**Nucleus:**

- The cell nucleus is a membrane-bound structure that contains the cell's hereditary information and controls the cell's growth and reproduction.
- It is the command center of a eukaryotic cell and is commonly the most prominent organelle in a cell accounting for about 10 percent of the cell's volume.
- In general, a eukaryotic cell has only one nucleus. However, some eukaryotic cells are enucleated cells (without a nucleus), for example, red blood cells (RBCs); whereas, some are multinucleate (consists of two or more nuclei), for example, slime **molds**.
- The nuclear envelope has a complex structure consisting of:

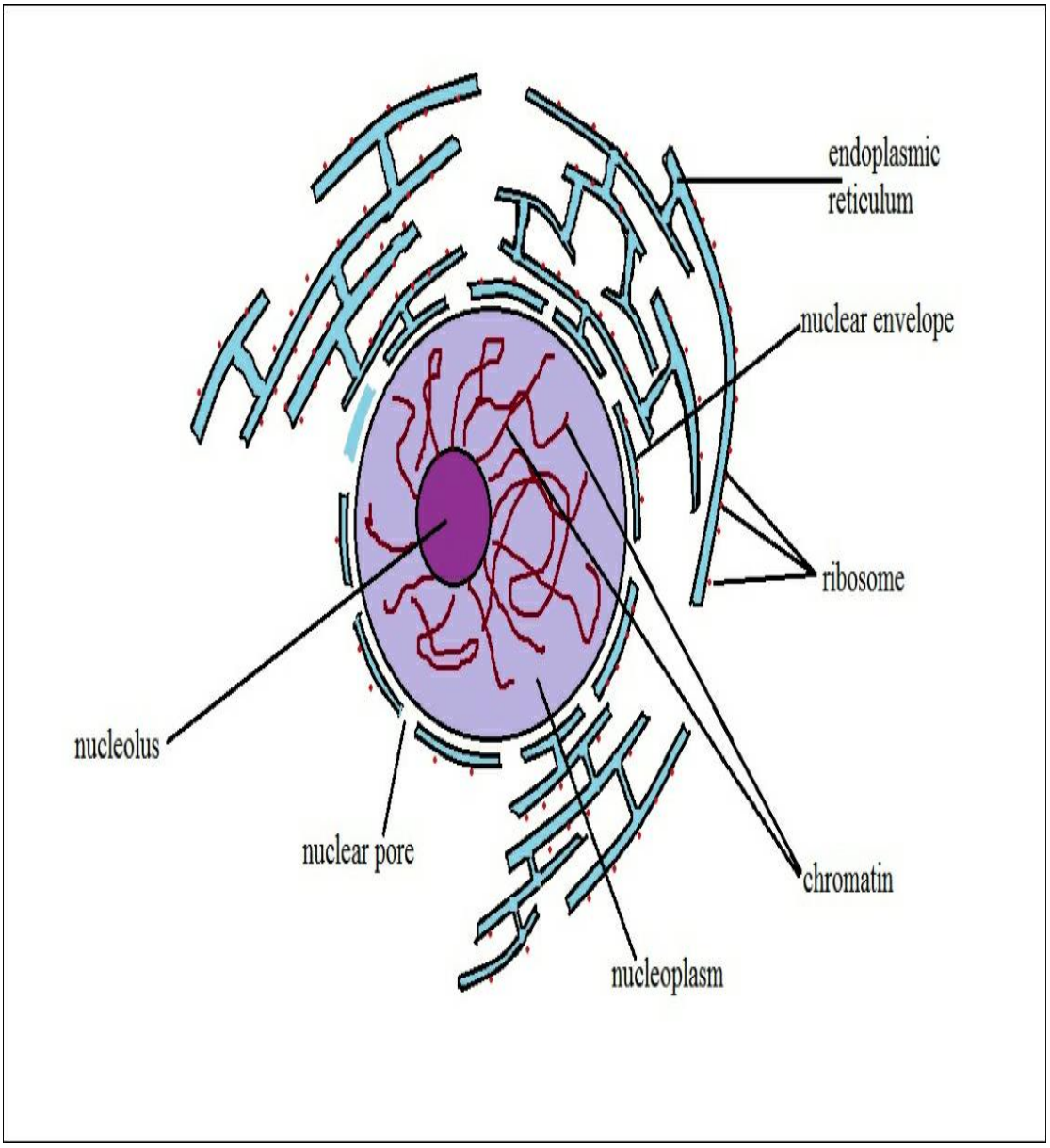
  a) Two nuclear membranes separated by a perinuclear space measuring about 20–40 nm.

  b) Underlying nuclear lamina

**Nuclear membrane:**

- The nucleus is surrounded by a system of two concentric membranes, called the inner and outer nuclear membranes
- The inner and outer nuclear membranes are joined at nuclear pore complex.
- The outer nuclear membrane is continuous with the endoplasmic reticulum, so the space between the inner and outer nuclear membranes is directly connected with the lumen of the ER. It is functionally similar to the membranes of the ER and has ribosomes bound to its cytoplasmic surface but protein composition differs slightly as they are enriched in proteins which binds to cytoskeleton
- The inner nuclear membrane carries proteins that are specific to the nucleus, such as those that bind the lamina

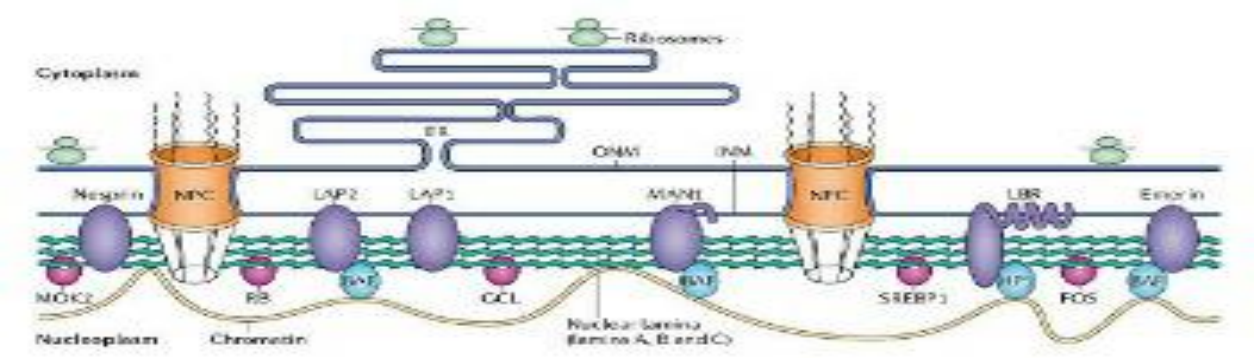
- The critical function of the nuclear membranes is to act as a barrier that separates the contents of the nucleus from the cytoplasm.




- Like other cell membranes, each nuclear membrane is a phospholipid bilayer permeable only to small nonpolar molecules. Other molecules are unable to diffuse through the bilayer.

**Nuclear lamina:**

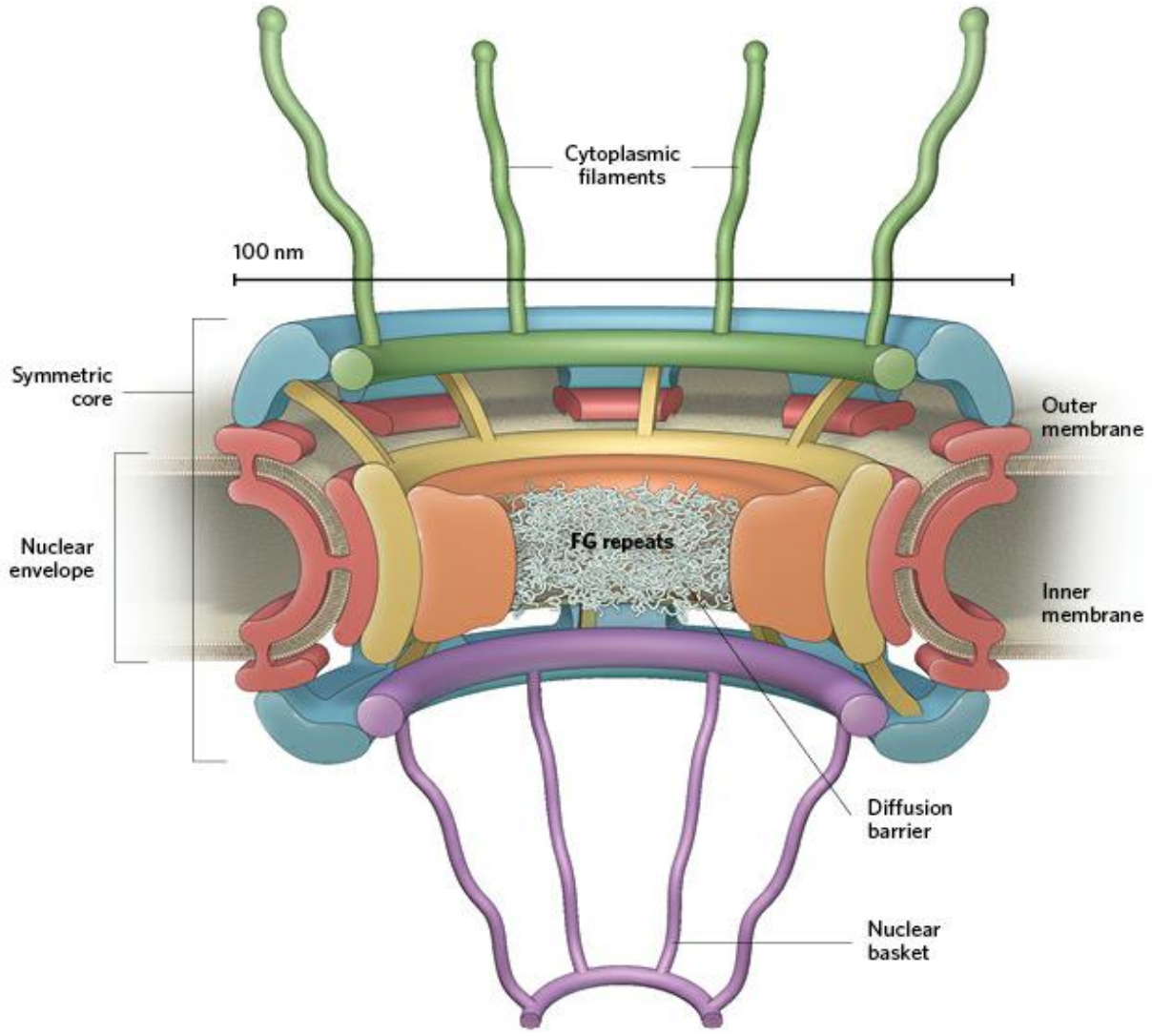
- It is a fibrous network that provides structural support to the nucleus envelope. Nuclear lamina is composed of fibrous proteins called Lamins.
- Lamins are a class of intermediate filament proteins. Mammalian cells have three lamin genes, designated A, B, and C, which code for at least seven distinct proteins.
- Like other intermediate filament proteins, the lamins associate with each other to form higher order structures although the extent and polarity of this association is thought to differ from that of other intermediate filament.




**Nuclear pore complex:**

- The nuclear pore complexes are the only channels through which small polar molecules, ions, and macromolecules (proteins and RNAs) can travel between the nucleus and the cytoplasm.
- The nuclear pore responsible for the selective traffic of proteins and RNAs between the nucleus and the cytoplasm.
- The nuclear pore complex is an extremely large structure about 30times the size of a ribosome with a diameter of about 120 nm. ln vertebrates, the nuclear pore complex is composed of 30-50 different pore proteins called nucleoporins, most of which are present in multiple copies.

- Nuclear pore complex consists of an assembly of eight spokes arranged around a central channel therefore we can say it has its octagonal symmetry.




• The spokes are connected to rings at the nuclear and cytoplasmic surfaces, and the spoke-ring assembly is anchored within the nuclear envelope at sites of fusion between the inner and outer nuclear membranes.

- Protein filaments extend from both the cytoplasmic and nuclear rings, forming a distinct basketlike structure on the nuclear side.

**Transport across nuclear pore complex:**

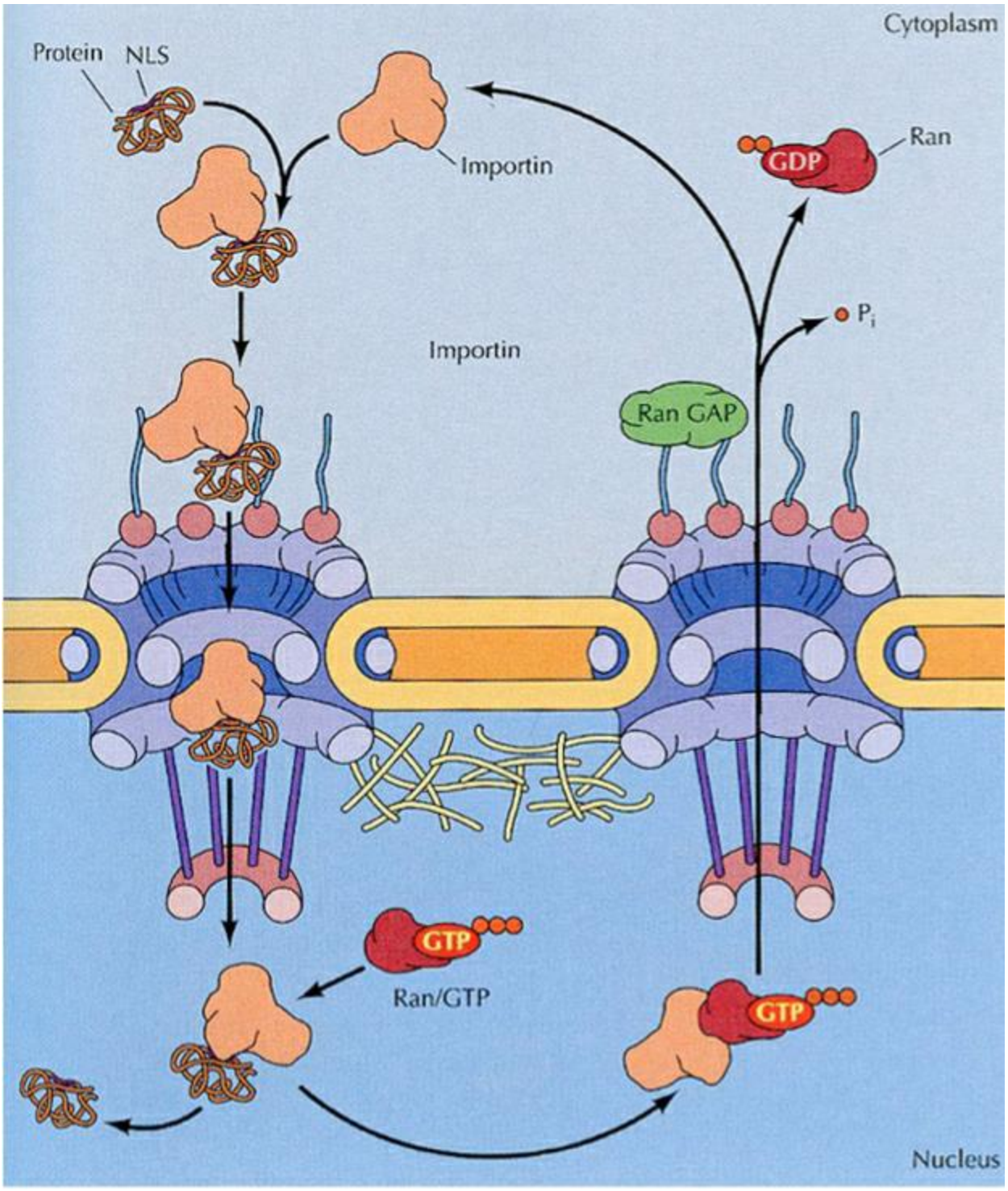
- The NPC forms the conduit for the exchange of information between the nucleus and cytoplasm.
- Important molecules transported across the NPC are Proteins required for DNA replication.

**Protein import through the NPC:**

- The Importin-Ran/GTP complex is then exported back through the nuclear pore complex.
- In the cytoplasm the GTP hydrolyzed to GDP releases the importin in the cytoplasm for another round of transport.
- The Ran/GDP formed in the cytoplasm is then transported back to the nucleus by its own import receptor (a protein called NTF2}, where Ran/GTP is regenerated.

**Protein export through the NPC:**

- Complexes between cargo proteins bearing nuclear export signals (NES), Exportins, and Ran/GTP form in the nucleus.
- Following transport through the nuclear pore complex, Ran GAP stimulates the hydrolysis of bound GTP, leading to formation of Ran/GDP and release of the cargo protein and Exportins into the cytoplasm.
- Exportins is then transported back to the nucleus.


Cytoplasm
Protein
NLS
Importin
GDP
Ran
Importin
$P_i$
Ran GAP
GTP
Ran/GTP
GTP
Nucleus