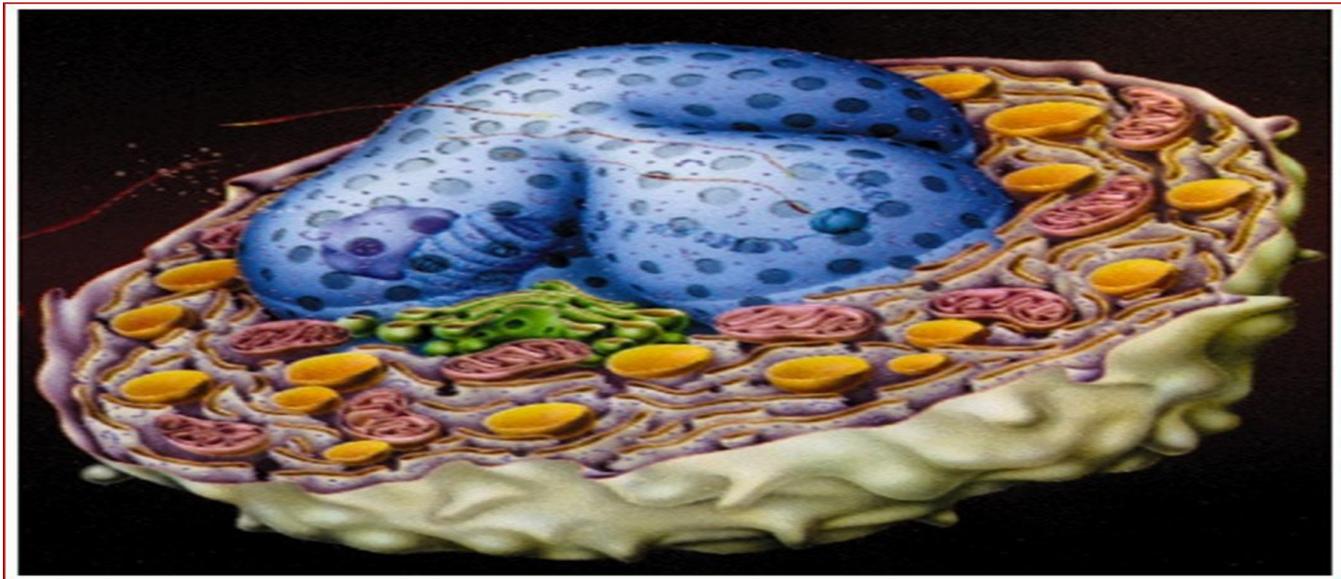


CELL INCLUSIONS & NUCLEUS



By

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OBJECTIVES OF THE LECTURE

1. Recognize types of cell inclusions.
2. describe the structure of different parts of the interphase nucleus.
3. know the functions of interphase nucleus.

CELL INCLUSIONS

□ Definition:

Inclusions are non-living components of the cell and not essential for its life.

□ Types:

➤ Stored foods:

- Glycogen: in muscle & liver.
- Lipids: in fat cells.

➤ Pigments:

- External (exogenous): carotenes, carbon, minerals (lead & silver).
- Internal (endogenous): hemoglobin, melanin, lipofuscin pigment.

Fat droplets

Glycogen (stored carbohydrates)

Sites

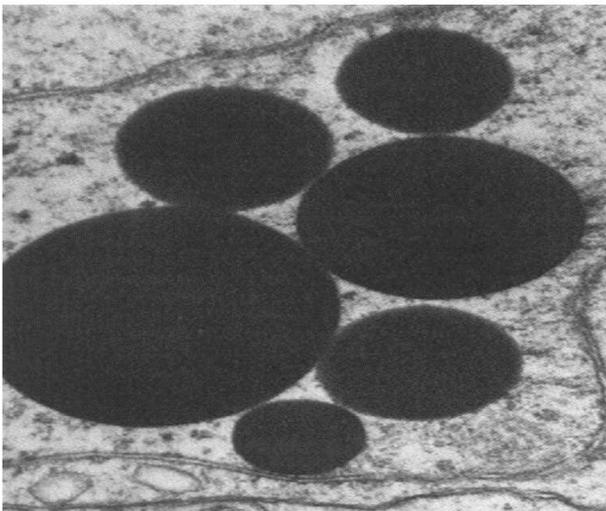
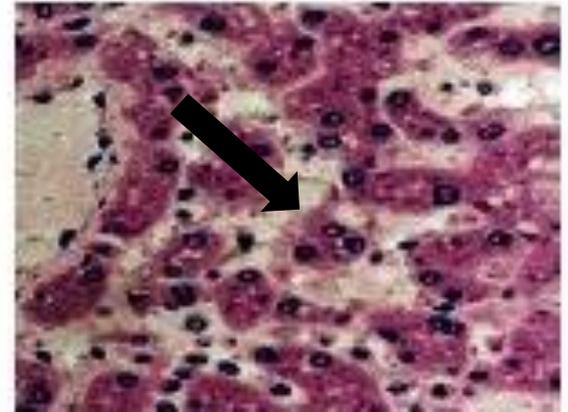
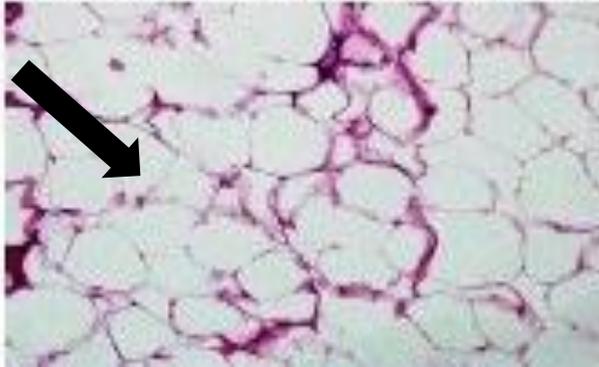
Fat cells

Liver and muscle fibers

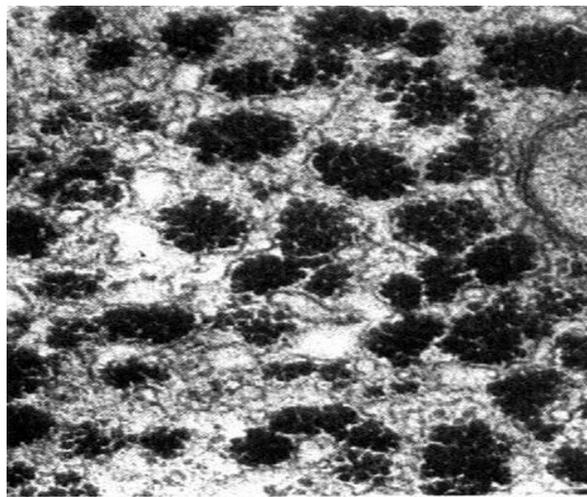
H & E

The fat is dissolved in xylol during preparation leaving empty spaces

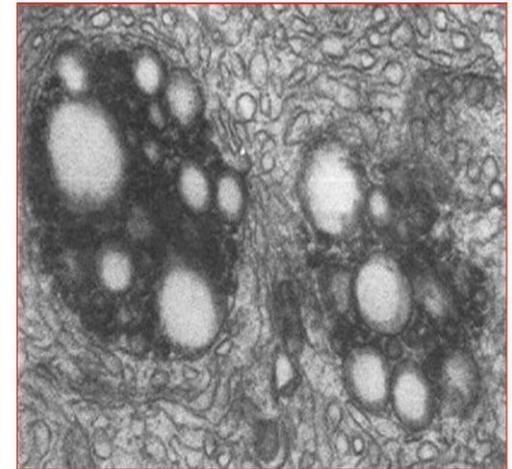
Vacuoles



Lipid droplets



Glycogen granules



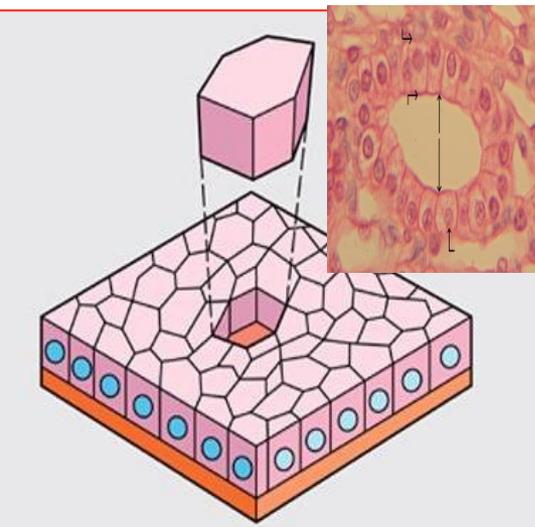
Lipofuscin pigment

The Nucleus

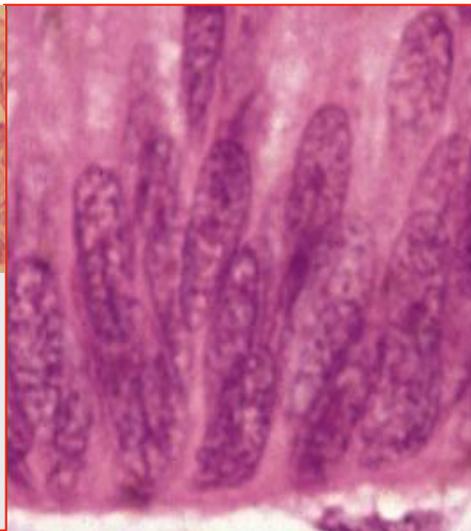
Site: present in all eukaryotic cells except mature erythrocytes and blood platelets.

Shape: varies in shape in different cell types: e.g

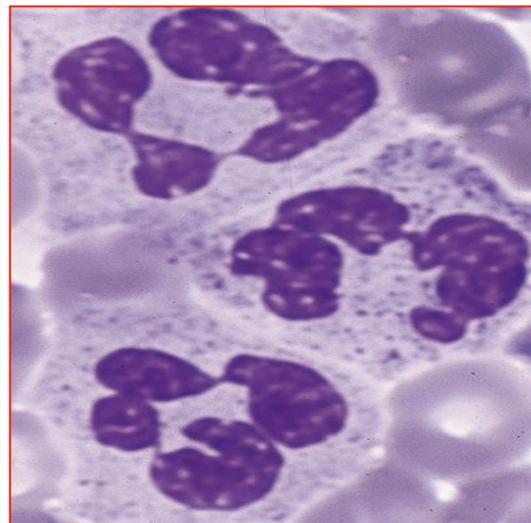
- Round in cuboidal cells.
- Flat: in mucous-secreting cells
- Elongated in columnar and spindle shaped cells
- Lobulated as in neutrophil



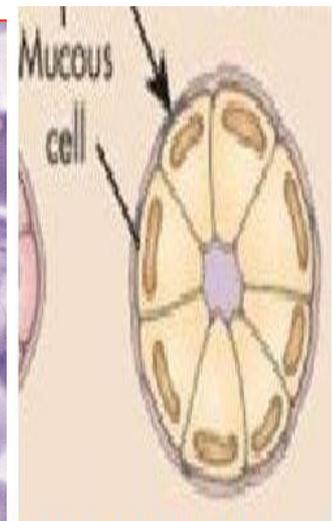
Round



Elongated



Lobulated

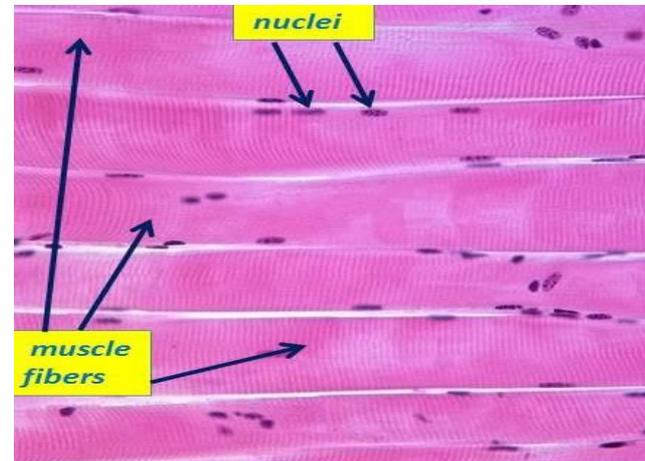
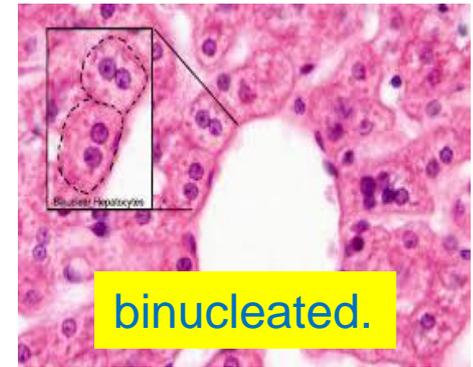


Flat

Number:

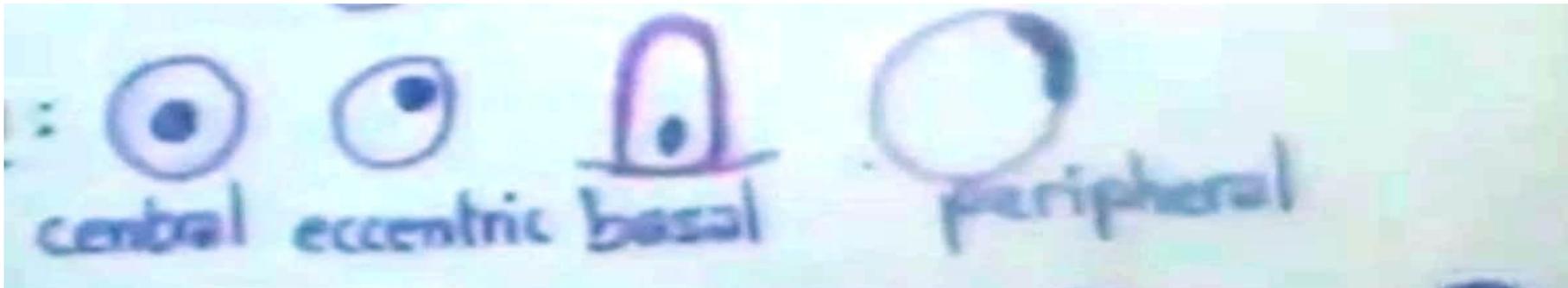
- The majority of cells have **only one nucleus**.
- Some cells e.g. liver cells are **binucleated**.
- Few others are **multinucleated**.

e.g. skeletal muscle fibers



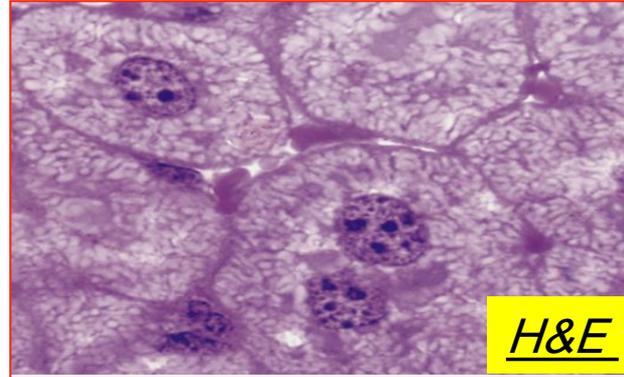
Position:

It may be: central, eccentric, peripheral or basal in position.



Staining:

- By H&E **basophilic** because of its content of nucleic acids (DNA & RNA).



- By Feulgen Stain, DNA is Feulgen positive (**red**) while RNA is Feulgen negative.



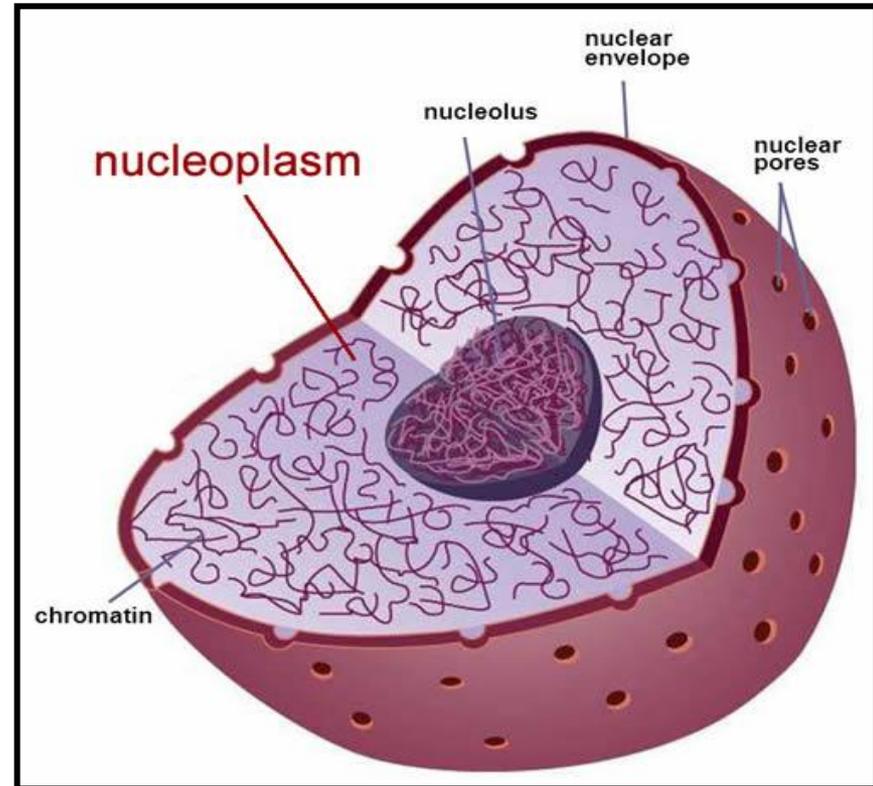
Functions of the nucleus

- It contains the **genetic information** (stores the cell's hereditary material (DNA))
- The nucleus is the **control center for all cell activities**. It has a direct influence on the metabolic activities of the cytoplasm e.g. protein synthesis.
- **Ribosome formation** (Nucleolus form r-RNA necessary for production of ribosomes)
- It plays a major role in **cell division**.

INTERPHASE NUCLEUS

The nucleus of an interphase cell (non-dividing cell in-between the end of one mitosis and the beginning of another) consists of the following components:

- **Nuclear envelope.**
- **Chromatin.**
- **Nucleolus or nucleoli.**
- **Nucleoplasm or karyoplasm.**

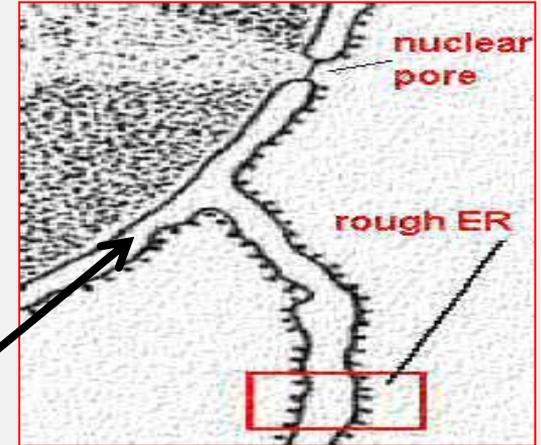


NUCLEAR ENVELOPE

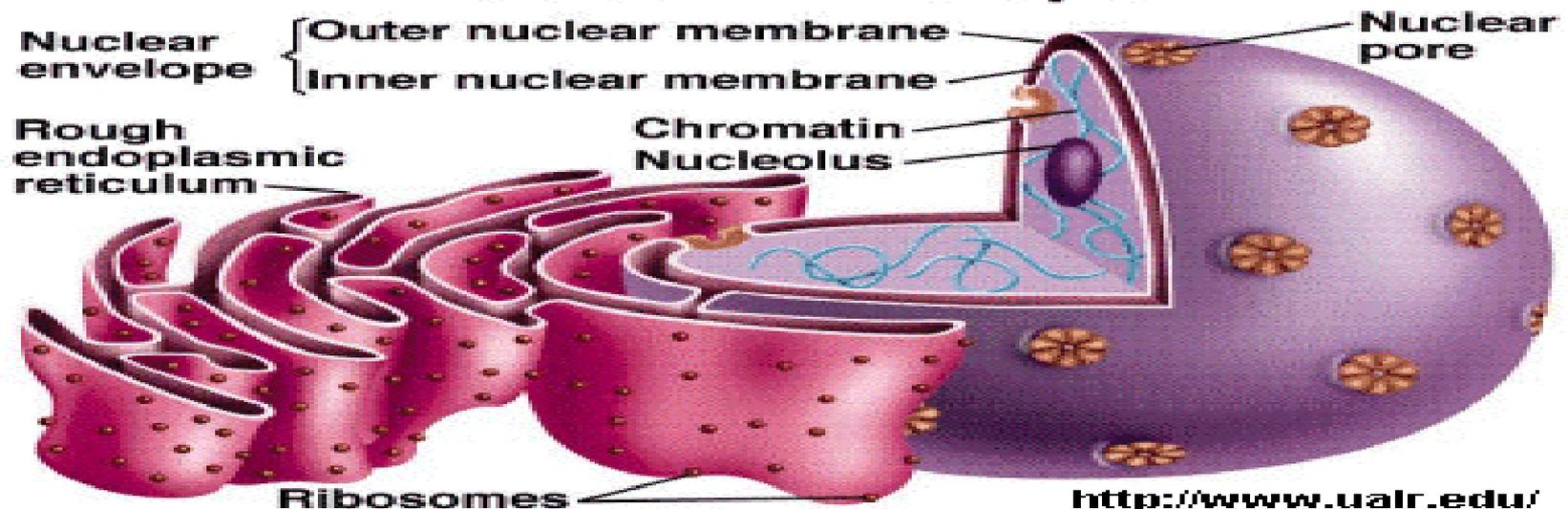
LM: H&E: dark basophilic line due to the presence of condensed chromatin on its inner layer and ribosomes on its outer layer.

EM:

- it is formed of **two parallel membranes**
- External (outer) nuclear membrane**
- Internal (inner) nuclear membrane**
- Each is a *unit membrane*
- **The two membranes** separated by **perinuclear cisterna**.



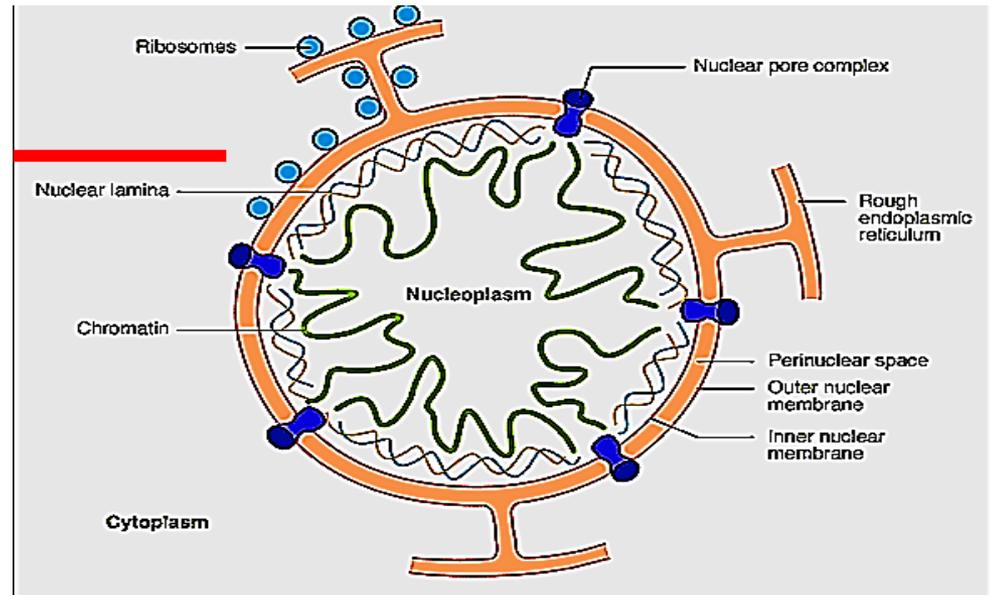
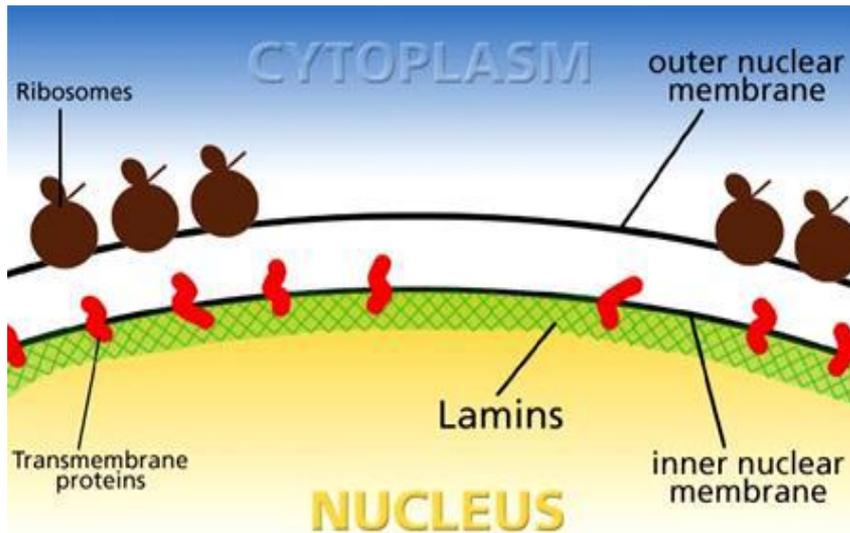
Nuclear Envelope



1. The inner nuclear membrane

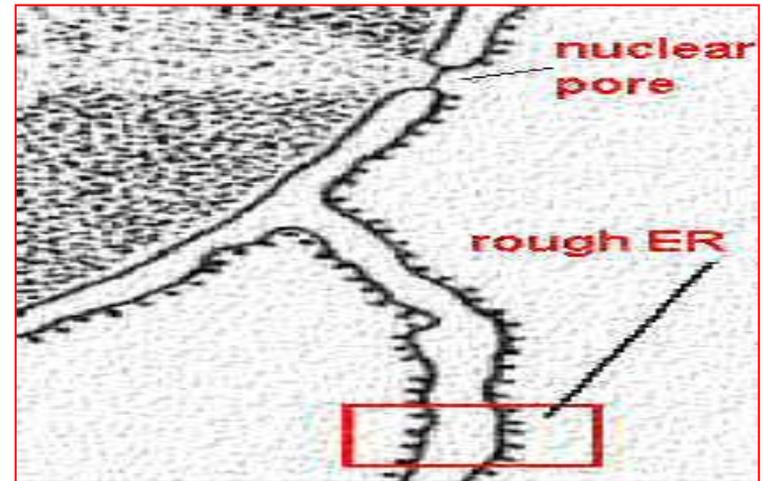
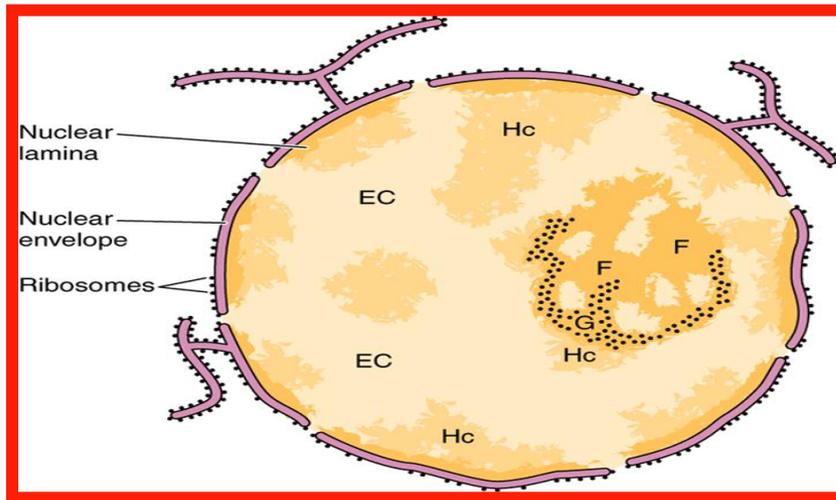
Associated with network of fine filaments called **fibrous lamina** which is formed of intermediate filaments called lamins (A, B & C).

- They provide structural support to the nucleus
- Lamins organize the interaction between the inner nuclear membrane and the peripheral chromatin (influence chromatin distribution & function).



2. The outer nuclear membrane

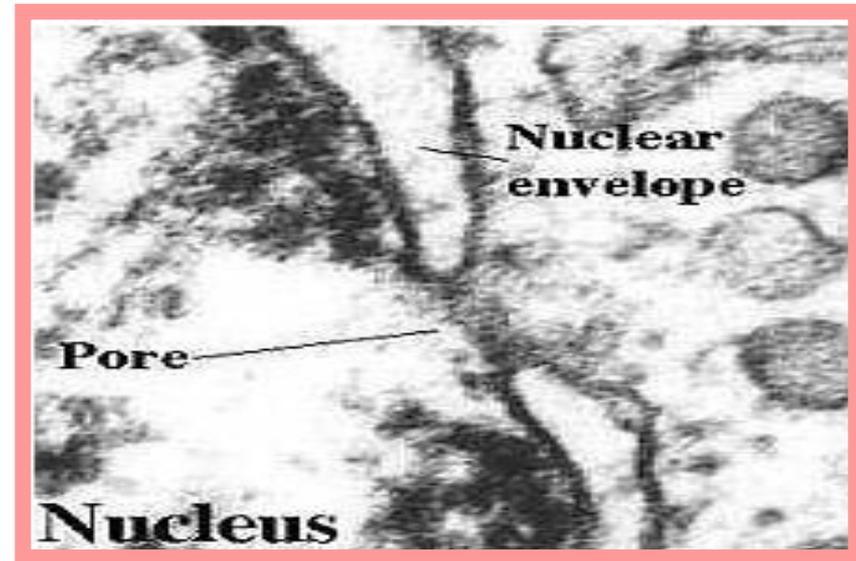
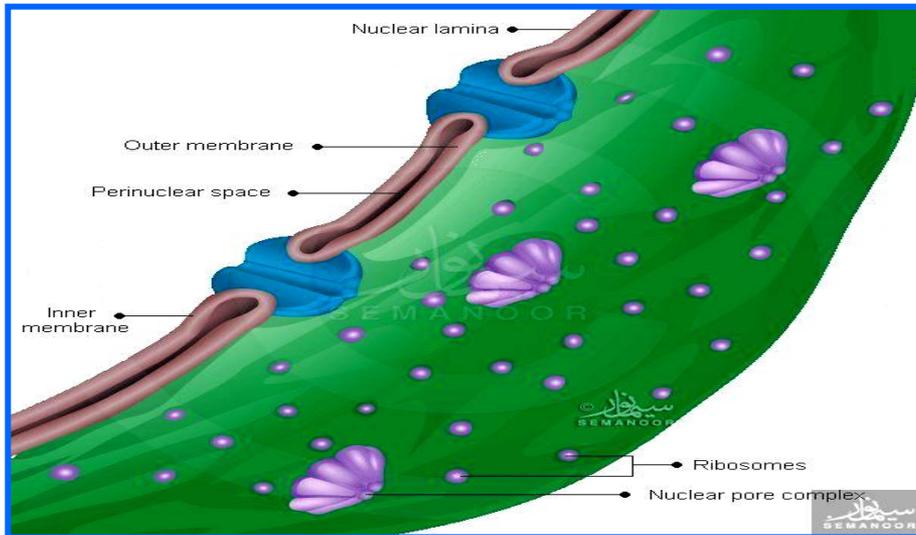
- Has **ribosomes** adhering to its outer surface often continuous with **rER**.
- It has the same function of synthesizing secretory proteins which are segregated in the cisterna.



- The nuclear envelope contains many **nuclear pores** which is covered by diaphragm.

Nuclear pores:

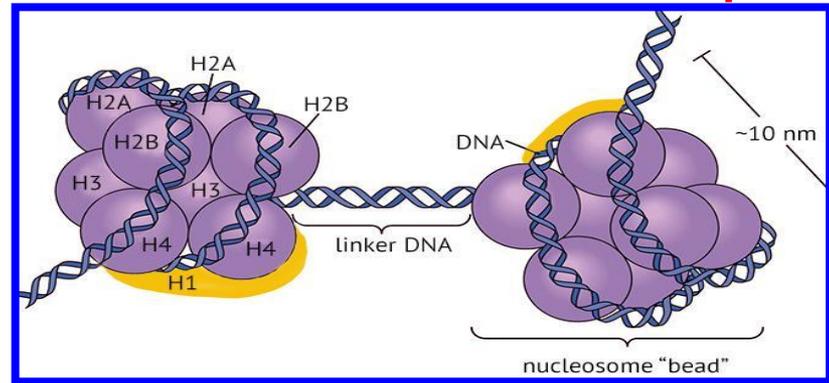
- At several points the outer and the inner nuclear membranes fuse **leaving gaps** called nuclear pores which is covered by thin diaphragm.
- A nuclear pore complex is a cylindrical channel formed from **transmembrane proteins** (nucleoporins).



- It is a channel which provide **bidirectional** communication between nucleoplasm and cytoplasm.

CHROMATIN

Definition: It is a thread like structure formed of double stranded DNA combined with basic proteins histones .



Staining: responsible for the characteristic *basophilia* of the nucleus.

Types:

❑ **Extended (Euchromatin)** : the **active** form.

❑ **Condensed (Heterochromatin)** the **inactive** form.

➤ Extended (Euchromatin): the **active** form.

-LM: It is invisible.

- EM: could not be distinguished from other parts of the nucleus.

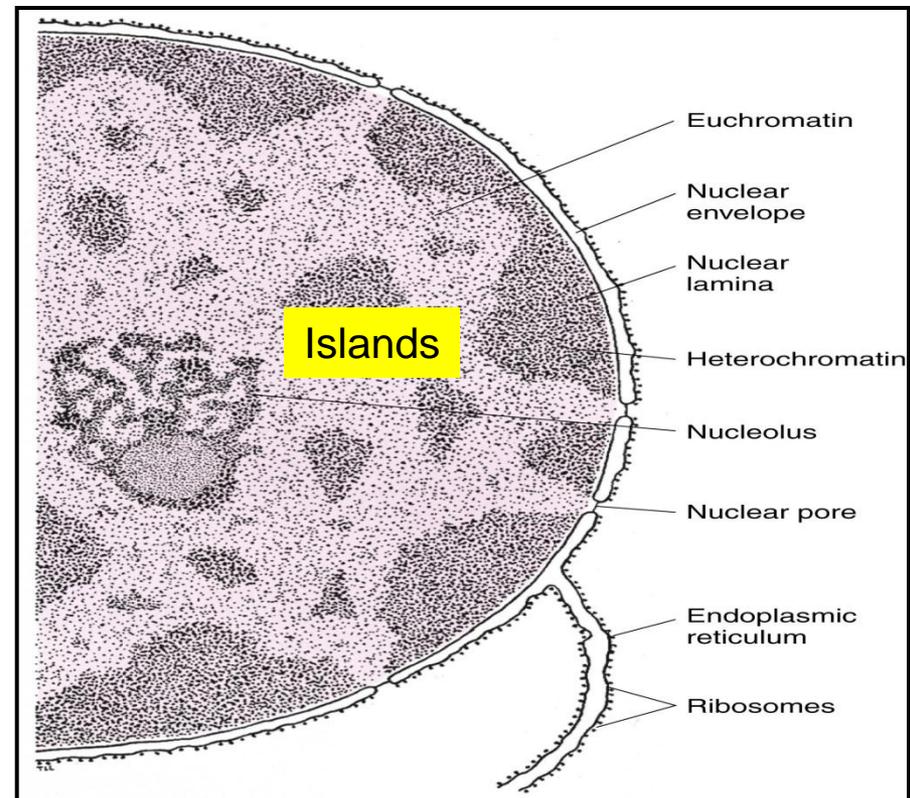
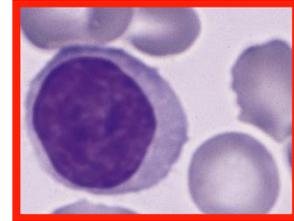
Function: It is active in the process of protein synthesis.

➤ Condensed (Heterochromatin) the **inactive** form.

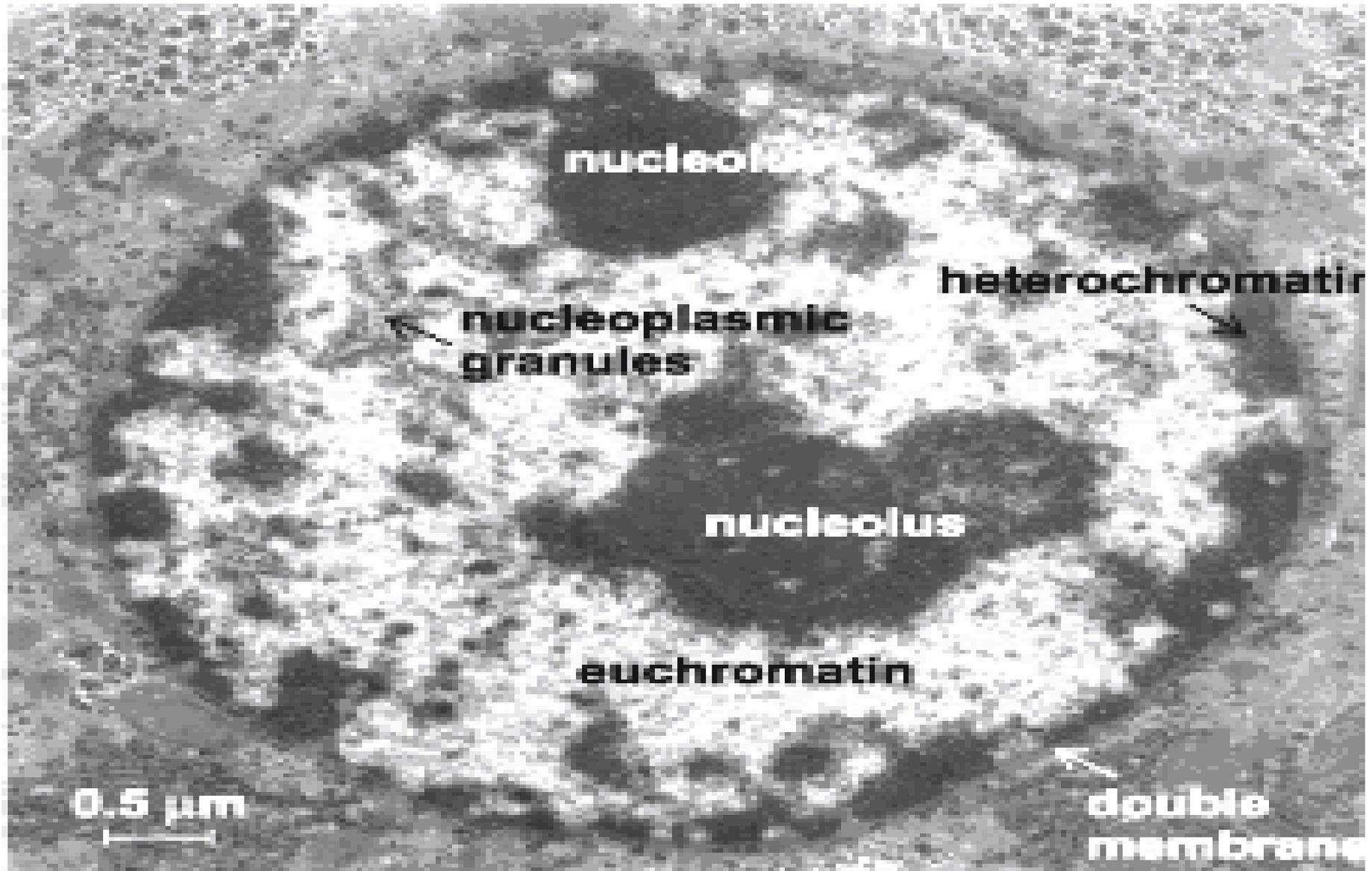
- **LM**: It appears as **fine basophilic granules** inside the nucleus with H&E.

- EM: It appears as electron dense **coarse granules** in the following sites;

1. Peripheral chromatin adjacent to nuclear envelope.
2. Nucleolar associated chromatin around the nucleolus.
3. Islands of chromatin in the nucleoplasm.



Chromatin



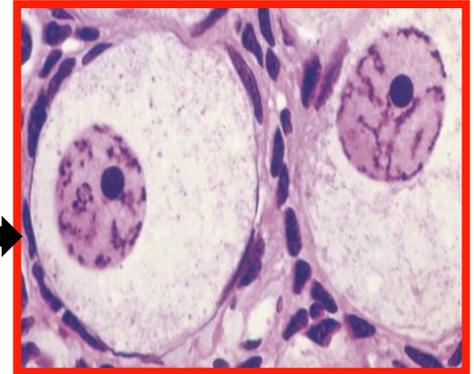
Comparison between Euchromatin and Heterochromatin

	Euchromatin	Heterochromatin
L/M	<ul style="list-style-type: none"> - Invisible as it is very thin - 	<ul style="list-style-type: none"> - Visible as Intensely basophilic clumps.
E/M	<ul style="list-style-type: none"> can not be distinguished from other granular components of nucleoplasm. 	<ul style="list-style-type: none"> appears as electron dense coarse granules in nucleoplasm.
Localization within the interphase nucleus.	<ul style="list-style-type: none"> - Dispersed in nucleoplasm and in nucleolar organizers. 	<ul style="list-style-type: none"> - Peripheral chromatin in association with inner nuclear membrane. - Chromatin islands of basophilic granular clusters scattered in nucleoplasm - Nucleolar associated chromatin surrounding the nucleolus.

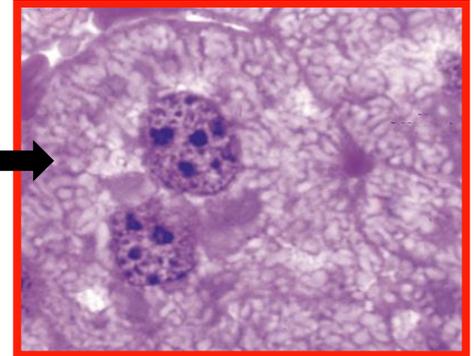
3-NUCLEOLUS

Function: formation of ribosomes

Size: varies in size, being *well developed* (large) in cells active in protein synthesis as pancreatic acinar cells and cancer cells.



Number: may be more than one nucleolus



Structure: observed only during interphase and disappear during cell division.

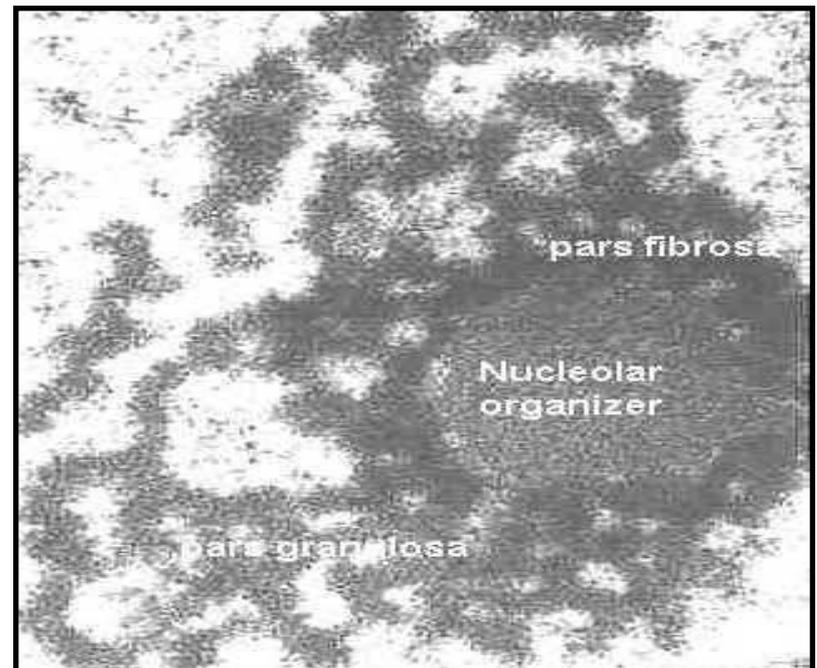
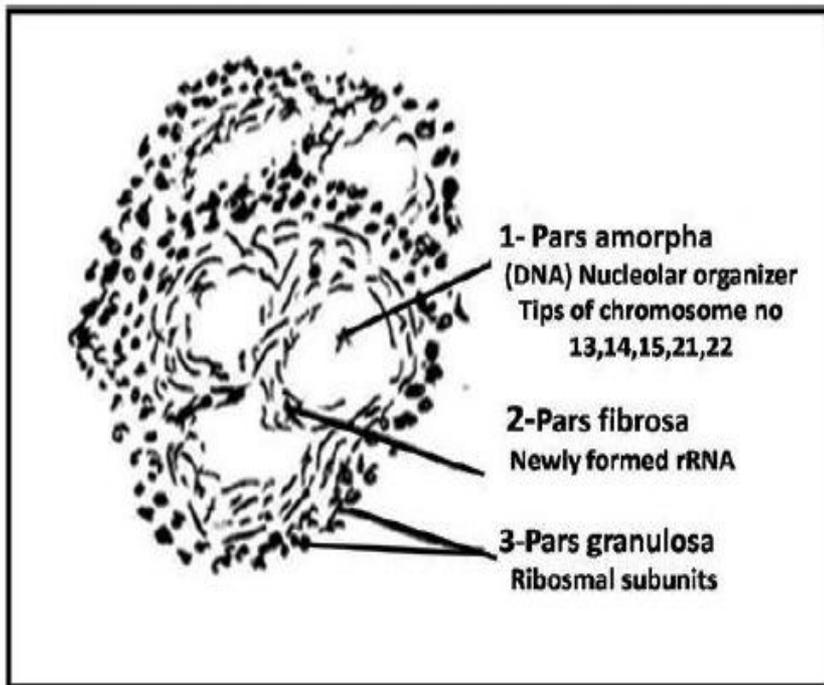
LM: deeply **basophilic** due to its content of RNA.

EM: 3 components

1. Pars amorpha: rounded **pale areas** formed of specific regions of **DNA**. These regions are named **nucleolar organizers** which are responsible for **formation of rRNA**.

2. Pars fibrosa: fine electron dense filaments of **newly formed rRNA**.

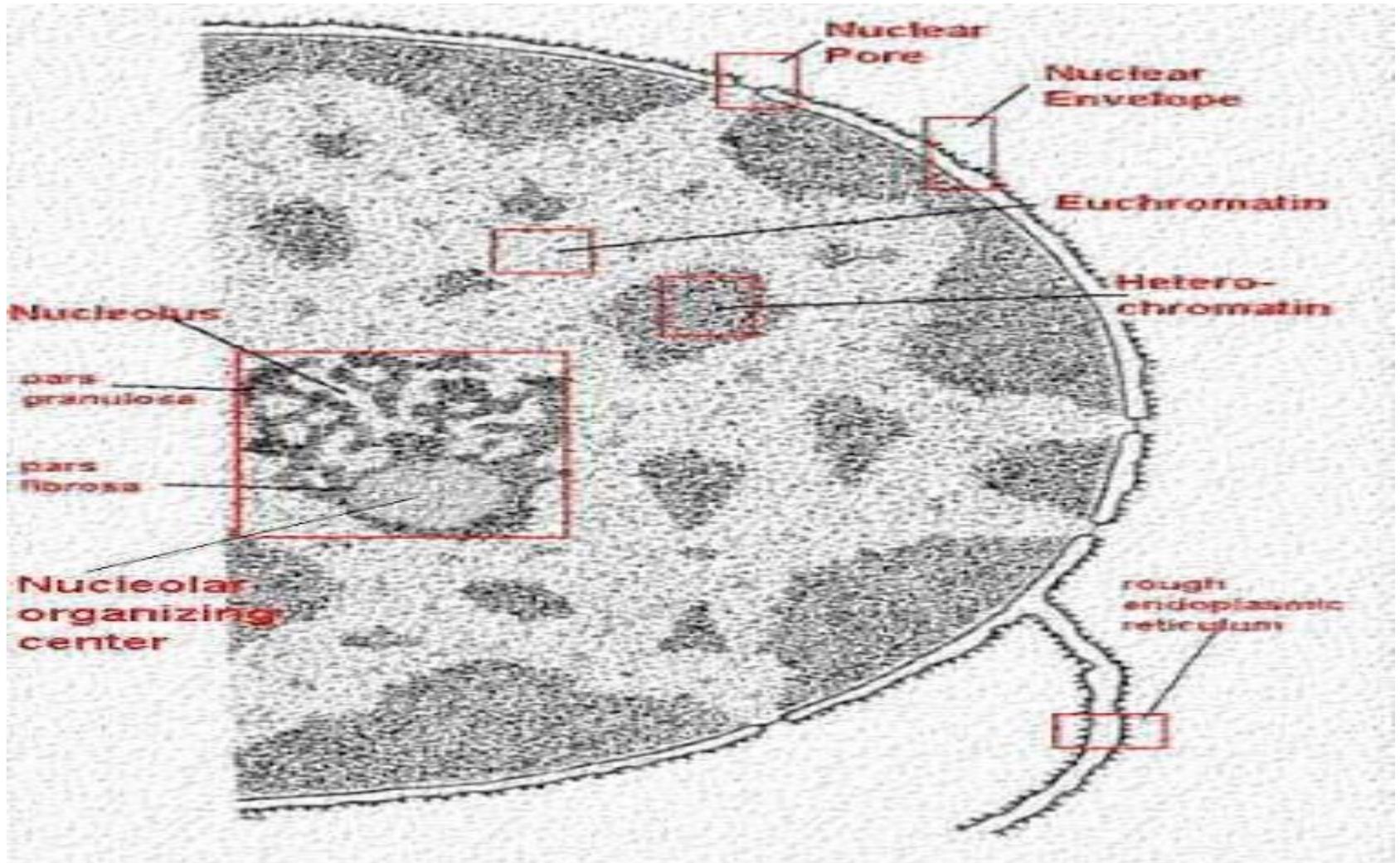
3. Pars granulosa: dense strands having **granular appearance**. it is the site of formation of **ribosomal subunits**.



4-nucleoplasm

- It is semifluid colloidal substance that fills the spaces between the chromatin and the nucleoli in the nucleus.
- It is composed mainly of proteins (some of which are enzymes).
- Also, it contains fibrillar structure which form nucleoskeleton.

The nucleus





THANK
YOU