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Introduction

The distinction between prokaryotes and eukaryotes is considered to be the most important distinction among groups of organisms. Prokaryotes were thought to be the only form of life for millions of years, until more complicated eukaryotic cells came into being through the process of evolution.

Based on their ultrastructure, all living things can be classified into two groups: prokaryotes and eukaryotes. The essay will consider both the similarities and the differences between prokaryotes and eukaryotes. When discussing such, it is important to not only consider their structure, but also the functions and features of the different cell types.

The first section of this essay will include definitions of what prokaryotes and eukaryotes while the second section of the essay will examine the similarities and the differences of the two organisms. Finally, I will compare the differences between the two cell types and DNA replication.

Prokaryotes and Eukaryotes share many similarities and differences. Prokaryotes (from the Greek meaning prenucleus) are mostly unicellular, however some prokaryotes are multicellular. Eukaryotes (from the Greek true nucleus) are organisms whose cells are organized into complex structures by internal membranes and a cytoskeleton.

The differences between prokaryotes and eukaryotes are pivotal to how each cell functions and which jobs each are suited to perform. As the Greek meaning of the name suggests, prokaryotic cells have a primitive nucleus – thus no nucleus is present in prokaryotic organisms. This is key difference to eukaryotic cells, similarly suggested by the Greek meaning, have a nucleus included in their cytoplasm. Prokaryotic cells are most commonly found in organisms such as Bacteria; most commonly eubacteria and Archae bacteria. Eukaryotic cells are therefore are found in all other living organisms, the name implying that there is a proper nucleus present. As there is no nucleus present in prokaryotic cells the DNA helix is a single coiled chromosome that is unsupported and so can float freely around the cell, however in a eukaryotic cell the DNA helix is made up of linear chromosomes supported by the histone protein. In Eukaryotic cells there is also a distinct nuclear membrane.

Prokaryotes and eukaryotes both contain nucleic acids, proteins, lipids and carbohydrates and for this reason they are considered chemically similar. As well as this they use the same kind of chemical reactions to metabolise food, mould proteins and store energy. But what distinguishes prokaryotes and eukaryotes lies primarily with the structure of the cell walls as well as the membranes and the absence of organelles (specialised cellular structures that have specific functions).

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The main distinguishing features of prokaryotes are as follows:

1. Their genetic material (DNA) is not enclosed within the membrane but instead is one circular chromosome
2. They lack other membrane bound organelles
3. Their DNA is not associated with histone proteins
4. Their cell walls almost always contain the complex polysaccharide peptidoglycan
5. They usually divide by binary fission.

Eukaryotes on the other hand do have linear structures of DNA called chromosomes that are found in the nucleus of the cell which is separated by the cells cytoplasm. The DNA of eukaryotic chromosomes is associated with histones – chromosomal proteins. Eukaryotes have a mitotic apparatus – various cellular structures that participate in mitosis – and a number of organelles that include mitochondria and endoplasmic reticulum (ER)

Size and Shape

Prokaryotic cells are smaller than Eukaryotic cells, according to "Pharmaceutical Microbiology" the majority of bacteria fall within the general dimensions of 0.75 to 4mm compared to the size of common eukaryotic cells which can be up to 40 times larger than Prokaryotic cells and measure between 50 and 150mm.

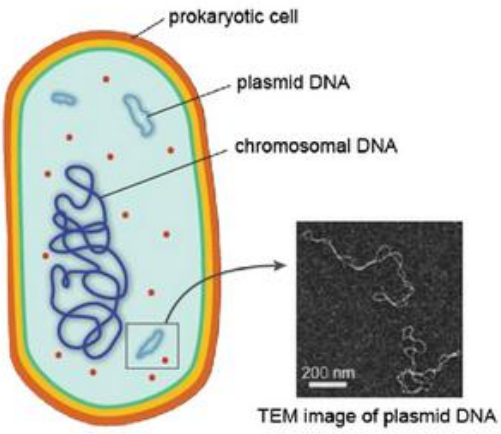

Figure 1.1 Showing Prokaryotic cell

Prokaryotic cells and Eukaryotic cells both can contain a cell wall. As previously stated, prokaryotic cell wall is made up of peptidoglycan (a mixture of sugar and protein) if the organism is a eubacteria, or pseudomurein

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if the organism is a archae bacteria. In eukaryotic cells a cell wall is only present if the organism is a plant or a fungi and the cell wall is constructed of cellulose in plants or chitin if the organism is a fungi.

Function

For prokaryotic organisms, the cell's function is being an entire organism. It eats, grows and reproduces as any other organism does.

For eukaryotic organisms, the cell's function depends on what type of cell it is. Each cell type (muscle, skin, fat, neuron, etc.) has a distinct purpose.

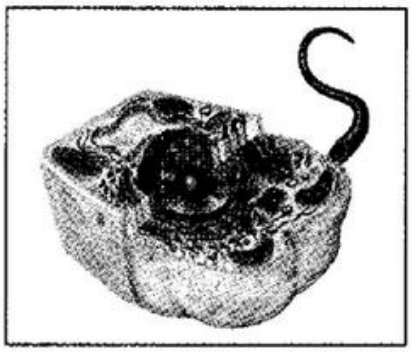

Figure 1.2 Showing Eukaryotic Cell

Table 1: Comparison the features of Eukaryotic and Prokaryotic cells

	Eukaryotic cell	Prokaryotic cell
Nucleus	Present	Absent
Number of chromosomes	More than one	One--but not true chromosome: Plasmids
Cell Type	Usually multicellular	Usually unicellular (some cyanobacteria may be multicellular)
True Membrane bound Nucleus	Present	Absent
Example	Animals and Plants	Bacteria and Archaea
Genetic Recombination	Meiosis and fusion of gametes	Partial, undirectional transfers DNA
Lysosomes and peroxisomes	Present	Absent
Microtubules	Present	Absent or rare
Endoplasmic reticulum	Present	Absent
Mitochondria	Present	Absent
Cytoskeleton	Present	May be absent
DNA wrapping on proteins.	Eukaryotes wrap their DNA around proteins called histones.	Multiple proteins act together to fold and condense prokaryotic DNA. Folded DNA is then organized into a variety of conformations that are supercoiled and wound around tetramers of the HU

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		protein.
Ribosomes	larger	smaller
Vesicles	Present	Present
Golgi apparatus	Present	Absent
Chloroplasts	Present (in plants)	Absent; chlorophyll scattered in the cytoplasm
Flagella	Microscopic in size; membrane bound; usually arranged as nine doublets surrounding two singlets	Submicroscopic in size, composed of only one fiber
Permeability of Nuclear Membrane	Selective	not present
Plasma membrane with steroid	Yes	Usually no
Cell wall	Only in plant cells and fungi (chemically simpler)	Usually chemically complexed
Vacuoles	Present	Present
Cell size	10-100um	1-10um

Differences between eukaryotic and prokaryotic cells

The difference between the structure of prokaryotes and eukaryotes is so great that it is considered to be the most important distinction among groups of organisms.

- Prokaryotes also differ from eukaryotes in the structure, packing, density, and arrangement of their genes on the chromosome. Prokaryotes have incredibly compact genomes compared to eukaryotes, mostly because prokaryote genes lack introns and large non-coding regions between each gene.
- Whereas nearly 95% of the human genome does not code for proteins or RNA or includes a gene promoter, nearly all of the prokaryote genome codes or controls something.
- Prokaryote genes are also expressed in groups, known as operons, instead of individually, as in eukaryotes.
- In a prokaryote cell, all genes in an operon(three in the case of the famous lac operon) are transcribed on the same piece of RNA and then made into separate proteins, whereas if these genes were native to eukaryotes, they each would have their own promoter and be transcribed on their own strand of mRNA. This lesser degree of control over gene expression contributes to the simplicity of the prokaryotes as compared to the eukaryotes.

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