

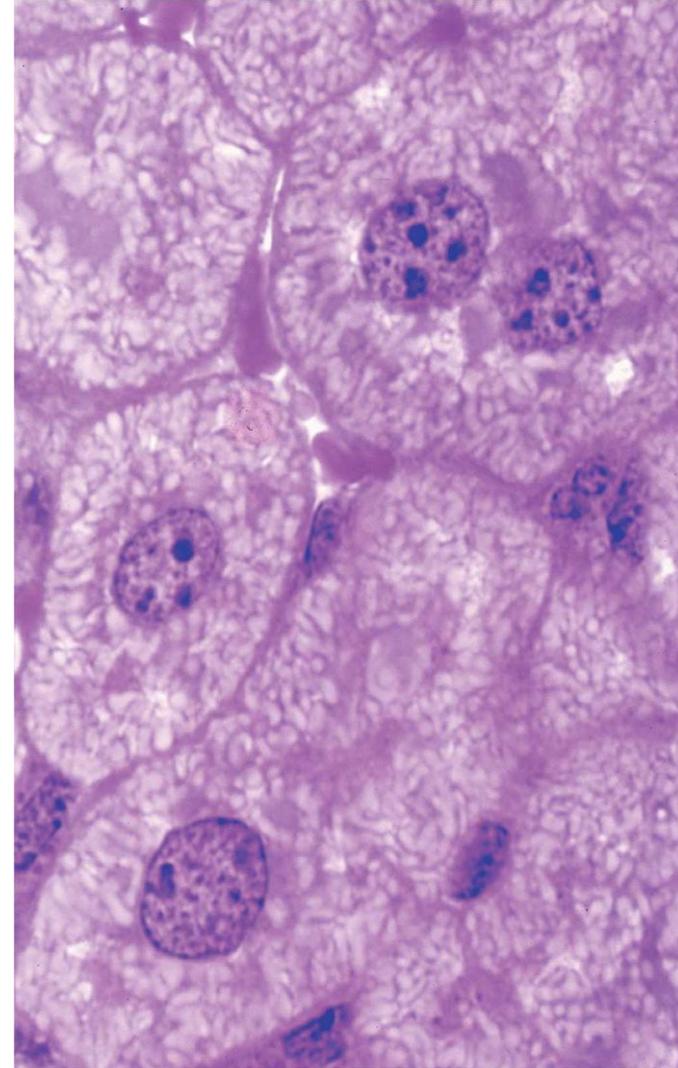
Nucleus

- ❑ The Nucleus is the largest a **membrane-enclosed organelle** which house **most** of the **genetic** information and regulatory machinery responsible for providing the cell with its unique characteristics

Functions

The nucleus (**controls** all cell activity)

- It stores the cell's hereditary material (DNA)
- Site of DNA replication
- Site of DNA transcription to mRNA
- Ribosomal formation
 - Nucleolus:** RNA & protein required for ribosomal synthesis
- It coordinates the cell's activities, which include growth, metabolism, protein synthesis, and reproduction (cell division) by regulating gene expression



LM: Basophilic

☐ It is the most obvious organelle

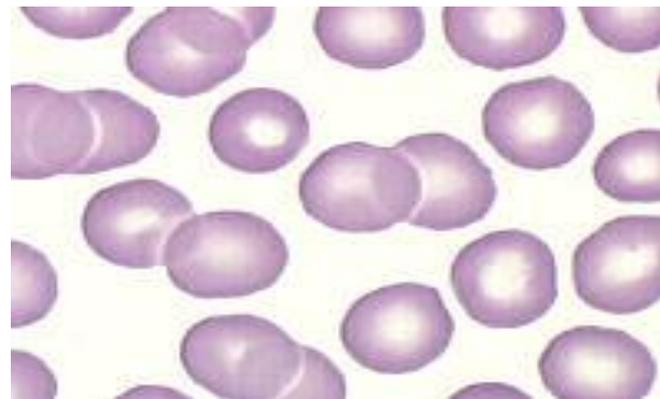
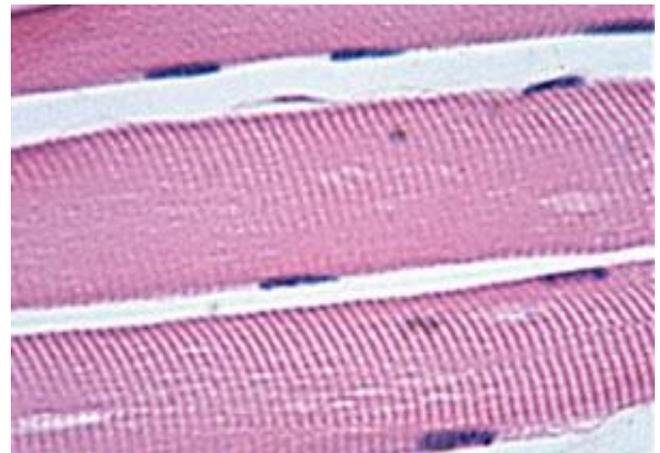
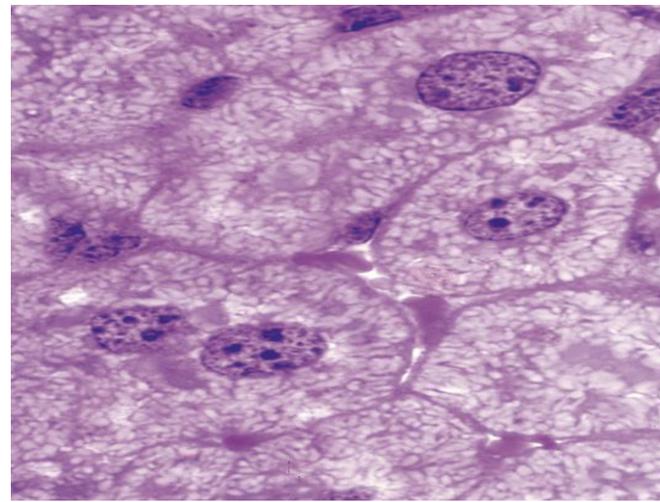
Variable in number

One = Mononucleated cells

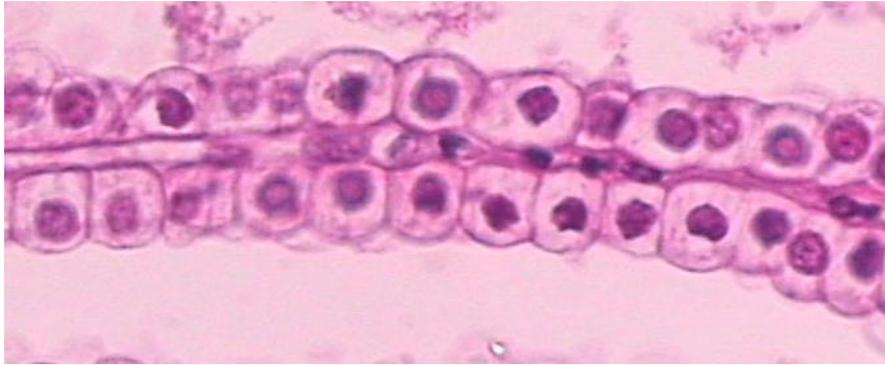
Two = Binucleated cells

Multiple = Multinucleated cells

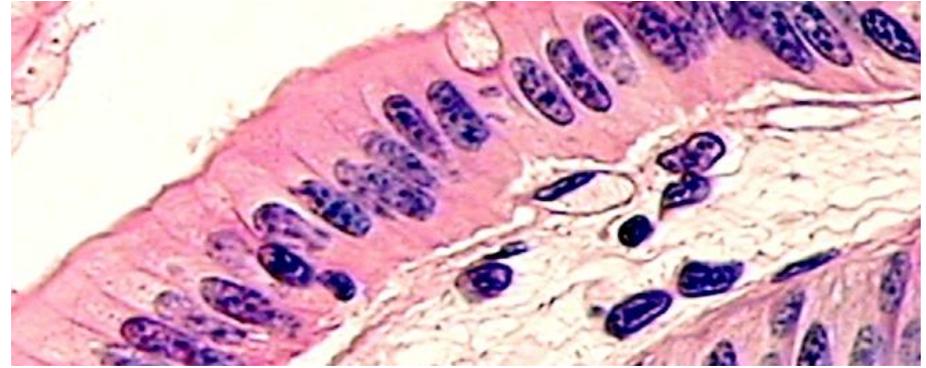
No = Anucleated



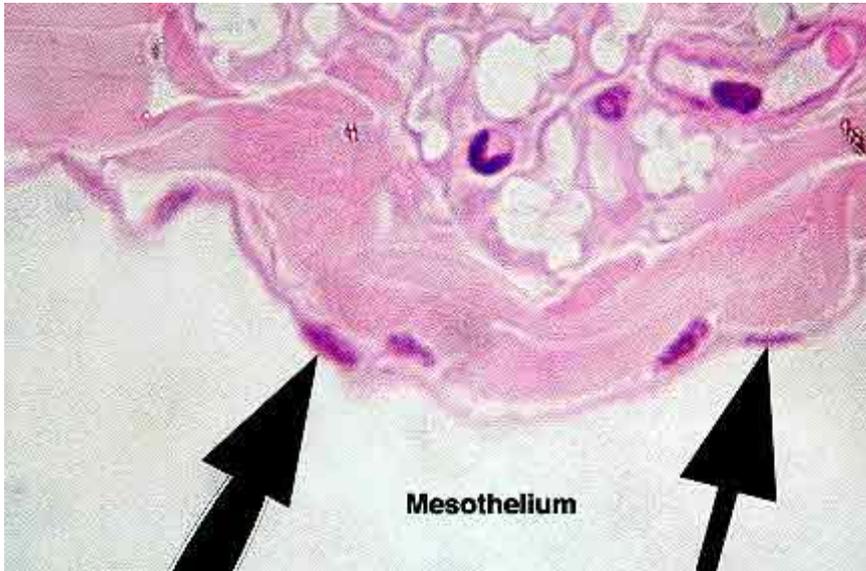
Variable in shape



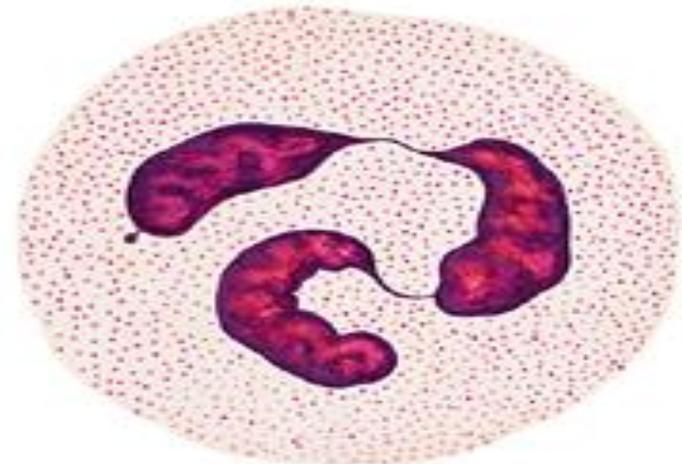
Rounded



Oval



Flat



Neutrophilic granulocyte

Lobulated

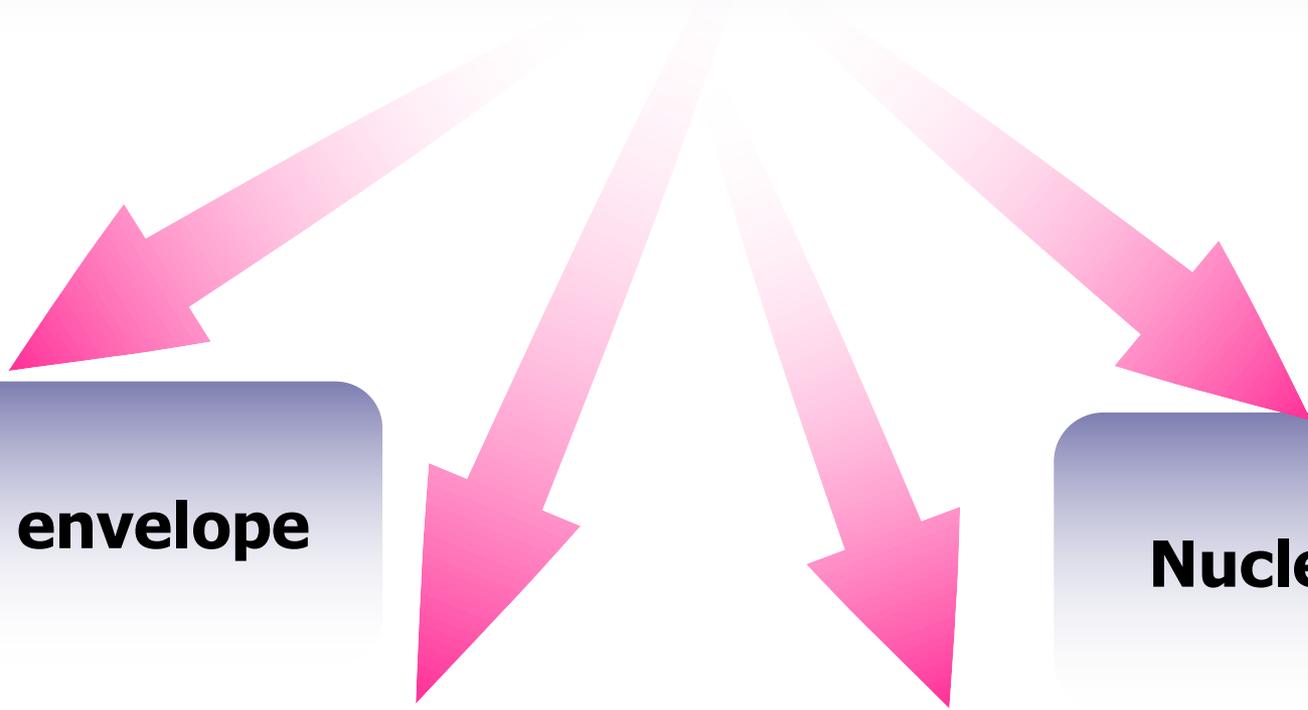
EM: Nucleus

Nuclear envelope

Chromatin

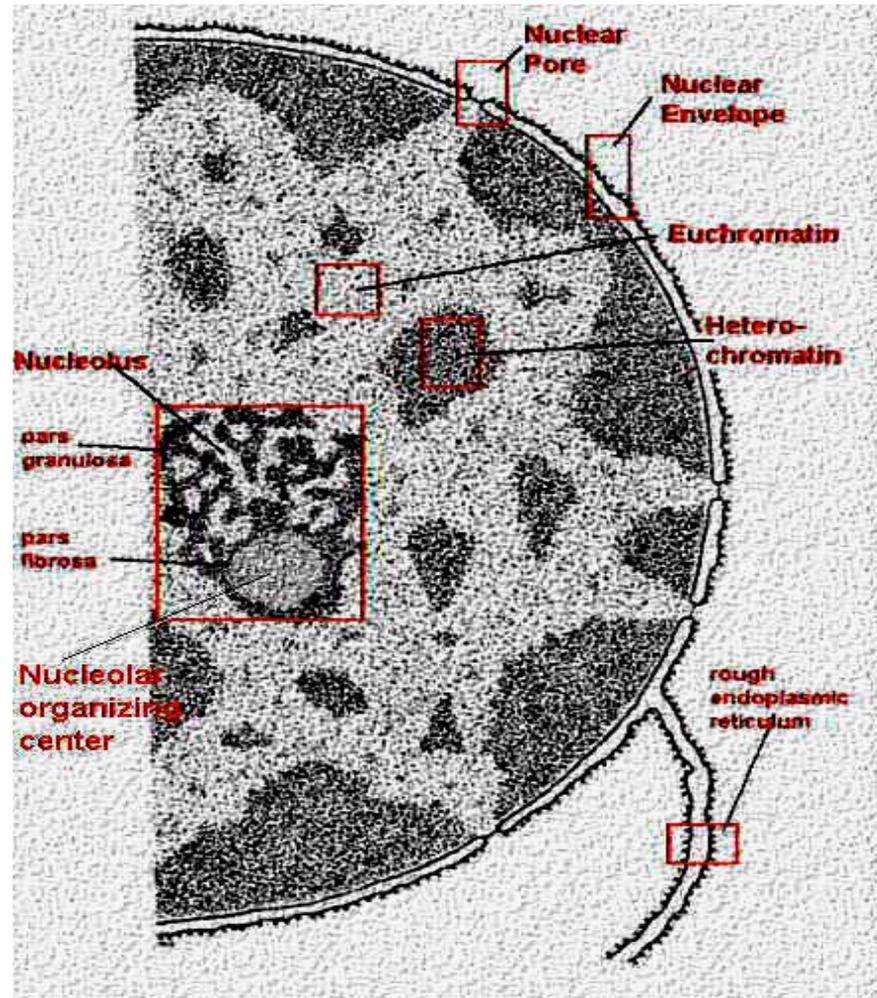
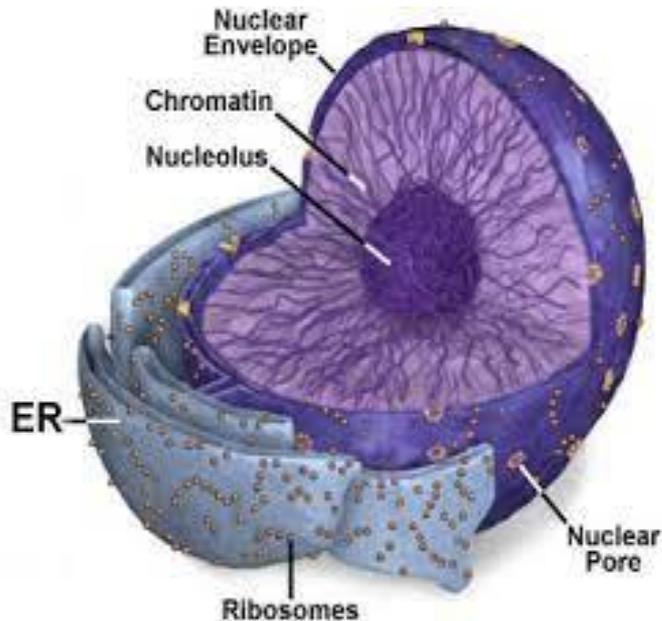
Nucleolus

Nuclear sap

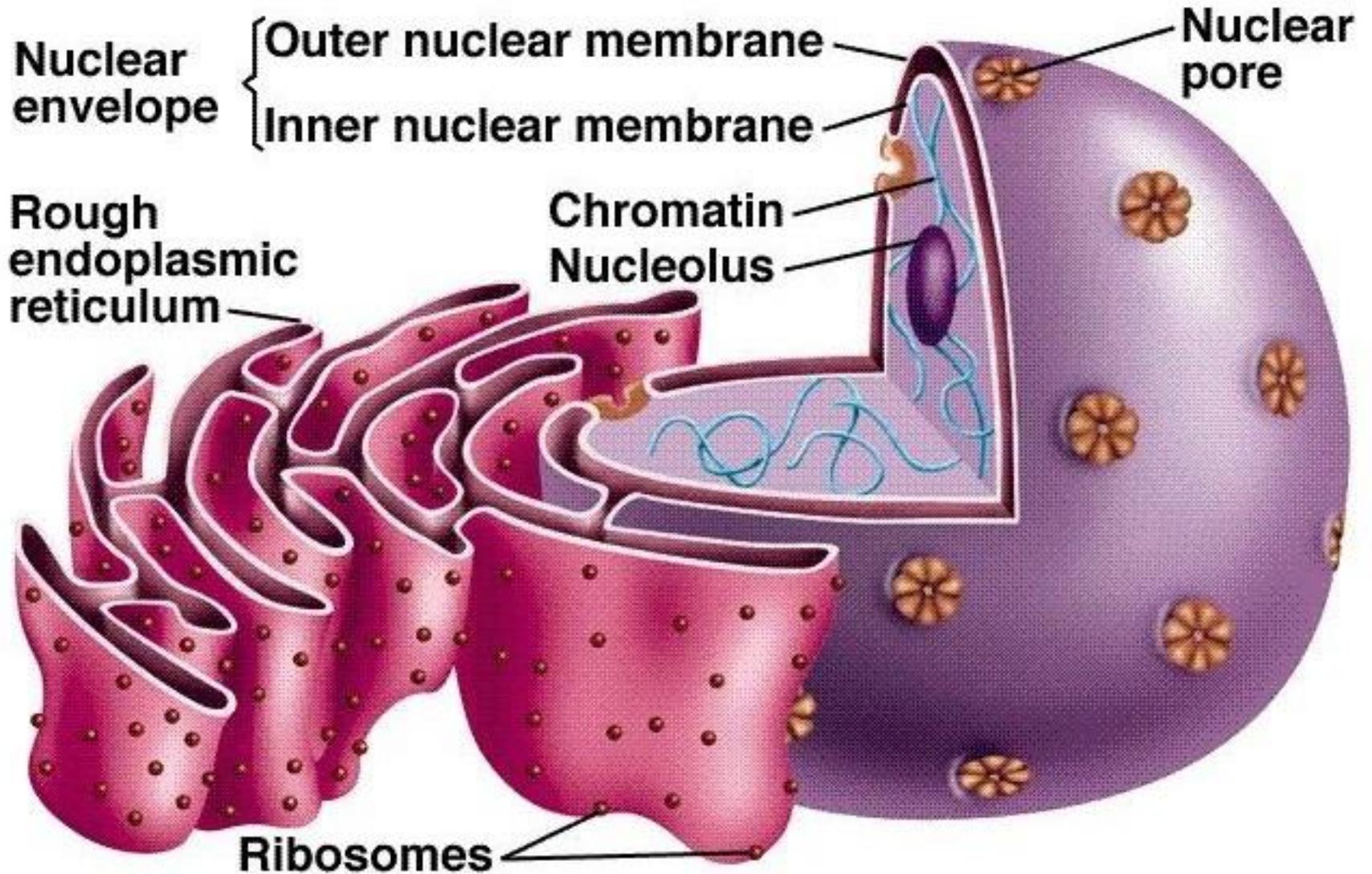


E.M STRUCTURE

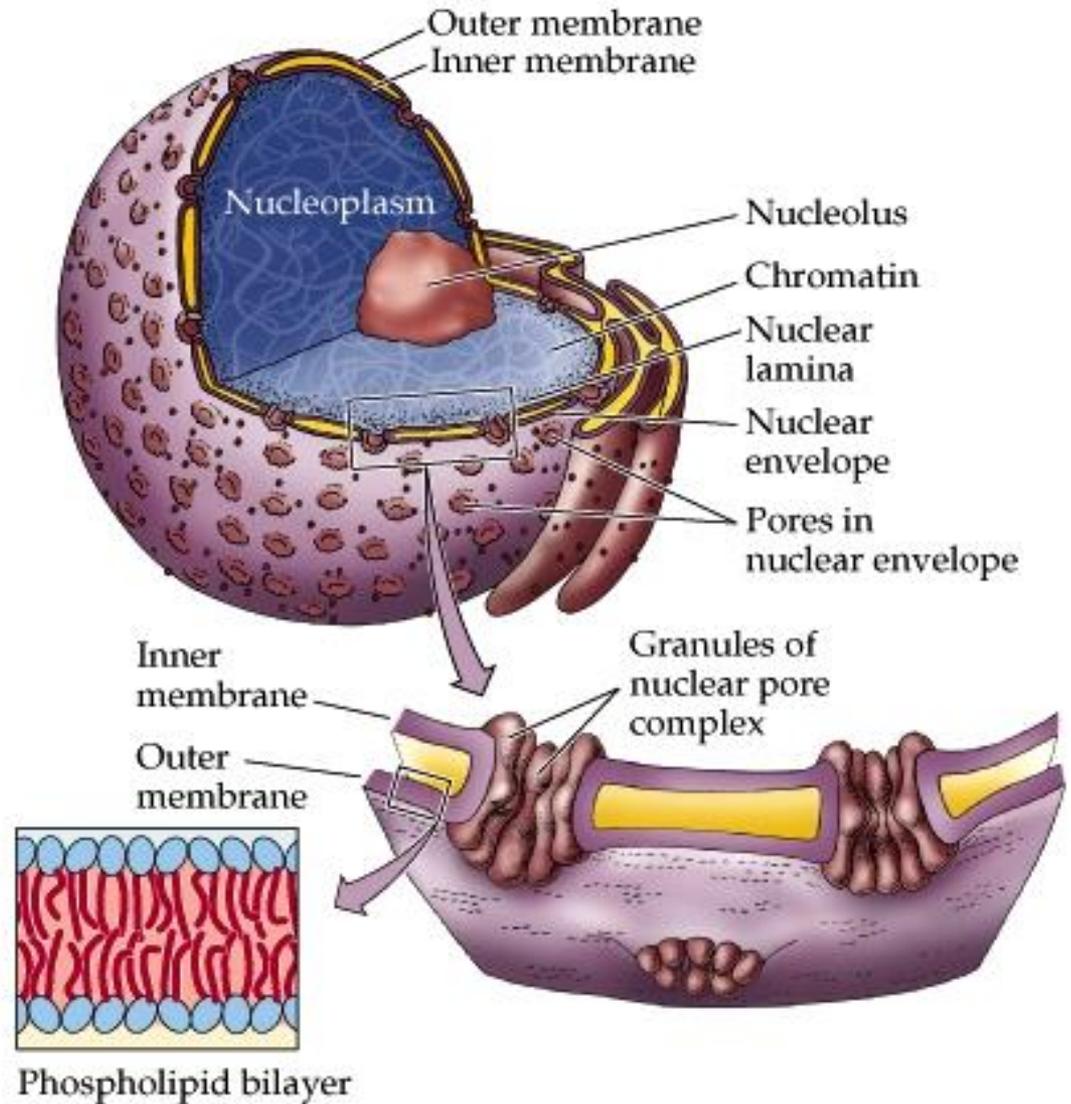
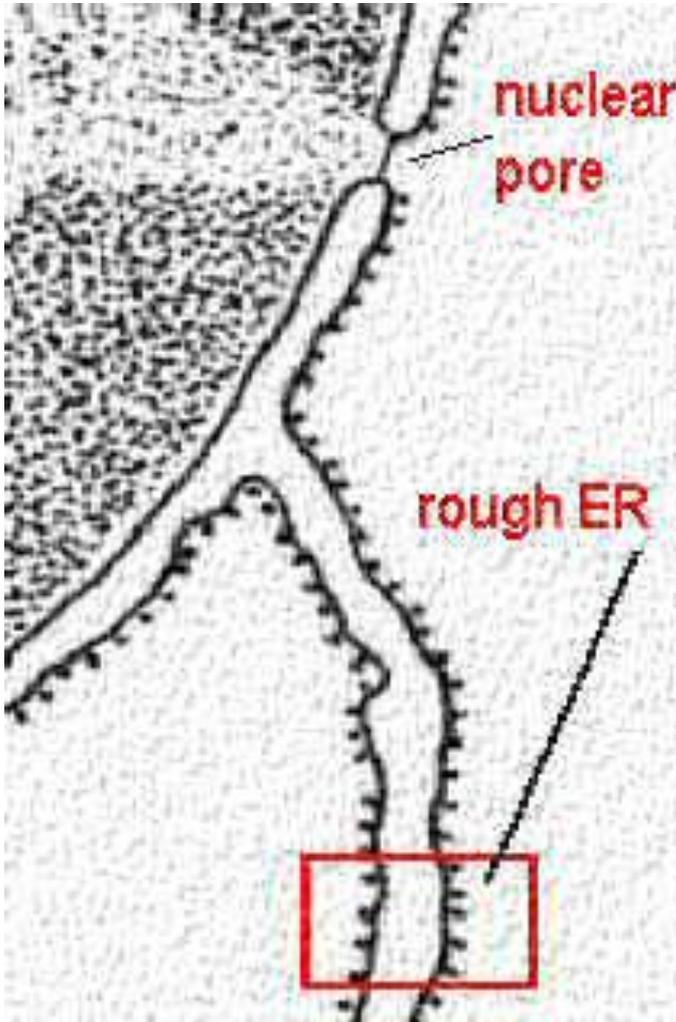
1. Nuclear envelope, double membrane and nuclear pores
2. Chromatin
3. Nucleolus
4. Nucleoplasm= Nuclear sap



Nuclear Envelope



Nuclear envelope



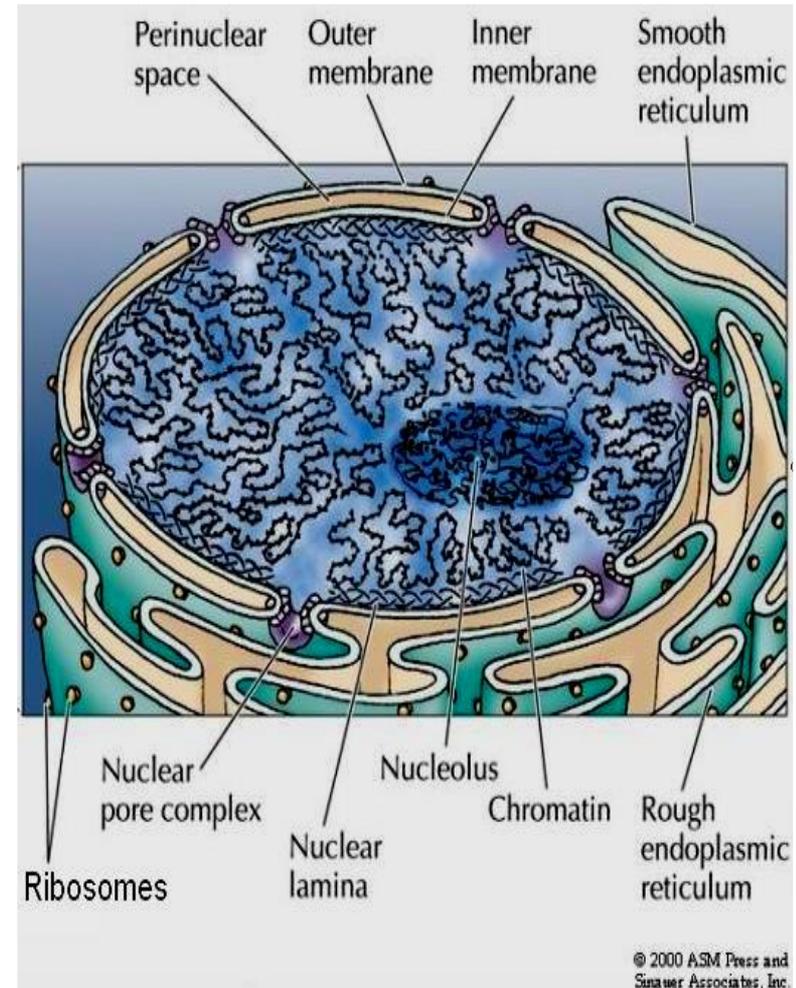
Nuclear envelope= nuclear membrane = (Nucleolemma)

Structure

- ❑ External (outer) nuclear membrane with ribosomes
- ❑ Perinuclear space
- ❑ Internal (inner) nuclear membrane with nuclear lamina
- ❑ Nuclear pores

Function

- Separates the enclosed nuclear compartment from cytoplasm
- Maintains the shape of nucleus
- Controls exchanges between nucleus and cytoplasm
- Important role in organization of nucleus content



External nuclear membrane

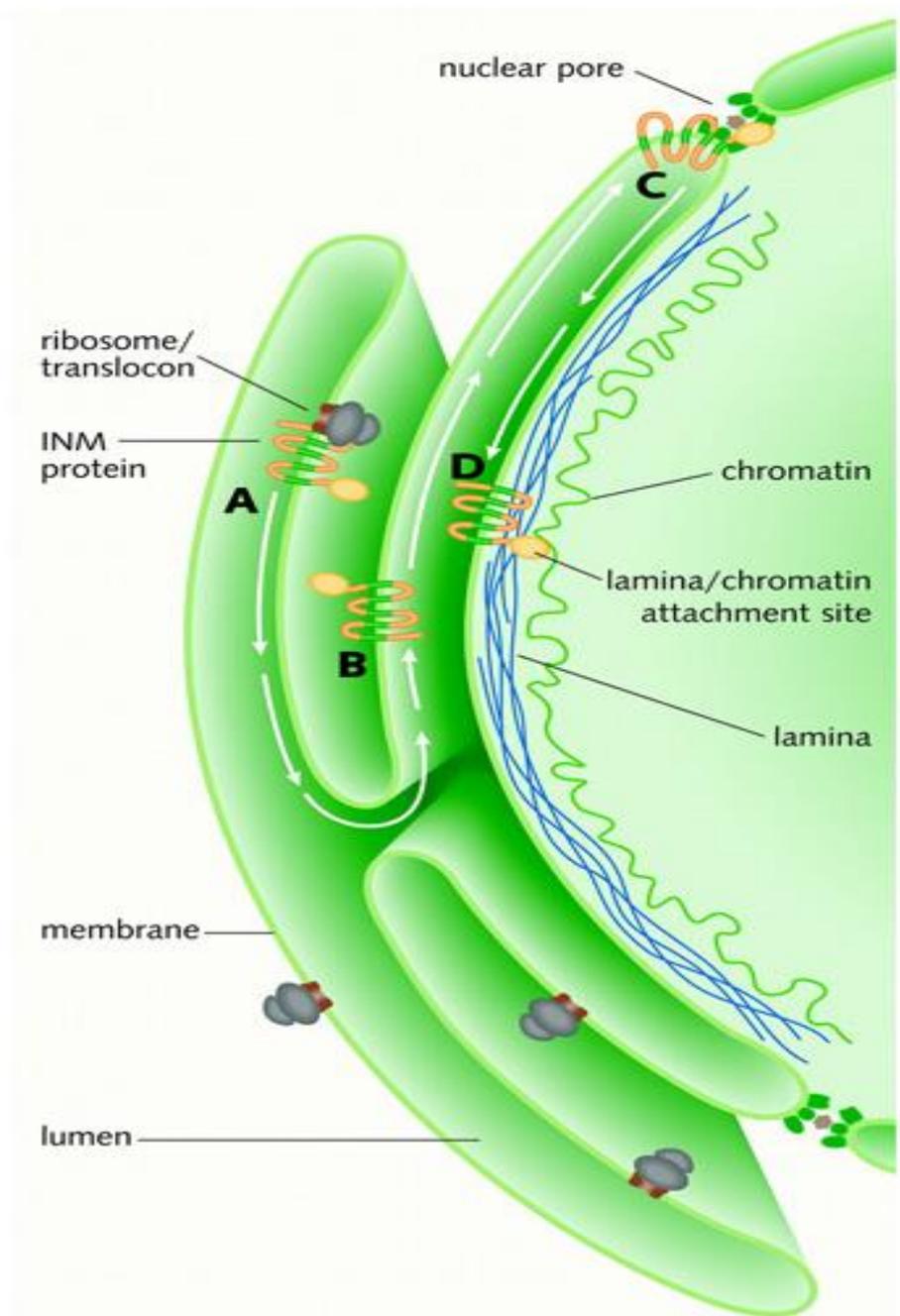
- Visible only by electron microscopy
- Ribosome attached on external face
- It **continues** with rER membrane

The perinuclear space

- It **communicates** with the rER interna space
- Contains the same molecules as rER

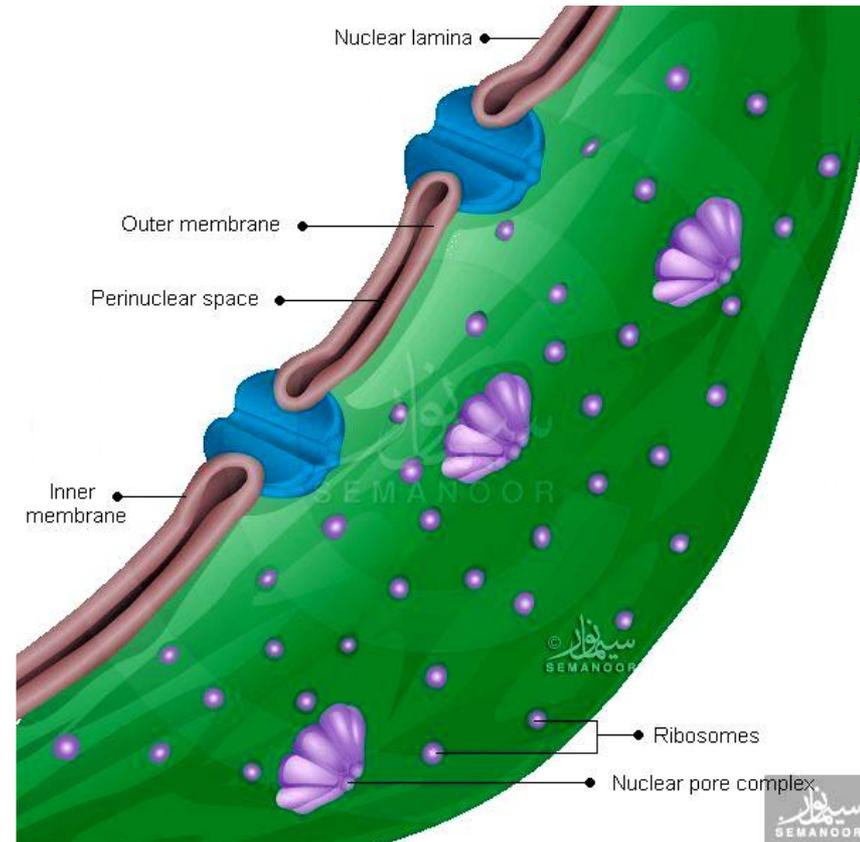
Internal nuclear membrane

- Visible only by electron microscopy;
- The inner surface of the nuclear envelop is bound to a thin filamentous network (*lamins polypeptides*) called the **nuclear lamina**.



THE NUCLEAR PORE

- Openings in the nuclear envelope, Area where the nuclear envelope is **interrupted**
- Regulates **exchanges** between nucleus and cytoplasm
- Ensures the **selective transport** for big molecules
- **Dynamic** structures – their number grows if it's necessary
- The nuclear pores are the gateways across which movement of **RNAs** and **proteins** takes place between the nucleus and cytoplasm in both direction.
- Proteins synthesized in the cytoplasm cross the nuclear envelop to initiate replication and transcription of genetic material. Similarly, mRNA, tRNA and ribosomal subunits built in the nucleus cross through the nuclear pores to the cytoplasm.



Nucleoplasm

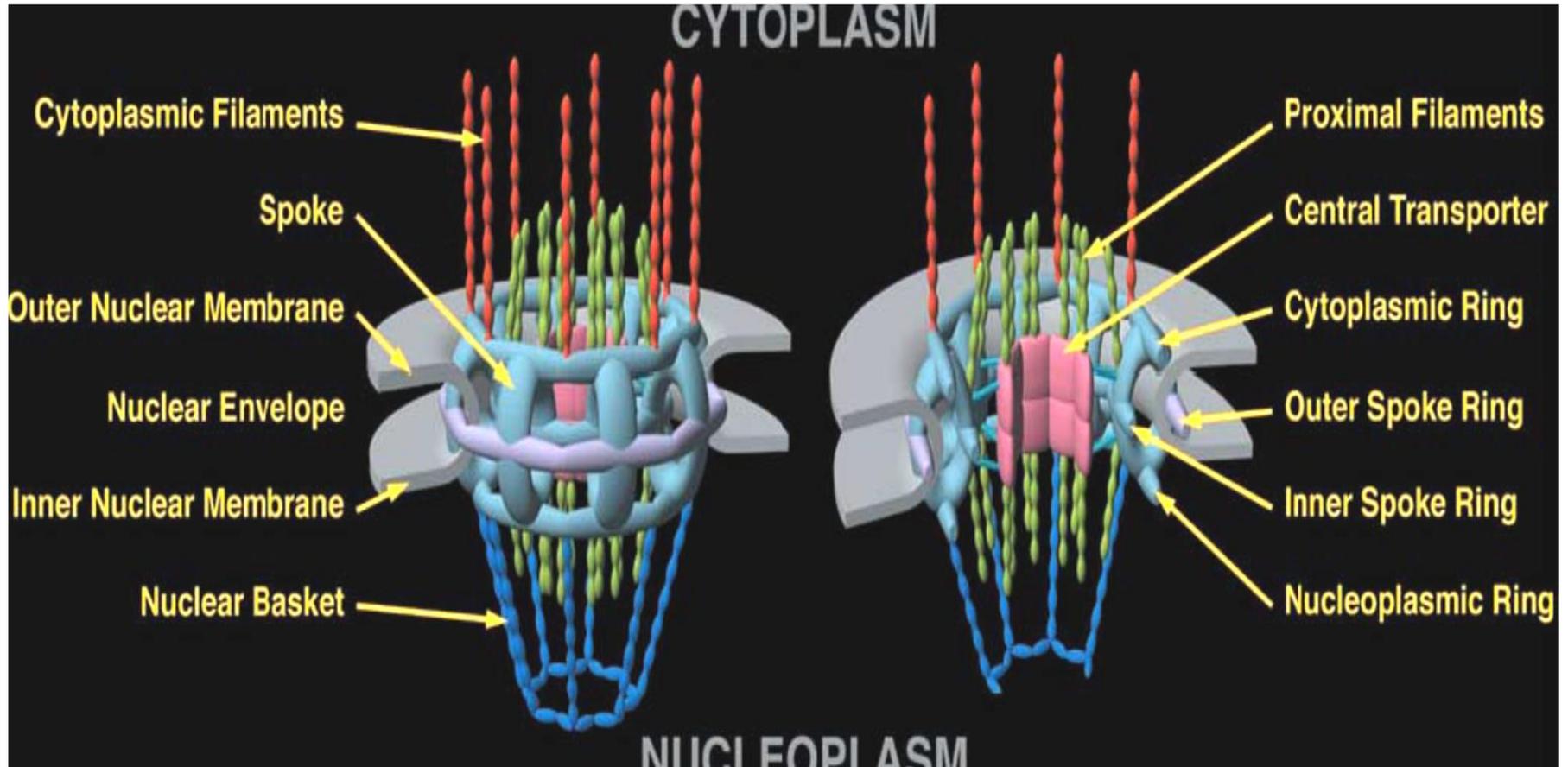
Nuclear Basket
Nuclear Ring
Filaments

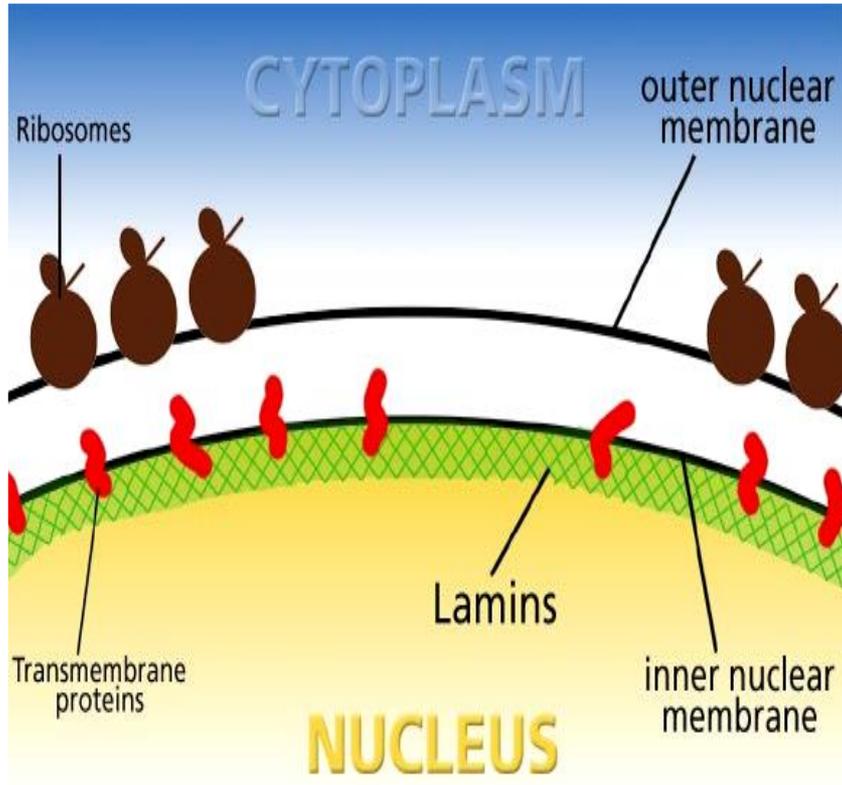
Nuclear Membrane

Central Transporter
Spoke Ring (inner & outer)

Cytoplasm

Cytoplasmic Ring
Cytoplasmic Filaments





Nuclear lamina

a network of **intermediate filaments** composed of various **lamins**

The lamina acts as a site of **attachment** for chromatin and provides structural **stability** to the nucleus.

The lamins have been associated with **various genetic disorders** collectively termed **laminopathies** (e.g. a rare form of **muscular dystrophy**).

CHROMATIN

Is the combination of **DNA** and **Histone proteins** that make up the contents of the nucleus of a cell, that is usually **dispersed** in the **interphase** and condensed to form **chromosomes** in mitosis and meiosis.

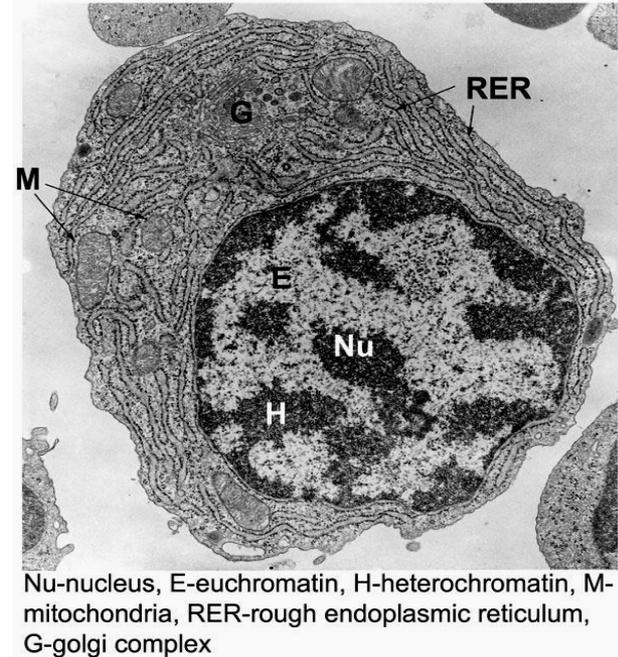
Functions

- Package DNA into a smaller volume to fit in the cell
- Strengthen the DNA to allow
mitosis and meiosis i.e. prevent DNA damage
- Control gene expression and DNA replication

Types (During **interphase** // **no** cell division)

1- Euchromatin: is a **lightly packed (less dense)** form of chromatin that is **rich** in gene concentration, and is often under **active transcription**. It is found in both eukaryotes and prokaryotes.

2- Heterochromatin: is a **tightly packed (dense)** form of DNA that is **inactive (no transcription)** and remains compact during interphase. Heterochromatin plays a role in **gene regulation** and the **protection** of the integrity of chromosomes



Types of Chromatin

other

Good

Heterochromatin

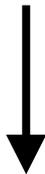
Euchromatin

(condensed chromatin)

(extended chromatin)

inactive chromatin

active chromatin



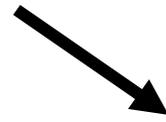
More: less active cell

More: active cell

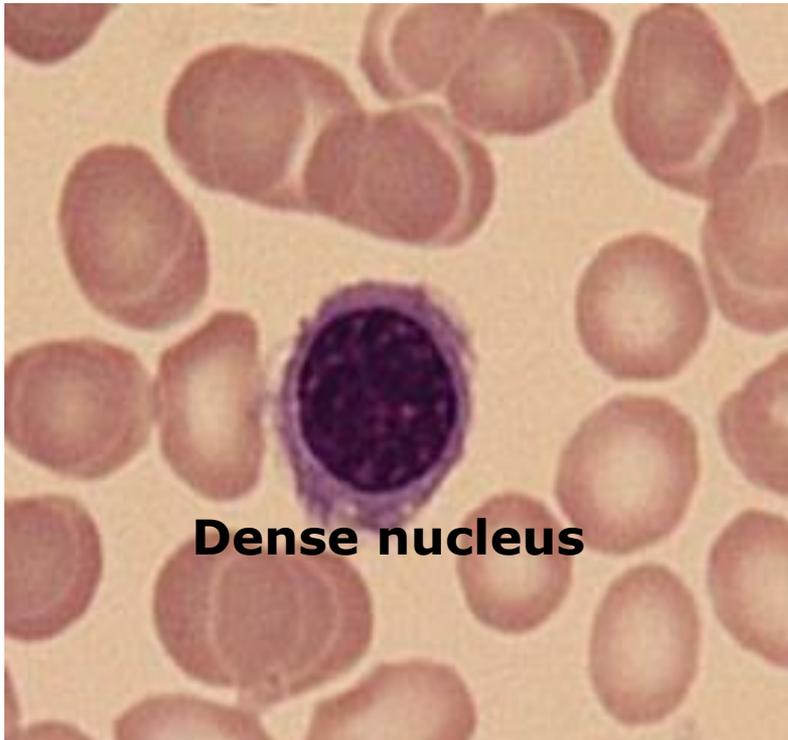
Nucleus



Closed face

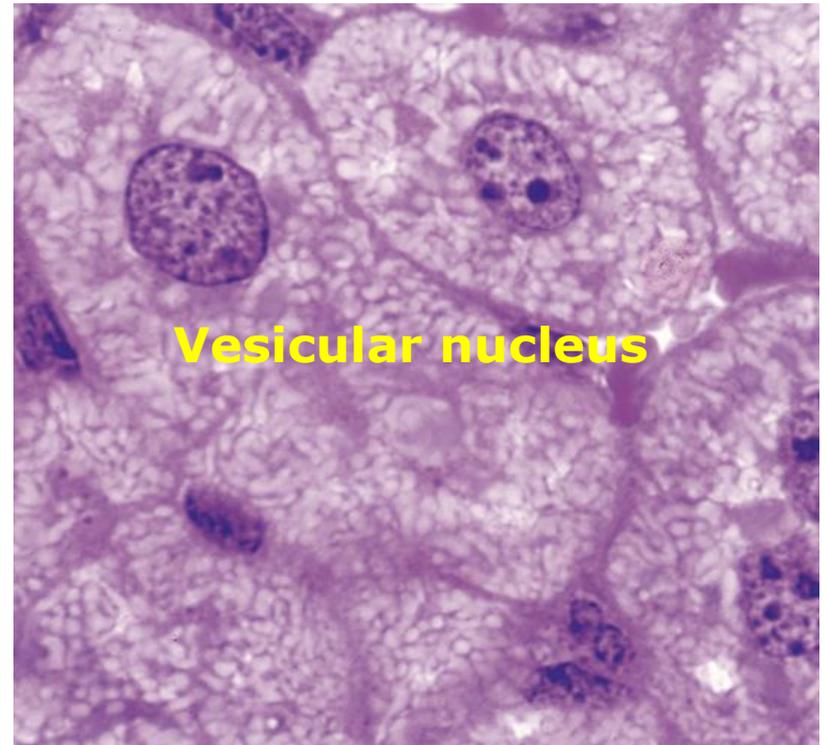


open face



Dense nucleus

more Heterochromatin
Inactive cell



Vesicular nucleus

more Euchromatins
Active cell

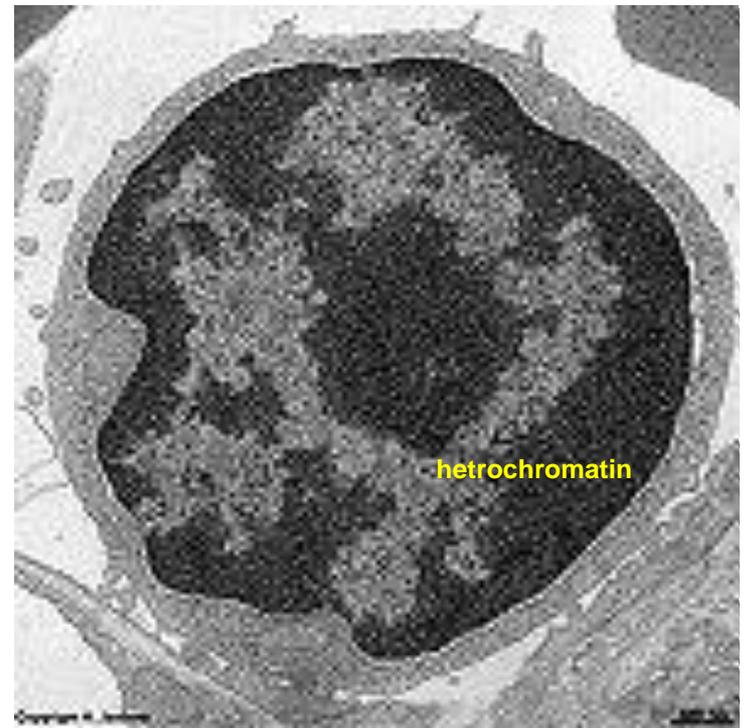
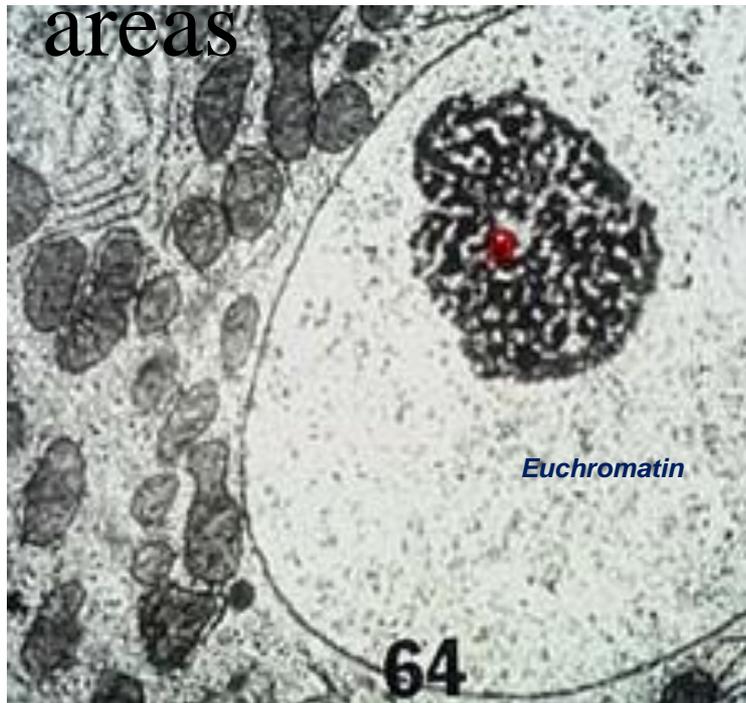
Chromatin

Euchromatin

electron lucent areas.

Heterochromatin

electron dense

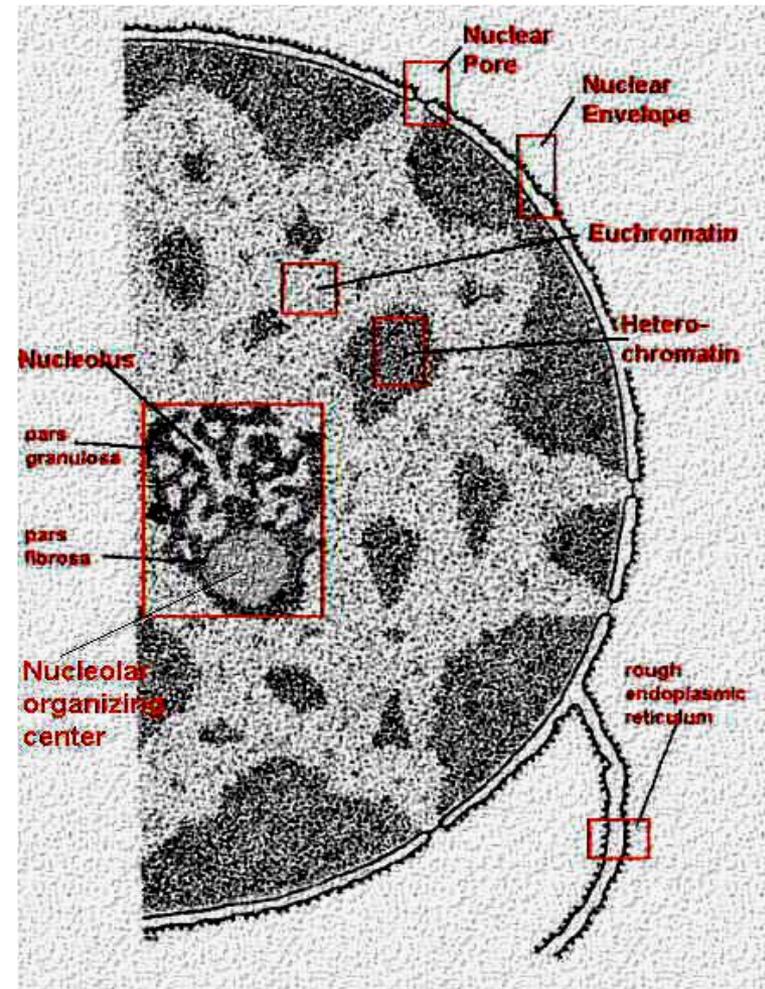


Distribution of heterochromatin

□-Peripheral Heterochromatin

□-Islands chromatin

□- Nucleolus associated
Chromatin



The Nucleolus

The **nucleolus** (plural **nucleoli**) is a **non-membrane** bound structure composed of **proteins** and **nucleic acids** found within the nucleus

It is the **most dense** (prominent) structure of the cell, and frequently is located in central area of nucleus

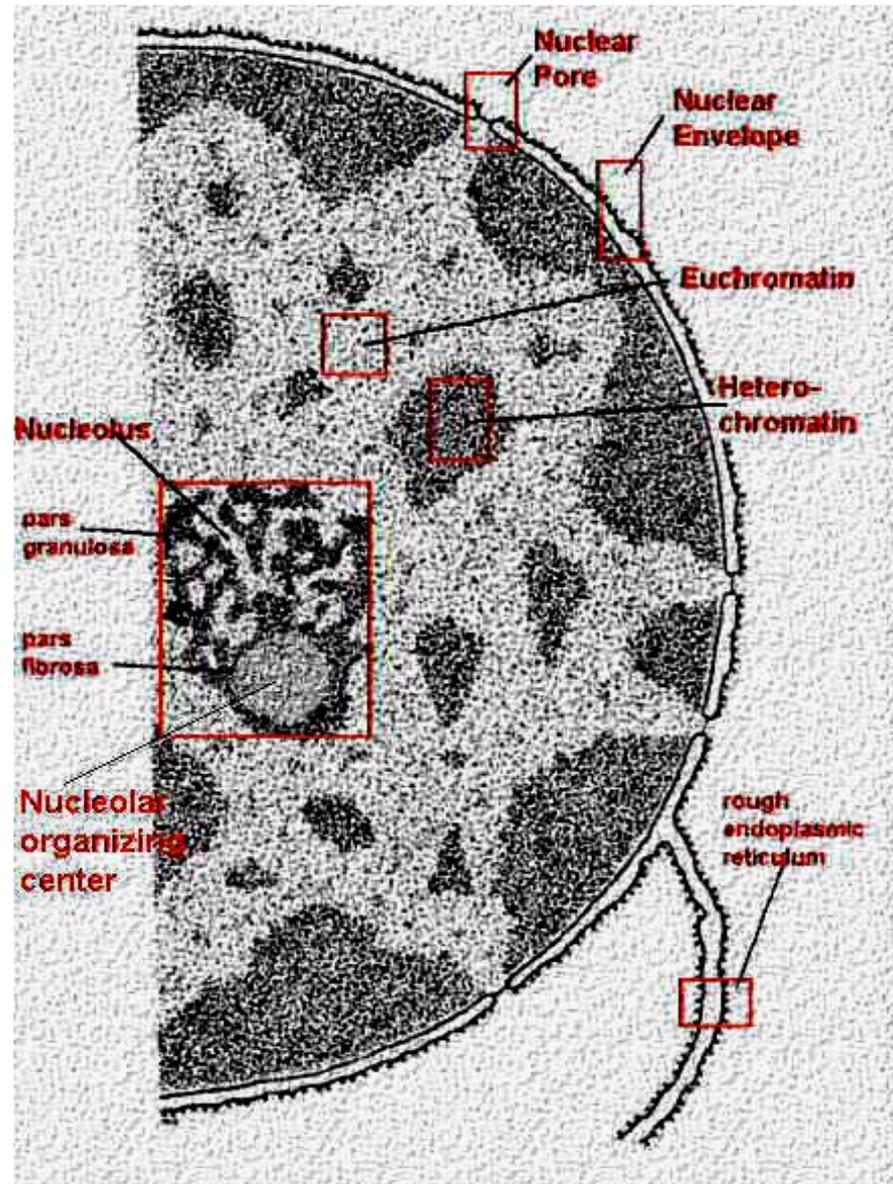
Function, site of **rRNA synthesis**, initial ribosomal **assembly**

Structure,

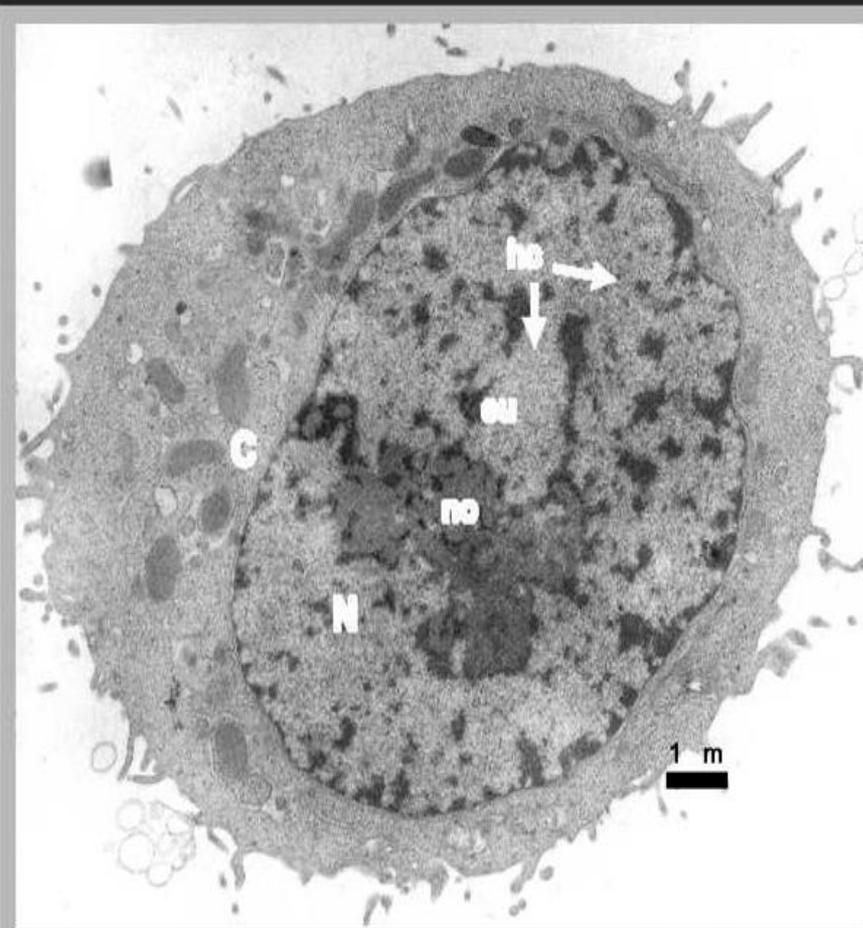
-**fibrillar centers**, filaments of chromatin

-**pars fibrosa**, newly transcribed rRNA

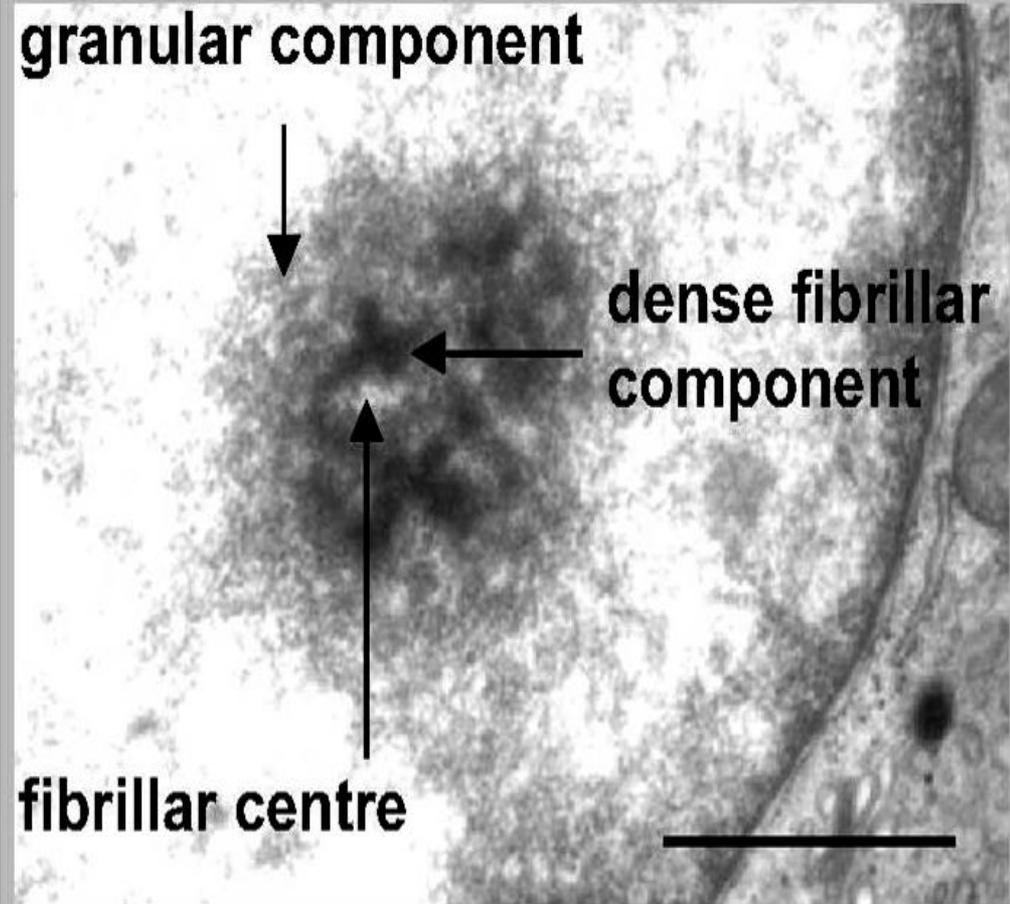
-**pars granulosa**, rRNA bound to ribosomal proteins that are beginning to **assemble** into ribosomes



Ultrastructure of the nucleolus



granular component



Nucleoplasm (nucleus sap) or karyoplasm

- **Analogy** with cytoplasm, that part of the nuclear contents other than the nucleolus.
- Highly **viscous** liquid that surrounds the chromosomes and nucleolus
- Many substances such as **nucleotides** and **enzymes** are dissolved in the nucleoplasm
- A network of **fibers** known as the **nuclear matrix** can also be found in the nucleoplasm

Cell membrane

Nuclear membrane

Number of Units	Single lipid bilayer membrane that surrounds the cytoplasm of the cell.	Two lipid bilayer membrane which surrounds the genetic material and nucleolus of the eukaryotic cell.
Membrane Pores	a continuous membrane without any pores.	a discontinuous membrane with complex pores.
Persistence	persists during the lifetime of the cell.	disappears during the cell division in prometaphase and reforms again in telophase.
Permeability and Transportation	semi-permeable membrane and regulates the flow of substances like ions, organic molecules between protoplasm and external environment	is permeable only to small non-polar molecules (mRNA and proteins) and regulates the flow of these molecules between nucleoplasm and cytoplasm.
Endoplasmic Reticulum (ER)	The endoplasmic reticulum is not found attached to the cell membrane.	The endoplasmic reticulum is normally found attached to the nuclear membrane.
Prokaryotic and Eukaryotic	found in both prokaryotic and eukaryotic organisms.	found only in eukaryotic organisms.