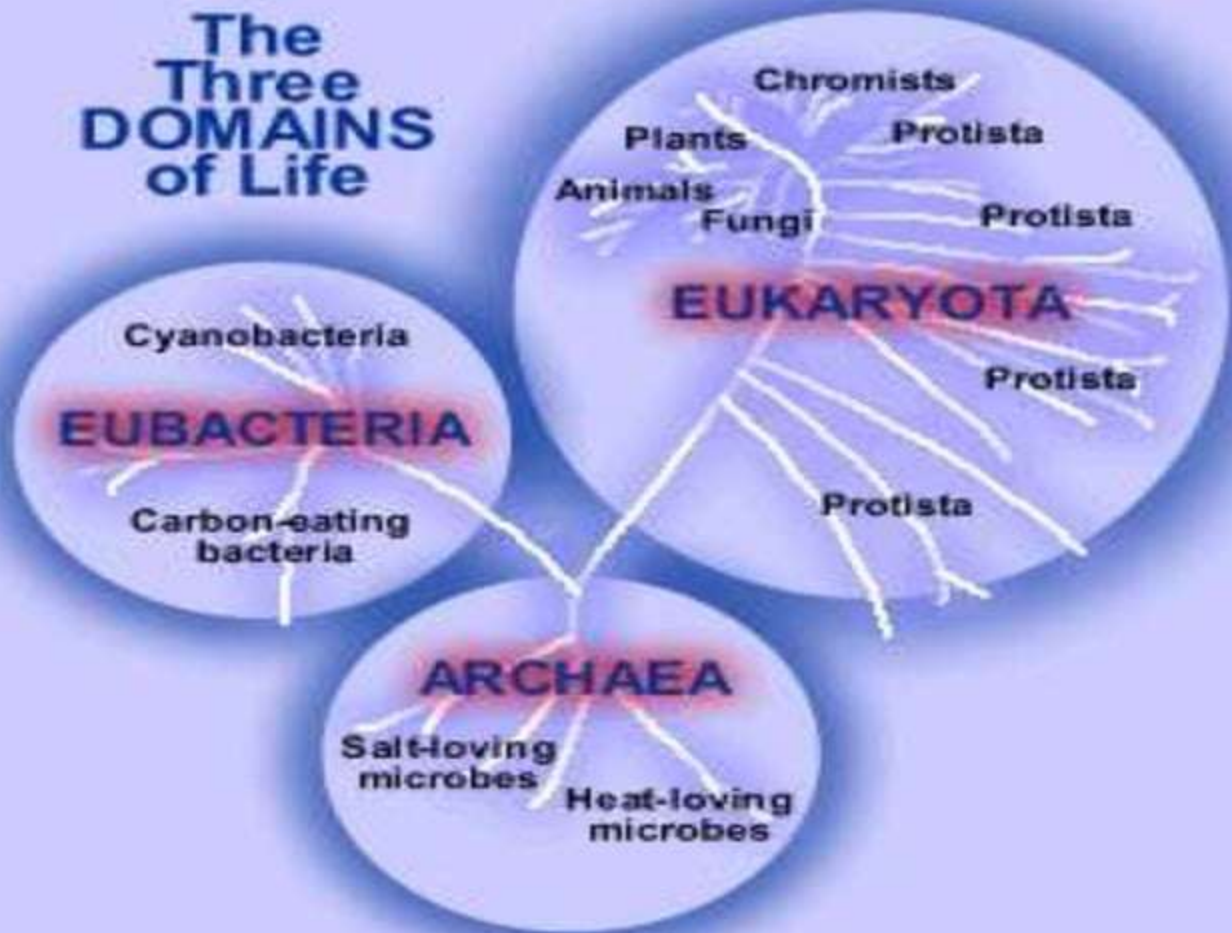
- Eukaryotic cells are found in animals, plants, fungi and protists cell;
- Cell with a true nucleus, where the genetic material is surrounded by a membrane;
- Eukaryotic genome is more complex than that of prokaryotes and distributed among multiple chromosomes;
- Eukaryotic DNA is linear;
- Eukaryotic DNA is complexed with proteins called histones;
- Numerous membrane-bound organelles;
- Complex internal structure;
- Cell division by mitosis.

Archaea

Archaea is prokaryotes; organisms without nucleus but some aspects of their molecular biology are more similar to those of eukaryotes.



The Three DOMAINS of Life



Nucleic acids

- **Nucleic acids** are biopolymers, or large biomolecules, essential for all known forms of life.
- **Nucleic acids**, which include **DNA** (deoxyribonucleic **acid**) and **RNA** (ribonucleic **acid**), are made from monomers known as nucleotides.
- **Nucleotides** are composed of a nitrogenous base, a five-carbon sugar (ribose or deoxyribose), and at least one phosphate group.

Chromosomes

- **Chromosomes** are thread-like structures located inside the nucleus of animal and plant cells.
- Each **chromosome** is made of protein and a single molecule of deoxyribonucleic acid (DNA).
- Passed from parents to offspring, DNA contains the specific instructions that make each type of living creature unique

Gene

- **The gene**; it is a segment within a very long strand of DNA.
 - Genes are the basic units of hereditary.
 - Genes located on chromosome on its place or locus.
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- **Allele**; a variant of the DNA sequence at a given locus. Each allele inherited from a different parent.

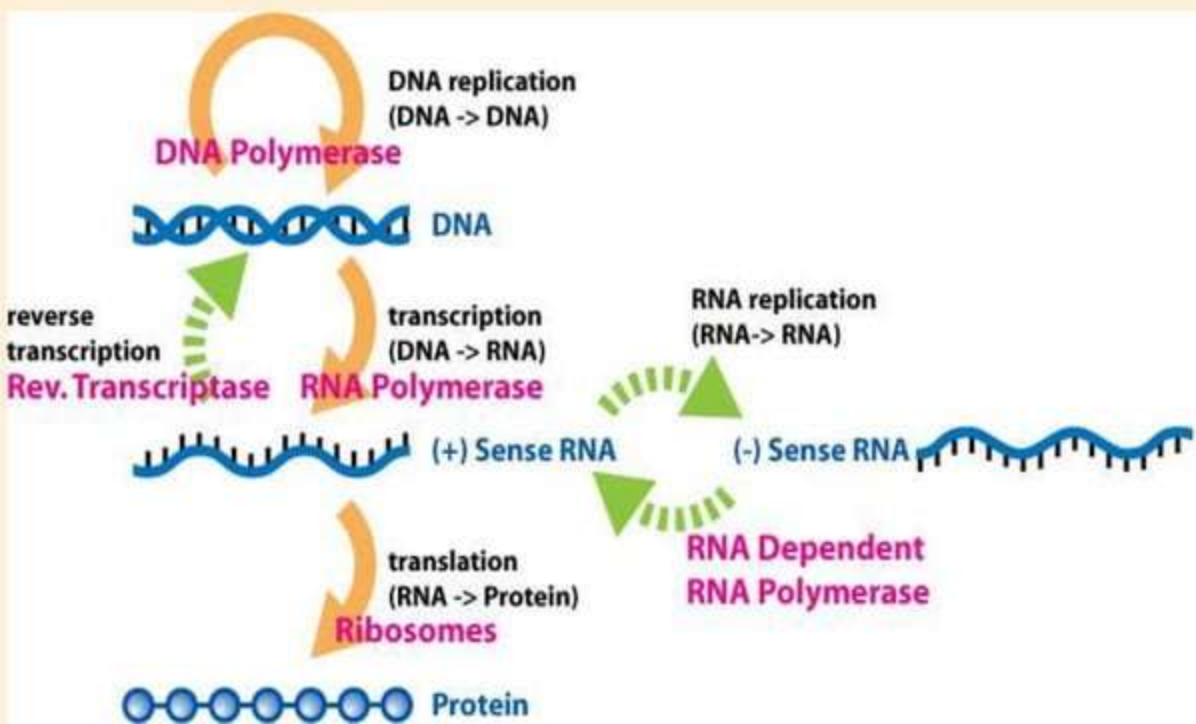
The Genome

- A **genome** is an organism's complete set of genetic information , including all of its genes.
- Each **genome** contains all of the information needed to build and maintain that organism.
- Encoded in the DNA (for some viruses, RNA).
- In humans, a copy of the entire **genome**—more than 3 billion DNA base pairs—is contained in all cells that have a nucleus.

Species/ Number of Chromosomes

Species	Number of chromosomes
Human	46
Chimpanzee & Gorilla	48
Rat	42
Fruit flies	8
Mango	40
Rice	24
Maize	20
Bacteria	1

The Central Dogma of Molecular Biology



Application of Molecular Biology

- **Research**
- **Diagnosis**
- **Transplantation**
- **Paternity**
- **Forensic analysis**
- **Gene therapy**
- **Drug Design**
- **.....**

Additive/processing aid	Product	Use
Enzymes	Amylase, isomerase	High fructose corn syrup
	Rennet	Cheesemaking
	Proteases	Meat tenderizer
	Pullulanase	Lite beer
Organic acids	Citric acid	Acidulant
	Benzoic, probionic acid	Food preservative
Amino acids	Methionine, lysine, tryptophan	Nutritional supplement
	Aspartic acid, phenylalanine	Ingredient in sweetener production
Low-calorie products	Aspartame, thaumatin, monellin	Non-nutritive sweeteners
	Modified fatty acids triglycerides	Food additives Cooking oil
Microbial polysaccharides	Xanthan gum	Stabilizers, thickeners and gelling agents
Flavours and pigments	Vanillin, Monascin	Flavouring and colouring agents
Single-cell protein		Animal and human food, supplement



Thank
you!