
تَنوير

# BIOLOGY

Lec no : 5+6

File Title : Nucleus + endomembrane system

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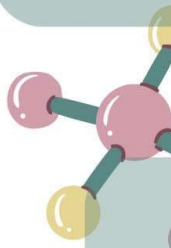


وَقُل رَّبِّ زِدْنِي عِلْمًا

# A TOUR OF THE CELL

**All living organisms one made of cells**

The simplest collection of matter that can be alive

Every cell is produced by the reproduction of another cell

Even though cells are too small to be seen with the unaided eye their structure is complex, so scientists invented **microscopes** to study the structure of the cell and its organelles

## Microscopes

- **Magnification** تكبير
- **Resolution** وضوح
- **Contrast** تباين (التمييز بين الأشياء المختلفة في الصورة)

**Light microscopes**
They use light and glass lenses
Magnification up to 1000 times
Can't show most organelles

**Electron microscopes**
They use electron beams and electromagnetic lenses
Magnification up to 1 million times

SEM ( scanning )
Internal structure of the cell
3D image

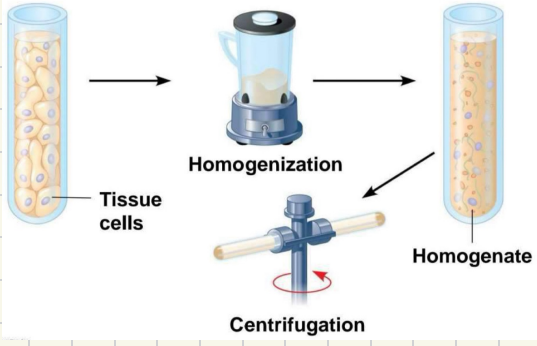
TEM ( transmission )
Surface of the cell
2D image

## Cell Fractionation

Using centrifuges to recognize different organelles in the cell to study their structure and function

الطرد المركزي

محلول متجانس ← **We start with making a homogenate and then use centrifuges two separate different cell organelles**

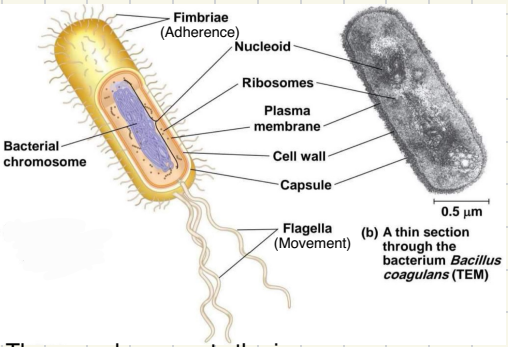



**The bigger organelles deposit first**
**العضيّات الأكبر تترسب أولًا**

Biochemistry and cytology help correlate cell function with structure

# Cells

- **Prokaryotes**
  - Bacteria (normal environment)
  - Archaea (Extremeenvironment)
- **Eukaryotes**
  - Plants
  - Fungi
  - Animals
  - Protists




The capsule prevents the immune system from detecting the bacteria

| Prokaryotes | Eukaryotes |
|---|---|
| No nucleus | Has a Nucleus |
| One circular chromosome in the nucleoid | Many linear chromosomes in the nucleus |
| No membrane bounded organelles | Has membrane bounded organelles |
| Smaller | Larger |
| Cytoplasm bound to the membrane | Cytoplasm between the membrane and the nucleus |

**Similarities between prokaryotes and eukaryotes** →

Basic features of all cells
- Plasma membrane
- Semifluid substance called **cytosol**
- Chromosomes (carry genes)
- Ribosomes (make proteins)

The **plasma membrane** is a selective barrier that allows sufficient passage of oxygen, nutrients, and waste to service the volume of every cell

The general structure of a biological membrane is a double layer of phospholipids

→ **The plasma membrane is not smooth because of the hydrophilic heads, and that increases the surface area**

Metabolic requirements set upper limits on the size of cells

The surface area to volume ratio of a cell is critical

As the surface area increases by a factor of $n^2$, the volume increases by a factor of $n^3$

Small cells have a greater surface area relative to volume

كل ما كانت مساحة سطح الخلية أكبر
تقدر تعمل الوظائف بشكل أفضل

Surface to volume are
= surface area / volume

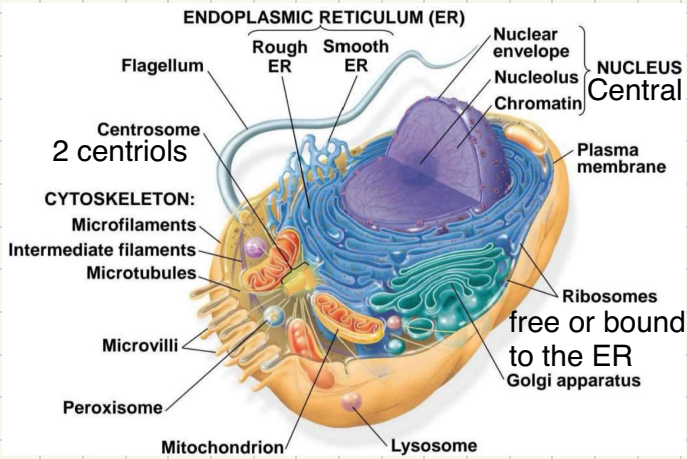
الخلايا حقيقية النوى بتحتوي على أغشية
بتفصل أجزاءها إلى غرف (عضيّات)

A eukaryotic cell has internal membranes that partition the cell into organelles

Plant and animal cells have most of the same organelles

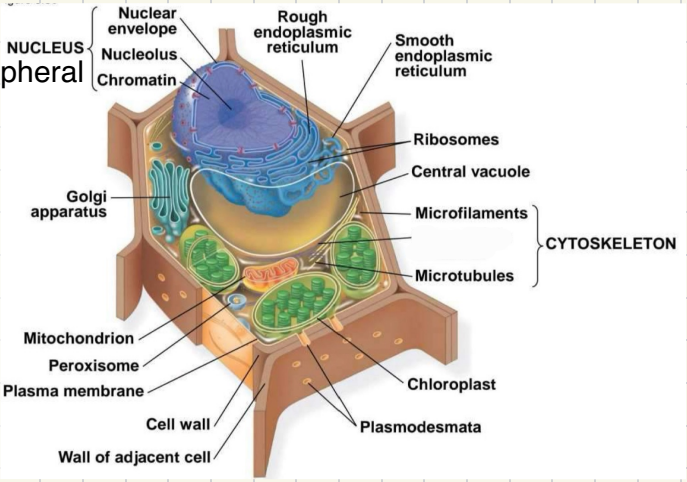
**Only in animal cells**

- 2 centriols
- Central nucleus
- Lysosomes
- The cytoskeleton is made of:-
  Microfilaments
  Intermediate filaments
  Microtubules




**Only implant cells**

- peripheral nucleus
- cell wall
- chloroplast
- Plasmodesmata
- The cytoskeleton made of:-
  Microfilaments
  Microtubules



# The nucleus

**Contains the DNA in eukaryotic cells**

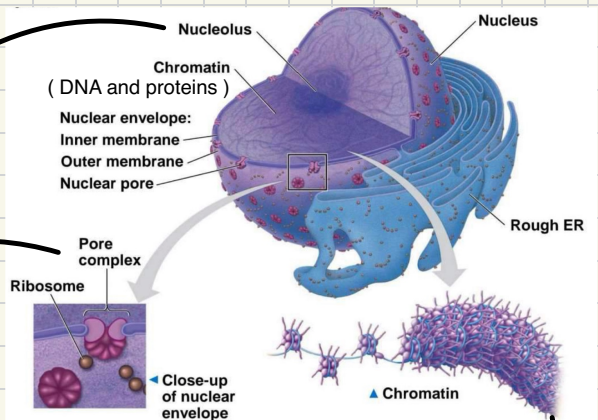
والنواة هي أكثر عضيّة ظاهرة في الخلية

It is surrounded by a nuclear envelope that consists of a **double membrane**, each membrane a **lipid bilayer**

محاطة بغشائين كل غشاء من طبقتين فهي محاطة بأربع طبقات من الدهون

On the inside of the inner membrane of the nuclear envelope there protein fibers called **lamina** and they keep the shape of the nucleus

**The nucleolus is found in the nucleus and it's the place where rRNA is synthesized**




**Pore complexes are pores coated in proteins and they regulate the entry and exit of molecules from the nucleus**

**The shape of the DNA when the cell is not dividing**

In the nucleus, DNA is organized into discrete units called **chromosomes**

Each chromosome is composed of a single DNA molecule associated with proteins

The DNA and proteins of chromosomes are together called **chromatin**

Chromatin condenses to form discrete **chromosomes** as a cell prepares to divide

**When the cell starts dividing chromatin, turns into chromosomes made of two chromatids, and each chromatid carries a copy of the DNA**

# The ribosome

Made of **protein** and **rRNA**

**ribosomes** synthesize protein using the information inherited by the DNA

**Ribosomes are made of two subunits made in the nucleolus**

free ribosomes (in the cytosol)
They synthesize proteins that work in the cytosol

Bound ribosomes (nuclear envelope and rough ER)
They synthesize proteins :
•secretory proteins
•proteins in organelles
•membrane proteins

# The endomembrane system

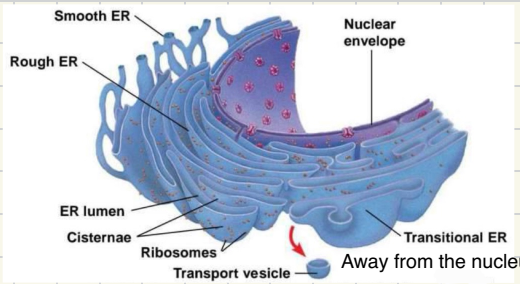
– Nuclear envelope
– Endoplasmic reticulum
– Golgi apparatus
– Lysosomes
– Vacuoles
– Plasma membrane

→ **They are continuous or connected through vesicles**

# Endoplasmic Reticulum

The **endoplasmic reticulum (ER)** accounts for more than half of the total membrane in many eukaryotic cells

**ER is continuous with the nuclear envelope**




Away from the nucleus

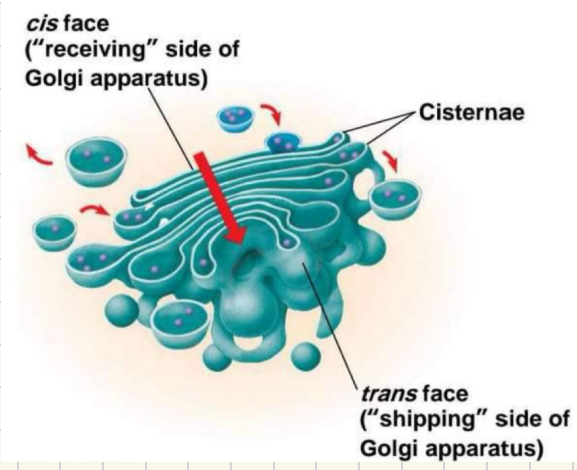
**Smooth ER Functions :**
- **calcium ions storage**
- **detoxification**
- **lipid synthesis**
- **Carbohydrates metabolism**

**Rough ER Functions :**
- **membrane factory**
- **synthesizes proteins and glycoproteins through ribosomes**
- **transport vehicles (proteins surrounded by membranes)**

# Golgi apparatus

**Flattered membranous sacs called cisternae**

**Functions:**
- **modifying products of the ER**
- **manufacturing some macromolecules (carbohydrates in cell wall)**
- **sorting and packaging materials into transport vesicles**




It has two faces
**cis** face snd **trans** face

# Lysosomes

**membranous sac of hydrolytic enzymes that can digest macromolecules**

Proteins, carbohydrates fats, nucleic acids

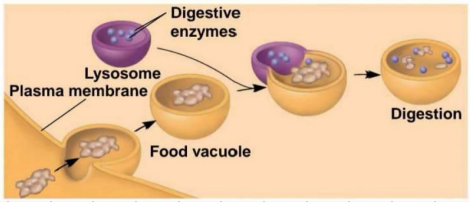
**The environment inside the lysosome is acidic**

**Intracellular digestion :**
- **Phagocytosis**
- **Autophagy**
- **Apoptosis (programmed cell death)**
- **Development**

## Phagocytosis

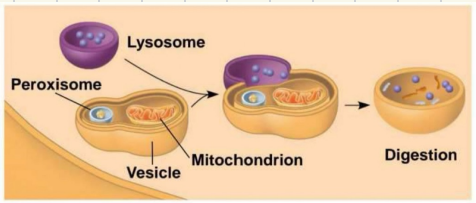
Some types of cell can engulf another cell by **phagocytosis**; this forms a food vacuole

A lysosome fuses with the food vacuole and digests the molecules




## Autophagy

Lysosomes also use enzymes to recycle the cell's own organelles and macromolecules, a process called autophagy




## Apoptosis

**The lysosomes start leaking their enzymes and digesting the cell**

## Development

- **Hydrolyzing the membranes between fingers in human embryos**
- **Hydrolyzing the tail of frogs during maturation**

# Vacuoles

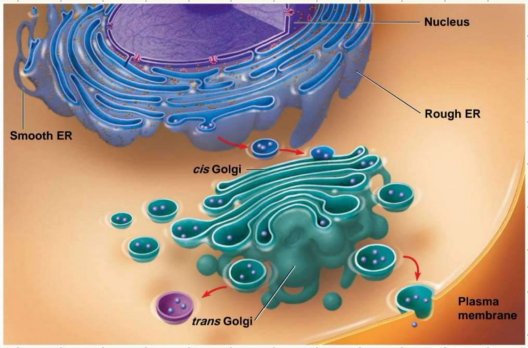
A plant cell or fungal cell may have one or several **vacuoles**, derived from endoplasmic reticulum and Golgi apparatus

**Food vacuoles** are formed by phagocytosis

**Contractile vacuoles**, found in many freshwater protists, pump excess water out of cells

**Central vacuoles**, found in many mature plant cells, hold organic compounds and water

- organic and inorganic substances
- pigments
- waste
- toxins




**the whole endomembrane system**