

## Chloroplast DNA

### Mitochondrial DNA

The mitochondrial DNA is resulted due to the endosymbiotic relation which change over a period of the time but nuclear DNA is natural genetic material from origin of life. The DNA is located in mitochondria are known as mitochondrial DNA (mtDNA). As mitochondria is known for powerhouse of cell for its energy production ATP. Mitochondria help regulate the self-destruction of cells (apoptosis). The process which are produced, maintained regulate and efficiently perform function under influences of genes of mtDNA.

Discovery: Mitochondrial DNA was discovered by Margit M.K. Nass and Sylvan Nass by electron microscopy as DNAse sensitive thread inside mitochondria, and by Elen Haslbrunner Hans Tuppy and Gottfried Schatz by biochemical assays on highly purified mitochondrial fractions.

Ques: MTDNA is the DNA located in MTDNA due to its specific location, but there is not any high chemical difference in composition with nuclear DNA.

Ans:

MTDNA is the <sup>DNA</sup> located in mitochondria, cellular organelle within eukaryotic cells that convert chemical energy from food into a form that cells can use, adenosine triphosphate (ATP). Mitochondrial DNA is only a small portion of the DNA in eukaryotic cell, most of DNA can be found in the cell nucleus and in plants, in chloroplast. The human MTDNA is double stranded, circular molecule of 16569 bp and contains 37 genes coding for two rRNAs, tRNAs and 13 polypeptide.

Structure and Composition of MTDNA:

Mitochondrial DNA is named MTDNA due to its specific location but there is not any high chemical difference in composition with



nuclear DNA. The ~~MTDNA~~ mitochondrial as well as nuclear DNA constitute of a long chain of nucleotides that composed of sugar, nitrogenous base and phosphate group. Mitochondrial DNA only has one chromosome and this is organized like a circular genome (similar to prokaryotic DNA). This single chromosome is much shorter and codes for specific proteins which are used in metabolic process.

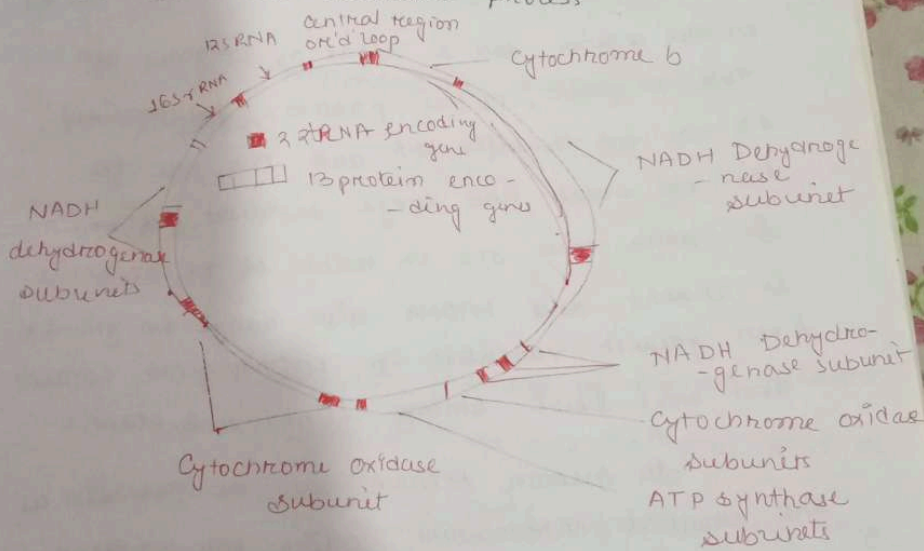


Fig: Mitochondrial DNA  
Structure and Organization of MTDNA;

In most multicellular organisms, the MTDNA

is organised as a circular, covalently closed double-stranded DNA. But in many unicellular there is both mtDNA & linearly organised DNA double stranded circular mtDNA molecule consist of 15,000-17,000 base pairs. The two strand of nucleotide content, heavy strand (or H-strand) and cytosine rich strand referred as light strand (L-strand). The H-strand encodes 28 genes, and the light strand encodes 9 genes for a total of 37 genes. of these 37 genes, 13 are proteins (polypeptides), 22 are for transfer RNA and two are for the small and large subunit of rRNA. In some case one or more of the 37 genes is absent and mtDNA size range is greater. Even greater variation in mtDNA genes content and size exist among fungi and plants.

In human, mtDNA can be assessed as the smallest chromosome coding for 37 genes and containing  $\approx$  16,600 base pairs in plants there are about 120 genes assemble on mtDNA.



### Chloroplast genes

Plants are unique among higher organisms in that they must obtain water and  $CO_2$  through photosynthesis. The specific photosynthetic genes in chloroplast which contain a single circular chromosome composed of DNA chloroplast DNA. Contains many genes necessary for photosynthesis and protein synthesis. Chloroplast deoxyribonucleic acid (ds) also known as cpDNA or CTDNA. It also known as plastomes when referring to genome of other plastids.

### Miscellany

Chloroplast existence was first proved in 1962 and first sequenced in 1984 when Eric Japanese researcher team sequenced the chloroplast DNA of *Linum catharticum* and tobacco but they are mostly experiment on green algae - glaucophytes, red algae and the basis of typical chloroplast.

### Structure and Composition

Chloroplast DNA are circular, and are

typical 120,000 - 170,000 base pairs long  
they are 20-60 million bp long. most  
chloroplast have their chloroplast genome  
combines into a single large ring. then  
the angiosperms genome is broken up into  
small plastids each 2000 - 10,000 base  
pairs long. ~~cpd~~ cpDNA have a circular  
structure, but some are linear  
shape 95%. cpDNA do have branched  
lines formed. cpDNA is not associated  
with true histones. In red algae a histone  
like chloroplast protein (H) coded by  
cpDNA tightly packs each chloroplast  
ring.

In green plant and green algae, the  
nucleoid are dispersed throughout stroma.  
In higher plant contain 120 genes more  
than 20 of chloroplast genome are sequenced  
salient features of cpDNA:

→ Ri's and Plant (1982), first reported

- DNA molecules in chloroplast of Chlamydomonas
- size DNA molecule here is double helical
  - Average length: 45  $\mu$ m, i.e. about 135,000 bp
  - Replication of chloroplast DNA has been followed with <sup>3</sup>H-thymidine
  - Genetic maps of CTDNA have been successfully made w/ use of restriction enzyme
  - CTDNA codes for follows —
    - Chloroplast mRNA
    - Chloroplast rRNA
    - Chloroplast tRNA
    - Chloroplast ribosomal protein
    - certain structural proteins of thylakoid membrane
  - The large subunit of CDAK enzyme weighs about 55,000 D.
  - In higher plants, cpDNA varies in size from 180 - 160 Kb.
  - In algae 85-292 Kb Chloroplast genome are found, which is circular.



CPNA *monas* *reimhanatii* contain 200 copies of

→ The large single chloroplast of *Chlamydomonas*  
about 200kb

*Asterionella*, the CPNA appear to be much  
→ In species of green algae of genus