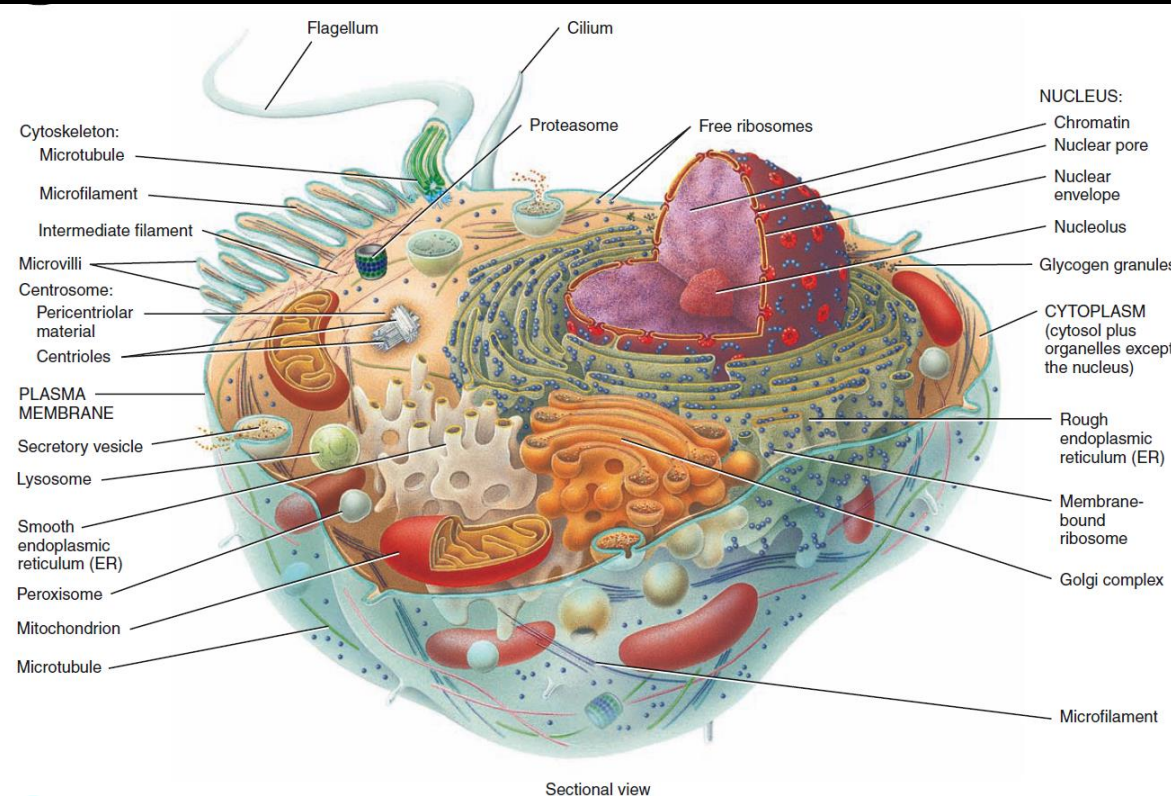


The Cellular Level Of Organisation



CYTOPLASM

- Cytoplasm consists of all the cellular contents between the plasma membrane and the nucleus, and has two components
 - (1) the cytosol
 - (2) organelles

Cytosol

- The **cytosol (intracellular fluid)** is the fluid portion of the cytoplasm that surrounds organelles and constitutes about 55% of total cell volume.
- Cytosol is 75–90% water plus various dissolved and suspended components.
- Different types of ions, glucose, amino acids, fatty acids, proteins, lipids, ATP, and waste products present in cytosol
- The cytosol is the site of many chemical reactions required for a cell's existence. For example, enzymes in cytosol catalyze *glycolysis*, a series of 10 chemical reactions that produce molecules of ATP from one molecule of glucose

Organelles

- *Ribosomes*
- *Endoplasmic Reticulum*
- *Golgi Complex*
- *Lysosomes*
- *Peroxisomes*
- *Mitochondria*
- Cilia and flagella
- Nucleus


Ribosome

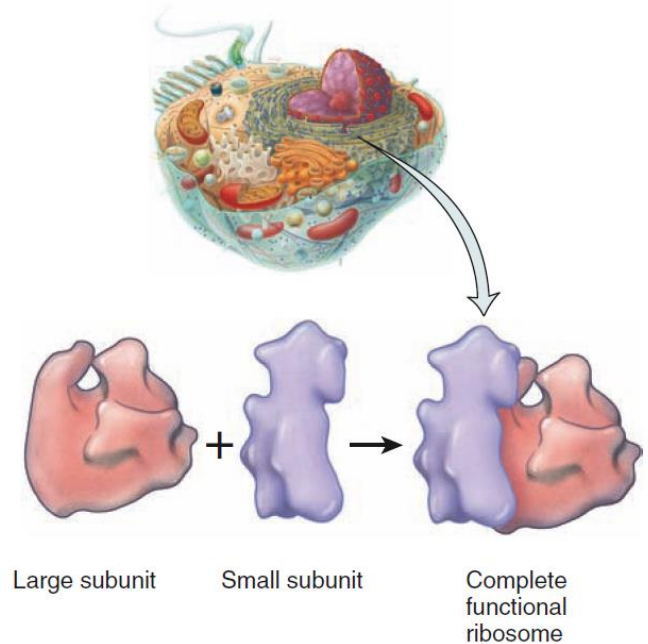
- **Ribosomes** are the sites of protein synthesis.
- Human Cell Contains 80s Ribosomes
 - Composed of 40s & 60s Subunit
- Composed of two subunits containing ribosomal RNA and proteins; may be free in cytosol or attached to rough ER.

Ribosome

1. Ribosomes associated with endoplasmic reticulum synthesize proteins destined for insertion in the plasma membrane or secretion from the cell.
2. Free ribosomes synthesize proteins used in the cytosol.

Figure 3.18 Ribosomes.

 Ribosomes are the sites of protein synthesis.



Details of ribosomal subunits

Endoplasmic Reticulum

- The **endoplasmic reticulum** or **ER** is a network of membranes in the form of flattened sacs or tubules
- The ER extends from the nuclear envelope (membrane around the nucleus), to which it is connected, throughout the cytoplasm.

Functions of ER

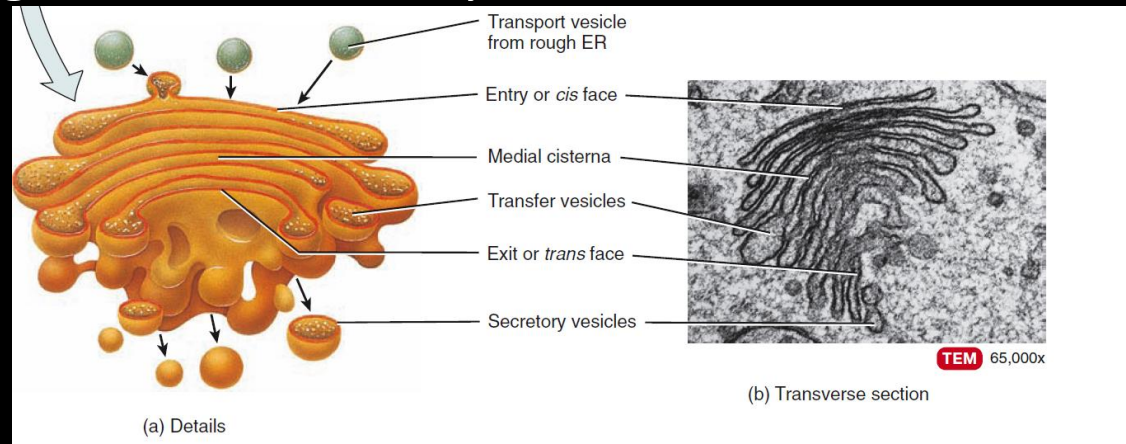
- **1. Rough ER** synthesizes glycoproteins and phospholipids that are transferred into cellular organelles, inserted into the plasma membrane, or secreted during exocytosis.
- **2. Smooth ER** synthesizes fatty acids and steroids, such as estrogens and testosterone; inactivates or detoxifies drugs and other potentially harmful substances; removes the phosphate group from glucose-6-phosphate; and stores and releases calcium ions that trigger contraction in muscle cells.

Golgi Complex

- Most of the proteins synthesized by ribosomes attached to rough ER are ultimately transported to other regions of the cell.
- The first step in the transport pathway is through an organelle called the **Golgi complex**
- It consists of 3 to 20 **cisternae**

Functions

1. Modifies, sorts, packages, and transports proteins received from the rough ER.
2. Forms secretory vesicles that discharge processed proteins via exocytosis into extracellular fluid; forms membrane vesicles that ferry new molecules to the plasma membrane; forms transport vesicles that carry molecules to other organelles, such as lysosomes.



Lysosomes

- **Lysosomes** are membrane-enclosed vesicles that form from the Golgi complex
- They can contain as many as 60 kinds of powerful digestive and hydrolytic enzymes that can break down a wide variety of molecules once lysosomes fuse with vesicles formed during endocytosis.

FUNCTIONS OF LYSOSOMES

1. Digest substances that enter a cell via endocytosis and transport final products of digestion into cytosol.
2. Carry out autophagy, the digestion of worn-out organelles.
3. Implement autolysis, the digestion of an entire cell.
4. Accomplish extracellular digestion.

Peroxisome

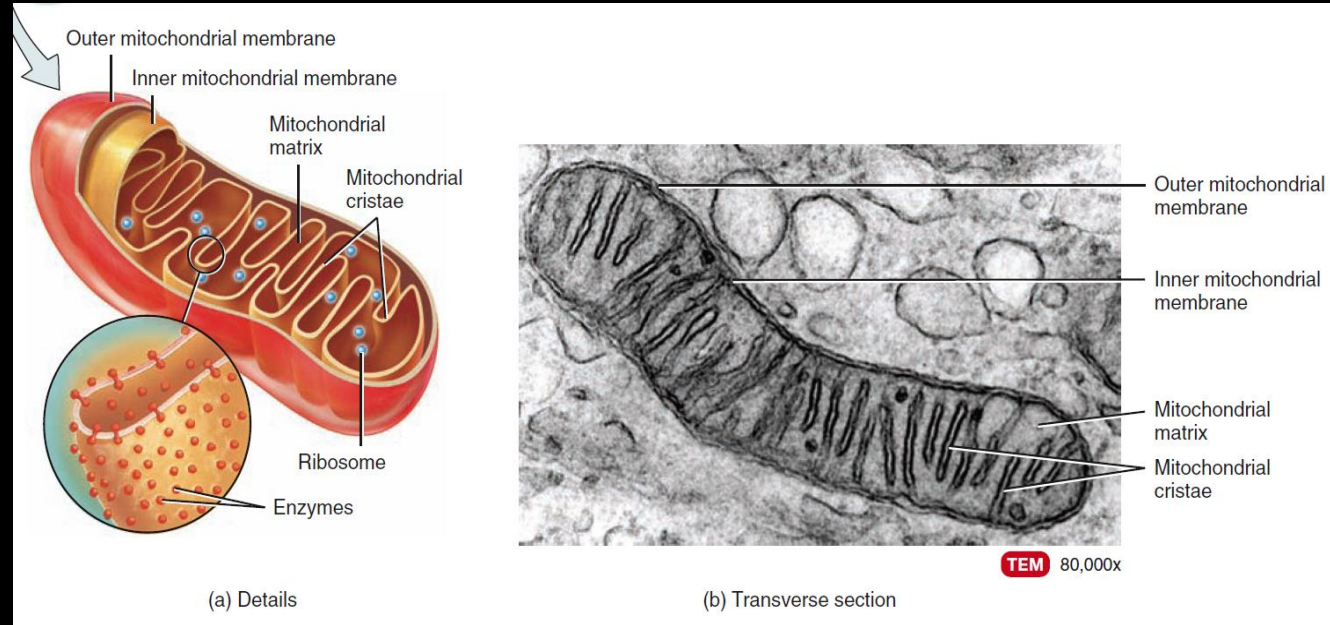
- **Description** Vesicle containing oxidases (oxidative enzymes) and catalase (decomposes hydrogen peroxide); new peroxisomes bud from preexisting ones.
- **Function** Oxidizes amino acids and fatty acids; detoxifies harmful substances, such as hydrogen peroxide and associated free radicals.

Mitochondria

- **Mitochondria** are referred to as the “powerhouses” of the cell
- cell may have as few as a hundred or as many as several thousand mitochondria, depending on its activity.
- Active cells, such as those found in the muscles, liver, and kidneys, which use ATP at a high rate, have a large number of mitochondria.

Functions

1. Generate ATP through reactions of aerobic cellular respiration.
2. Play an important early role in apoptosis(Cell Death).



Cilia and Flagella

- Motile cell surface projections that contain 20 microtubules and a basal body.
- **Cilia:** move fluids over cell's surface
- **flagella:** move entire cell.

Nucleus

- The **nucleus** is a spherical or oval-shaped structure that usually is the most prominent (IMPORTANT) feature of a cell
- Most cells have a single nucleus
- **But mature red blood cells doesn't .**
- A double membrane called the **nuclear envelope** separates the nucleus from the cytoplasm.
- Both layers of the nuclear envelope are lipid bilayers similar to the plasma membrane.

- The outer membrane of the nuclear envelope is continuous with rough ER and resembles it in structure.
- Many openings called **nuclear pores**.
- Nuclear pores control the movement of substances between the nucleus and the cytoplasm
- Inside the nucleus are one or more spherical bodies called
- **nucleoli** (singular is *nucleolus*) that function in producing ribosomes.
- Within the nucleus are most of the cell's hereditary units, called **genes**

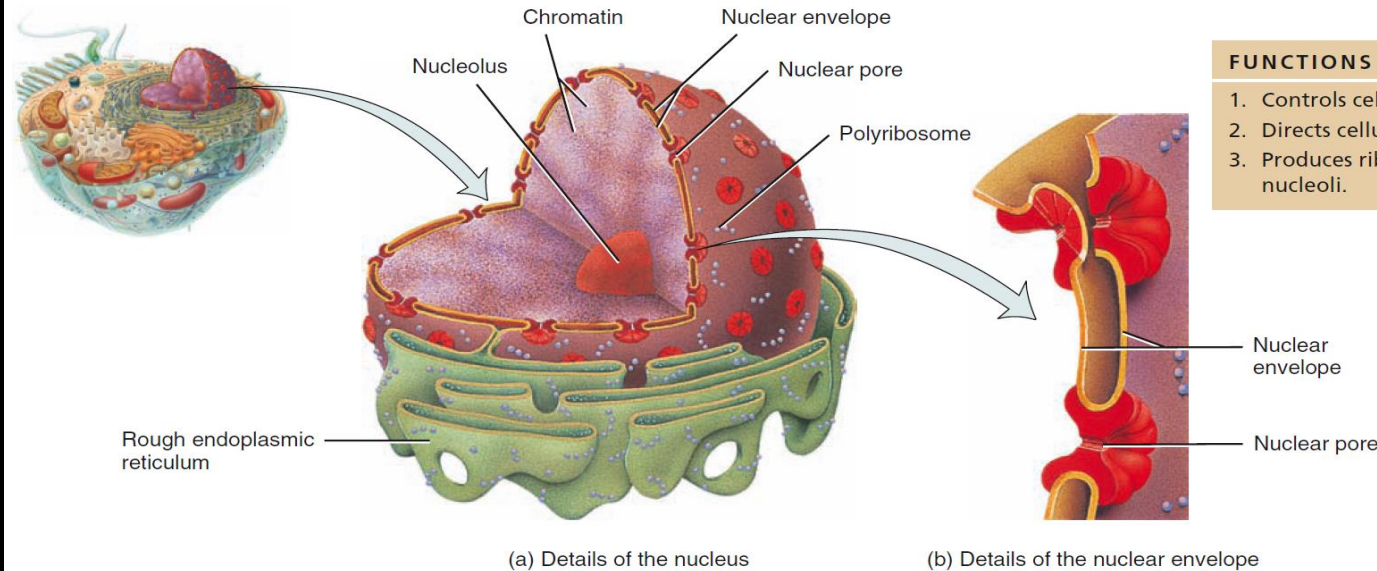
FUNCTIONS OF NUCLEUS

1. Controls cellular structure.
2. Directs cellular activities.
3. Produces ribosomes in nucleoli.

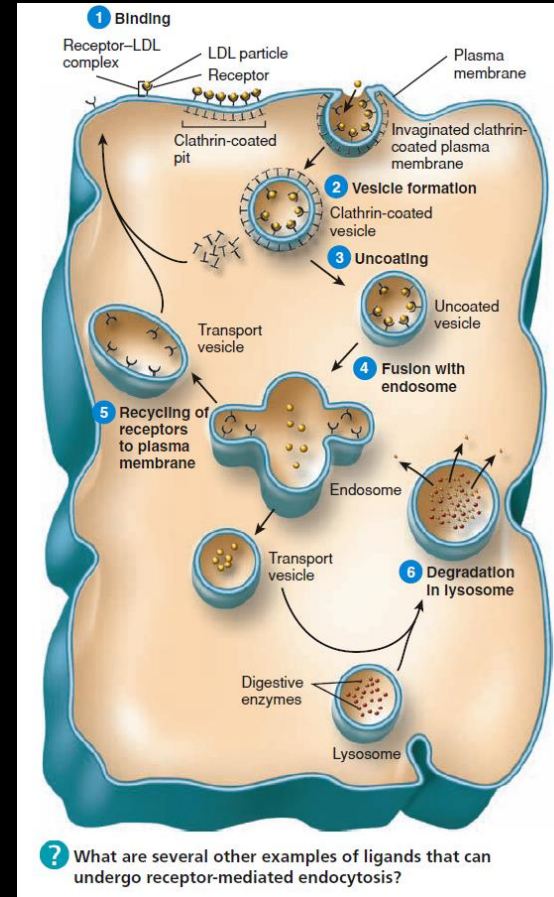
Figure 3.24 Nucleus.



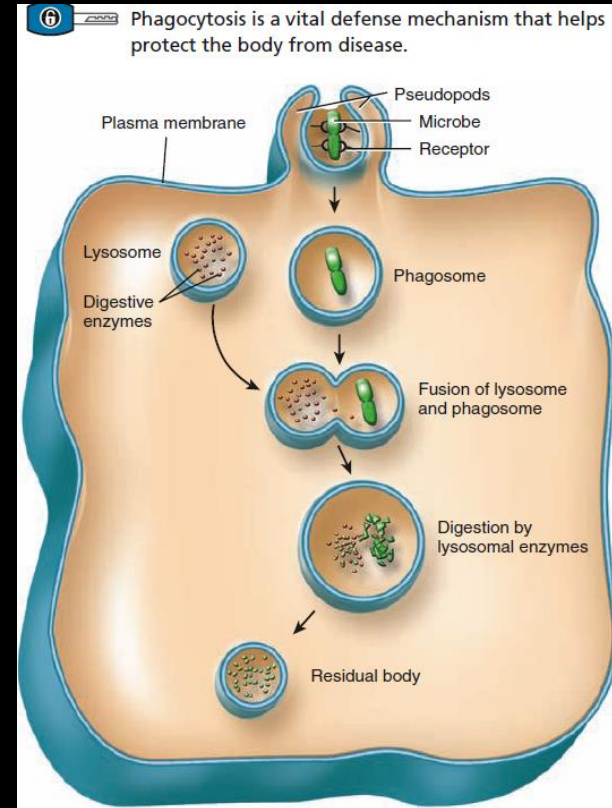
The nucleus contains most of the cell's genes, which are located on chromosomes.



- **ENDOCYTOSIS** Here we consider three types of endocytosis: receptor-mediated endocytosis, phagocytosis, and bulk-phase endocytosis.

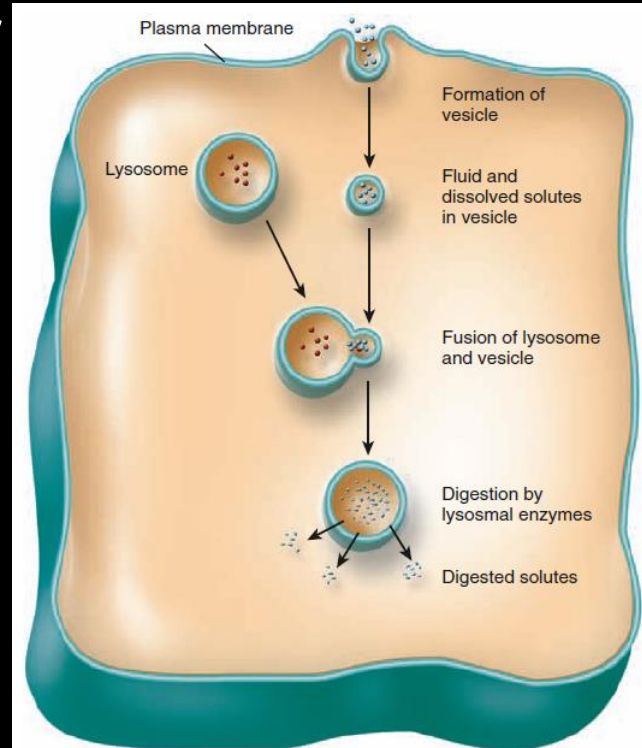


- **Phagocytosis** is a form of endocytosis in which the cell engulfs large solid particles, such as worn-out cells, whole bacteria, or viruses



(a) Diagram of the process

- **Pinocytosis** (*pino-* to drink), a form of endocytosis in which tiny droplets of extracellular fluid are taken up



? How do receptor-mediated endocytosis and phagocytosis differ from bulk-phase endocytosis?