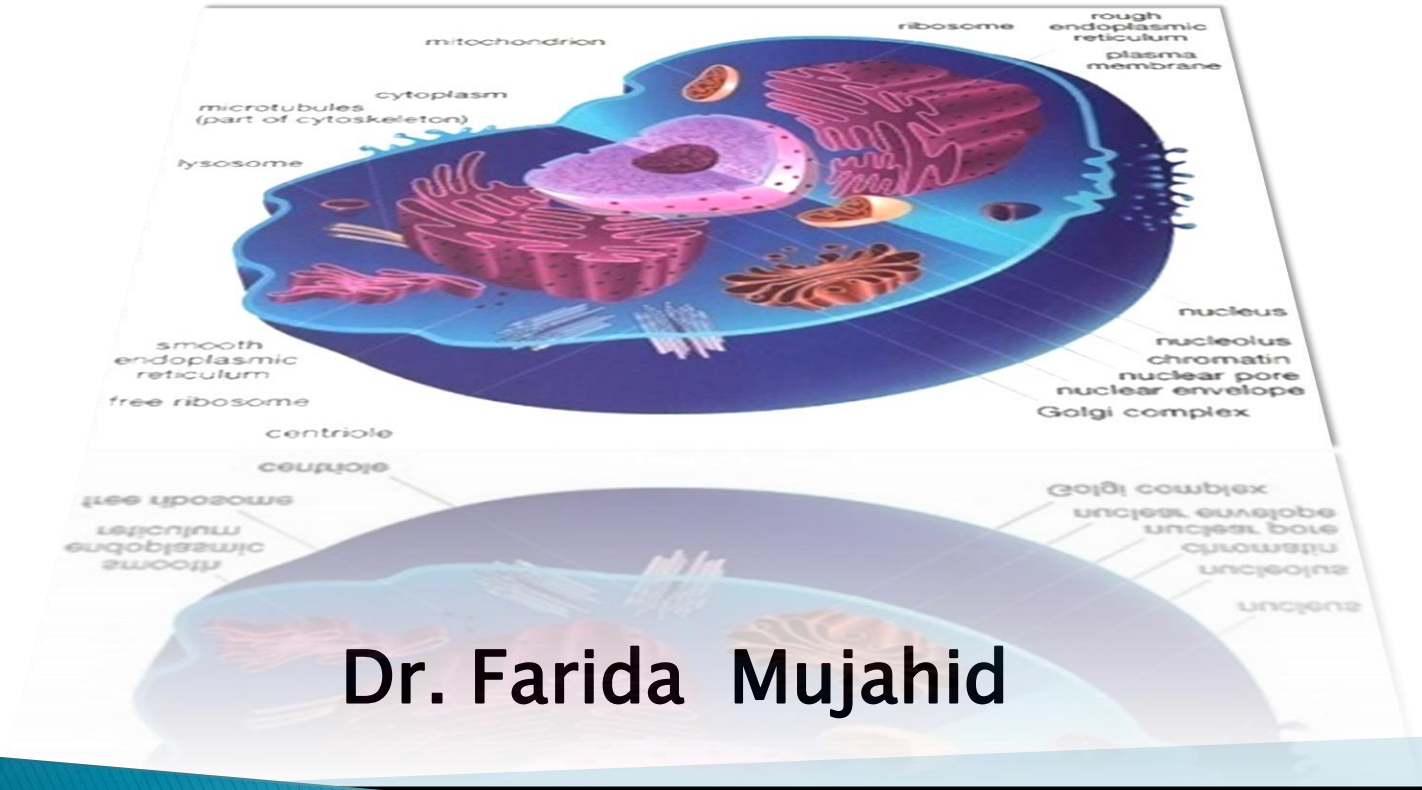
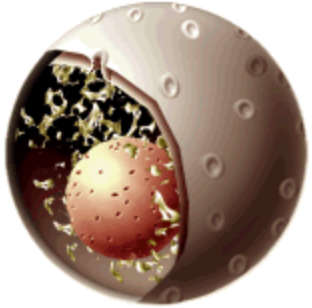
CELL AND CELL ORGANELLES



Dr. Farida Mujahid

Nucleus(control centre of the cell)

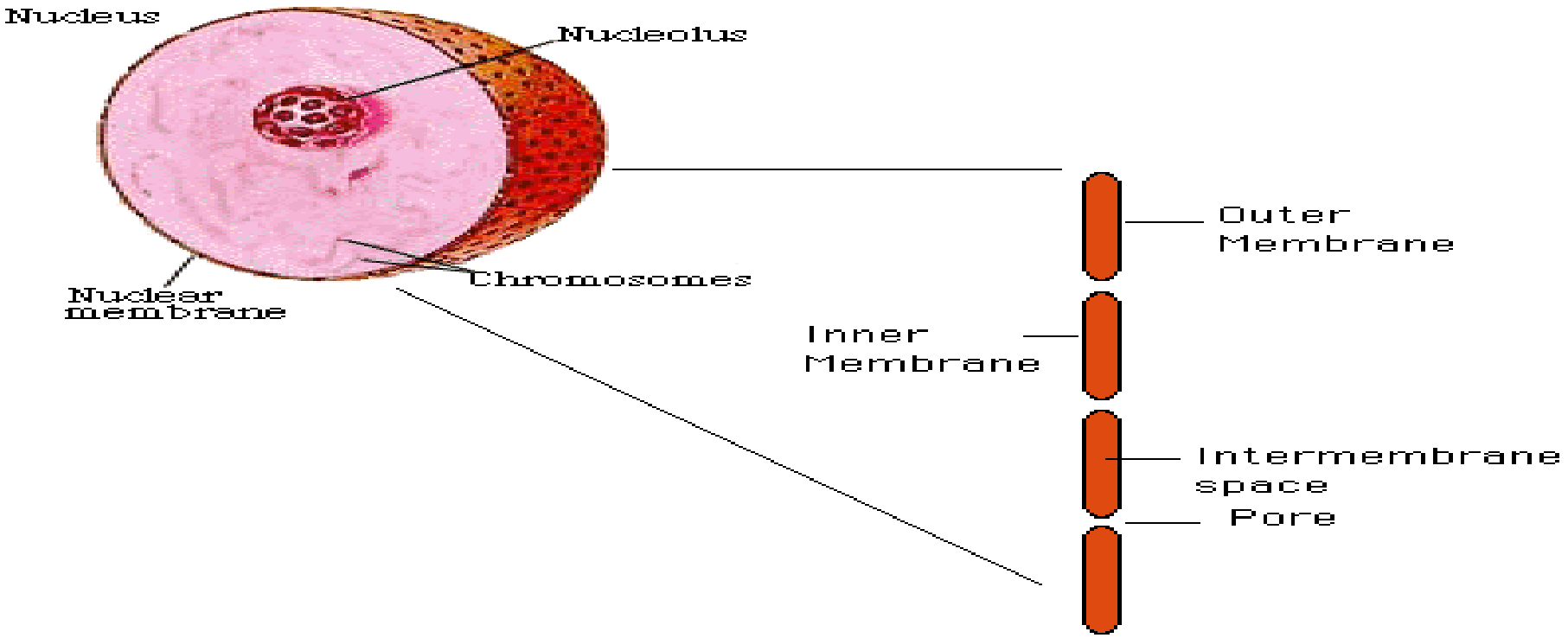


Double membrane surrounding the chromosomes, nucleolus in nucleoplasm.

- Nuclear envelope
- Nuclear pore complexes
- Chromatin
- Nucleolus
- Nucleoplasm

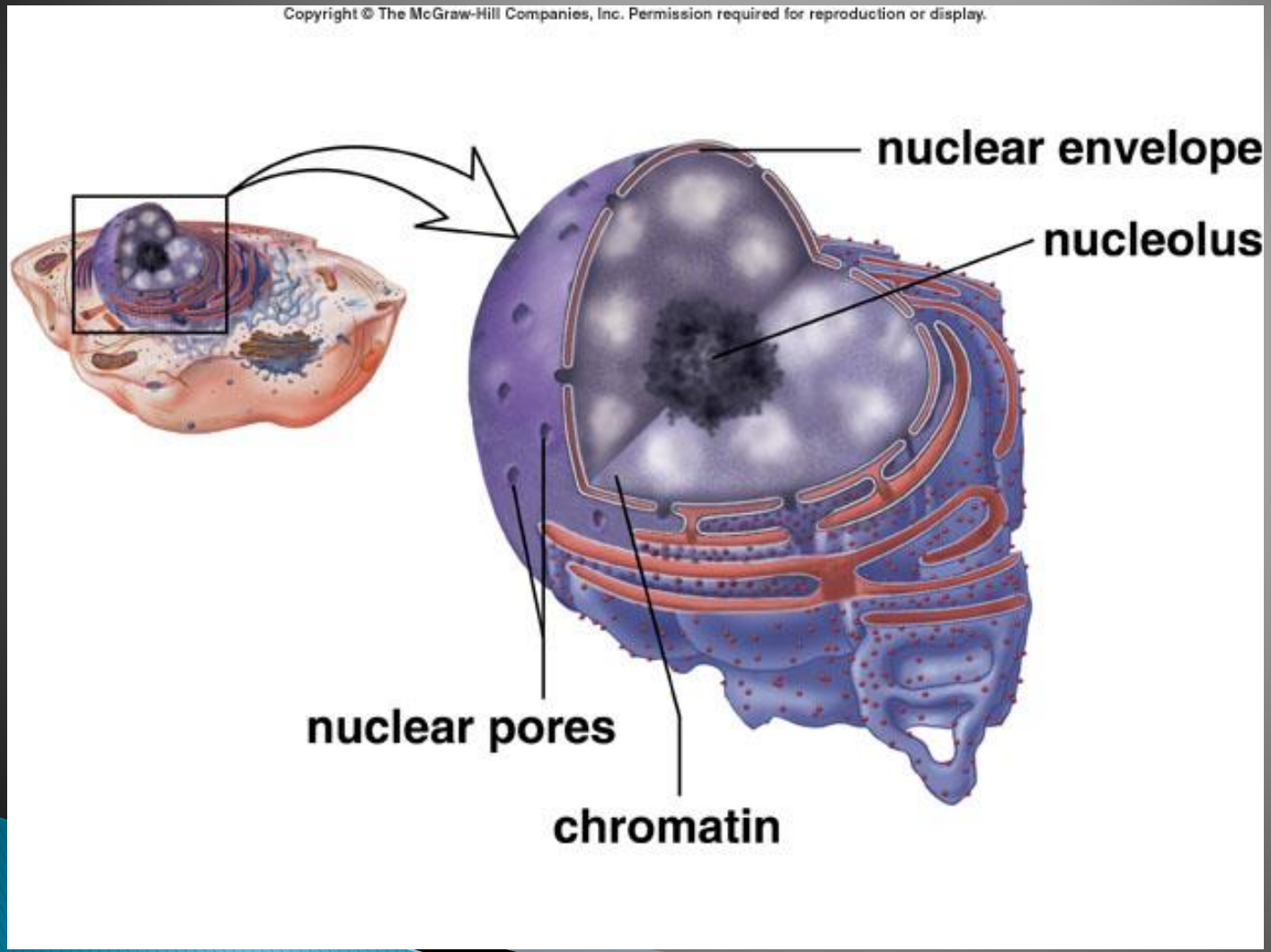
Nuclear membrane

- The nucleus is separated from the cytoplasm by the double membrane nuclear envelope.
- Embedded in the nuclear envelope are nuclear pore complexes, which control the movement of proteins & RNAs across the nuclear envelope.



Nucleus: DNA stored here.

The Control Center



Nuclear envelope: membrane surrounding the nucleus

Nuclear pores: openings of communication between the nucleus & cytoplasm

Chromatin: condensed DNA

Chromosome: very tightly packed DNA

Nucleolus: dense region of chromatin

Nuclear pore

- The exchange of substances between the nucleus and the cytoplasm is mediated by pore complexes. The nuclear pores consist of numerous proteins that form several connected rings of varying diameter.
- Low-molecular structures and small protein s can enter the nucleus without difficulty. By contrast, larger proteins can only pass through the nuclear pores if they carry a nuclear localization signal. mRNAs and rRNAs formed in the nucleus cross the pores into the cytoplasm.

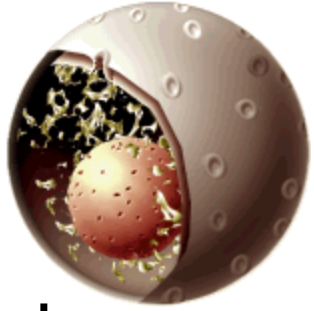
Nucleolus (Nucleoli)

- A spherical structure visible in the nucleus during interphase.
- The nucleoli are involved in r RNA synthesis and ribosome formation.
- No membranes separate nucleoli from the surrounding chromatin in the nucleus.

Chromatin

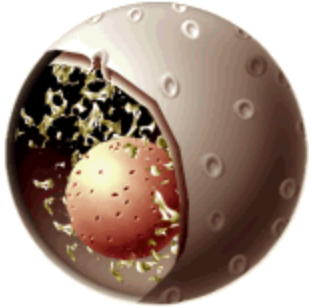
- Nucleus is the control center of the cell containing 95% of its DNA, which is tightly packed with positively charged proteins called histones and coiled into a dense mass called chromatin. Replication of DNA and transcription of DNA into RNA occur in the nucleus. The nucleus is not capable of synthesizing proteins. All of the nuclear proteins therefore have to be imported from cytoplasm.

Functions of nucleus



- Chromosomes present in the nucleus which serve to store, express and transfer the genetic information from one to other generation.
- Nucleolus the factory of r RNA synthesis & is also the major site where ribosome subunits are assembled
- DNA replication takes place in the nucleus during cell division.

Biomedical significance of nucleus



- **Karyoplasmic index constant (N:C ratio)**

- the ratio b/w nucleus and cytoplasmic volume is proportional but in malignant tumours cells nucleus are irregular in shape and large in size.

MITOCHONDRIA

- It's a Greek word means: mito <thread> and chondrion <granule>
- It is a double membrane bound organelle found in eukaryotic cell.
- Found in cytoplasm.
- First observed by Richard Altman in 1894.
- Term mitochondria was coined by Carl Bend in 1898.

Mitochondria

- The mitochondria major role is ATP production in the eukaryotic cell.
- These are mobile and flexible organelles, although in some cells they tend to stay in a fixed position.
- Mitochondria have their own circular DNA but are not autonomous as the genes encoding most mitochondrial proteins are present in nuclear DNA.

Morphology

- **Shape** variable from rod-shape to spherical.
- **Size** 1.0- 10 um in length to 0.2- 0.8um in width.
- **Numbers** 500-800 upto 2500/cell.
- **Occurrence** uniformly distributed in cytoplasm.

Chemical composition

- Protiens 70%
- Lipids 25-30%
- 0.5 % RNA
- Traces of DNA comprise1% of total DNA
- Several enzymes for oxidative phosphorylation and ETC.

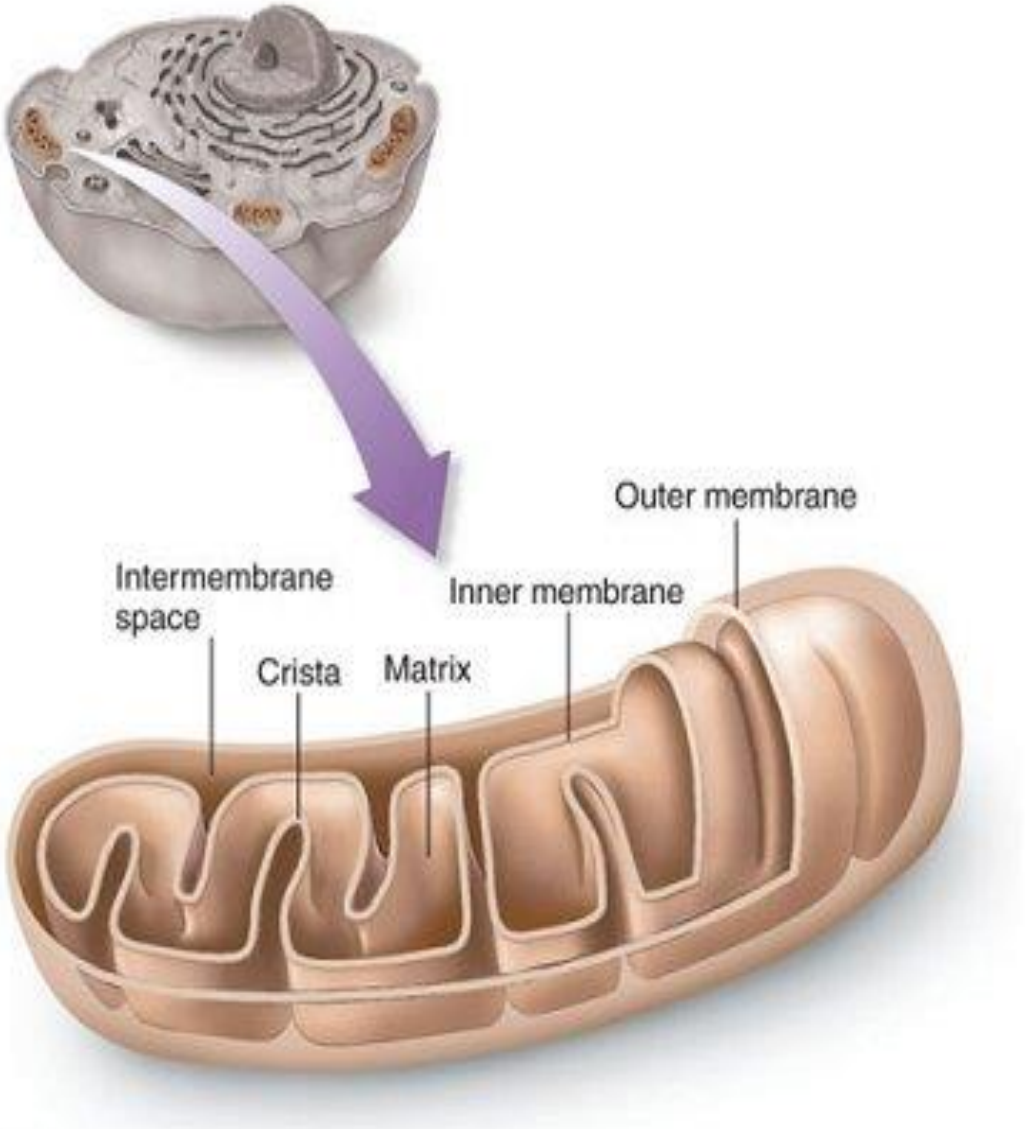
Mt DNA

- Contain its own copies of DNA and RNA along with transcription and translation system.
- Are able to regenerate themselves

Cytoplasmic Inheritance

- In most of the animals mitochondria is inherited from mothers .
- Mitochondria in sperms also enters oocyte but are destroyed by the egg cells after fertilization.

MITOCHONDRIA–"powerhouse of the cell"



- Outer membrane
- Inner membrane
- Inter membrane space
- matrix
- Cristae

Outer membrane

- Its simple phospholipid bilayer.
- It encloses mitochondria.
- The outer membrane possess protein called **'Porin'** involved in some oxidation reactions & in transportation by forming channels.
- Ions, nutrients, ATP, ADP etc. can pass it easily.
- Oxidation of epinephrine
- Degradation of Tryptophan
- Elongation of fatty acids

} Functions

Inner membrane

- It Is freely permeable only to oxygen, CO2 and water.
- Others material can pass it only by transporter proteins help.
- Contain complexes of ETC, the ATP Synthase complex and the transport proteins.
- Oxidative phosphorylation.
- ETC cycle
- Pyruvate import
- others

} functions

Inter membrane space

- The space between outer and inner membrane.
- It is high in proton concentration.

Cristae

- The inner membrane creates folding's that provides a large surface area for different reactions to occur.
- high surface area allows greater capacity for ATP production.

Matrix

- Matrix contains several enzymes involved in citric acid cycle & fatty acid oxidation.
- Kreb's cycle
- Beta oxidation
- Detoxification of NH3
- Storage of calcium ions

} Functions

Important enzymes

Outer membrane

- Cytochrome b5
- Cytochrome b5 reductase
- Fatty acid coA
- Phospholipase A
- Nucleoside diphosphokinase

Inner membrane enzymes

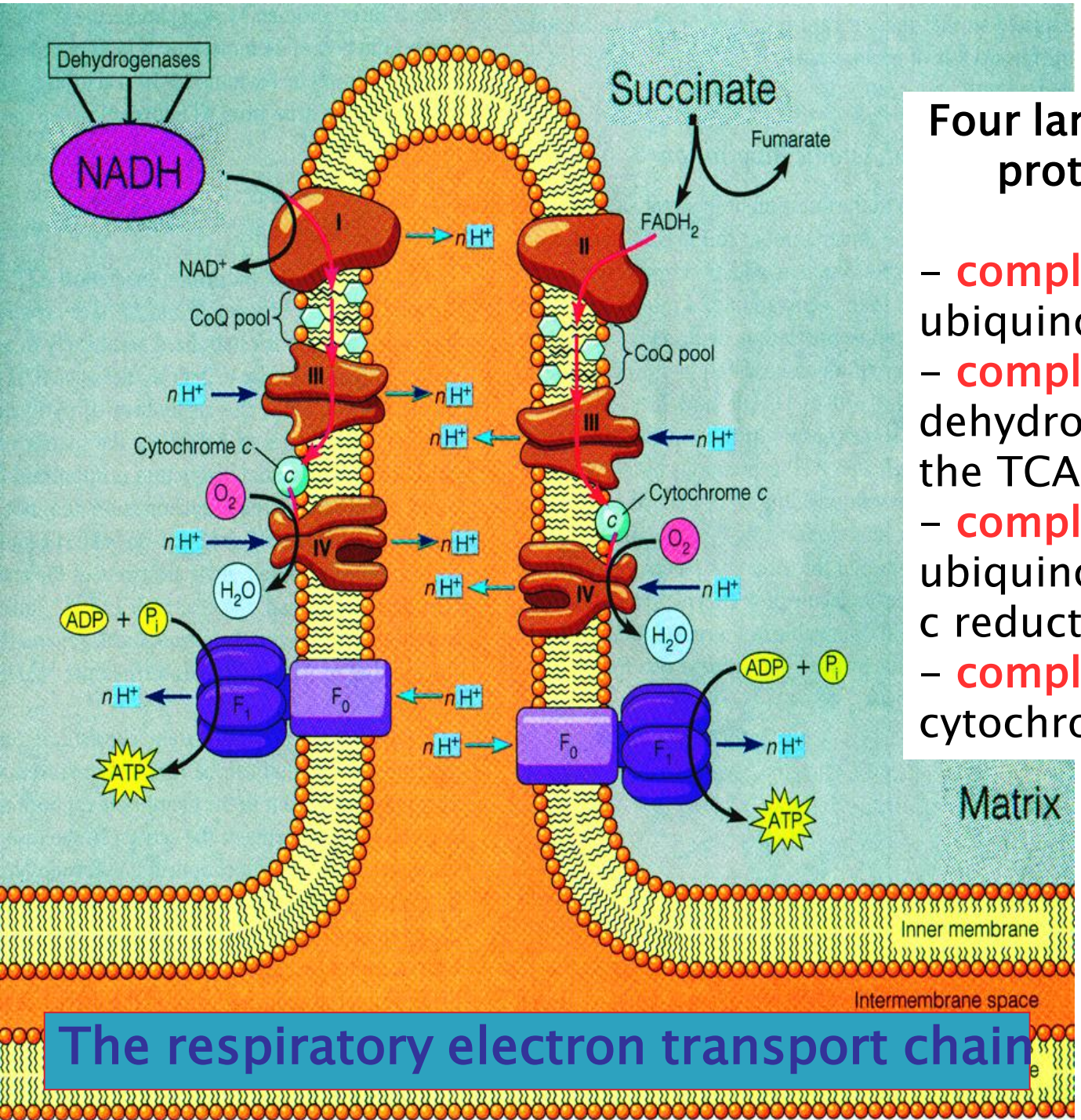
- Cytochrome b, C1,C, a and a3
- NADH dehydrogenase
- Succinate dehydrogenase
- Ubiquinone
- Electron transferring flavoprotiens
- Vector ATP synthase
- Beta- OH-butyrate dehydrogenase
- Carnitine palmityl transferases
- All translocases

Matrix enzymes

- Pyruvate dehydrogenase complex
- Citrate synthase
- Aconitase
- Isocitrate dehydrogenase
- Alpha-oxoglutarate dehydrogenase
- Malate dehydrogenase
- Fatty acid oxidation system
- Ornithin transcarbomylase
- Carbomyle phosphate synthase I

Inner membrane space enzymes

- Adenylate kinase
- Sulphite oxidase
- Nucleoside diphosphokinase



The respiratory electron transport chain

Four large, multi-subunit protein complexes

- **complex I** is a NADH-ubiquinone reductase
- **complex II** is succinate dehydrogenase (part of the TCA cycle)
- **complex III** is the ubiquinone -cytochrome c reductase
- **complex IV** is cytochrome oxidase

Biomedical significance of mitochondria

Mitochondrial diseases are caused by dysfunction of mitochondria

(known as mitochondrial cytopathy) .

Can occur in all ages groups.

Deficient energy production caused from defects in its structure or enzymes within this organelle.

This dysfunction may be genetic are acquired.e.g

- Luft's disease. Occure due to the damage to mitochondria by free radicals.
- Genetic disorders like Leigh syndrome.
- others


Thank
you!