

GPAT

2027-28



HUMAN ANATOMY & PHYSIOLOGY

CLASS- 11



TIME- 8 : 30 P.M

CELL AND ITS STRUCTURE

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GPAT



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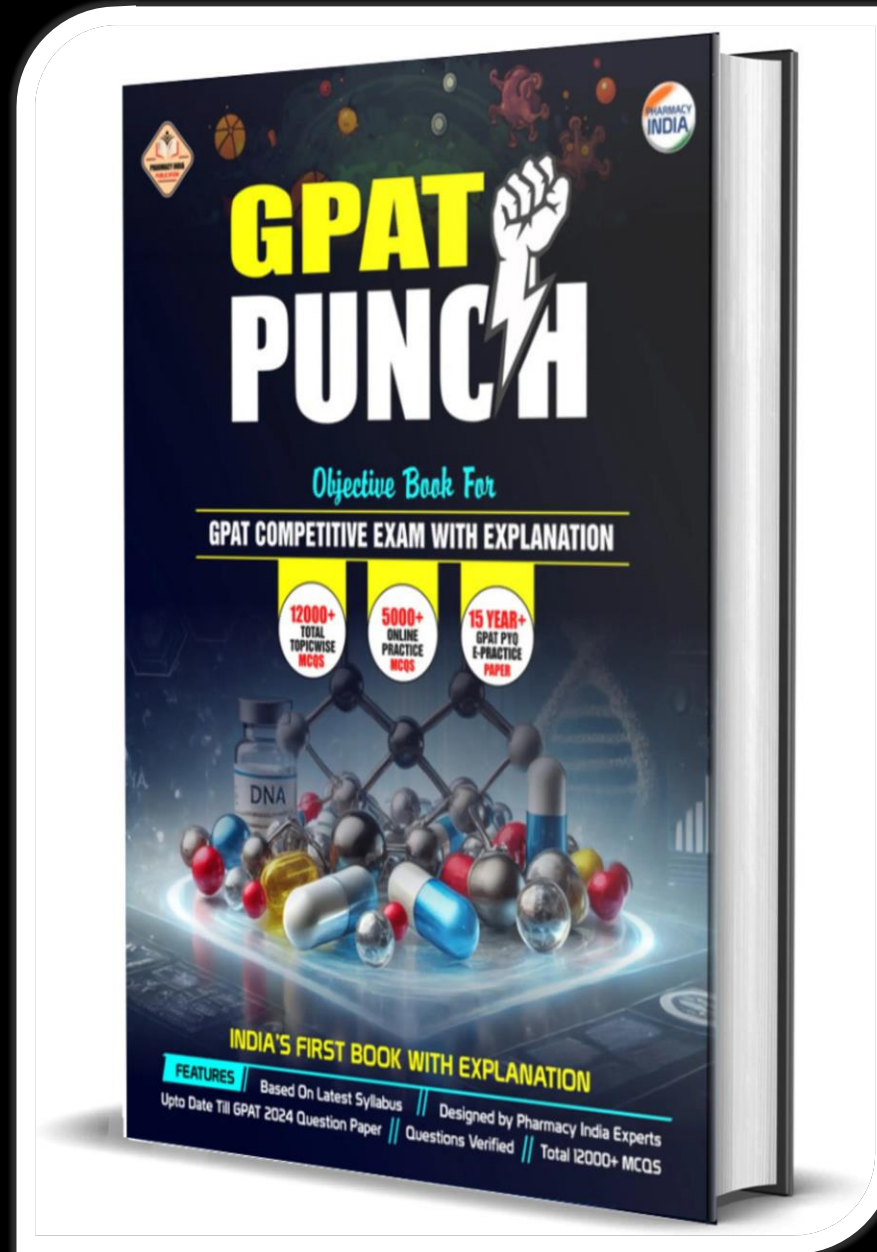
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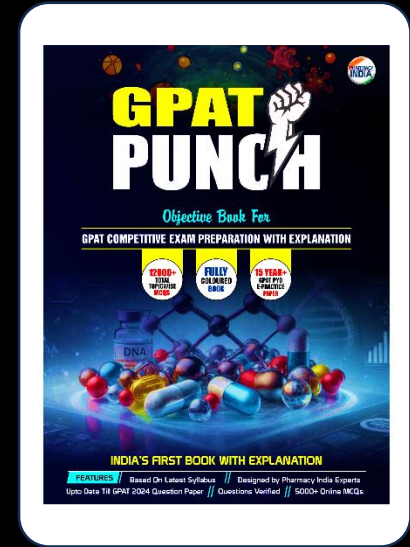
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01. The phase in which two identical copies of DNA are formed is: [GPAT-2024]

- (a) G1 phase
- (b) S phase
- (c) G2 phase
- (d) M phase



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01.

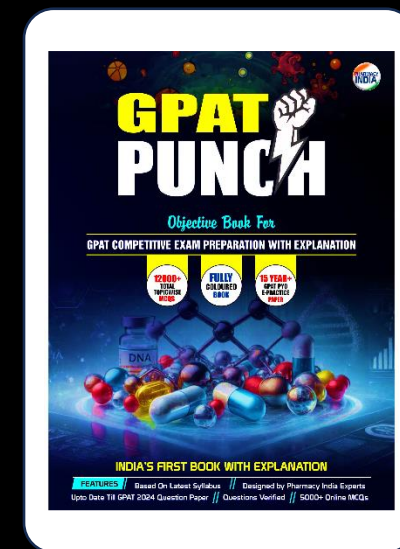
The phase in which two identical copies of DNA are formed is: [GPAT-2024]

(a) G1 phase

(b) S phase

(c) G2 phase

(d) M phase



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S Phase - DNA Replication



S Phase is the Synthesis phase of the cell cycle.



DNA replication occurs in this phase. The DNA is copied.



Each chromosome is replicated and forms two sister chromatids joined at the centromere.



G₁ Phase is mainly for cell growth and protein synthesis.



G₂ Phase prepares the cell for mitosis.



Therefore, DNA copies are formed in S phase.

DNA REPLICATION

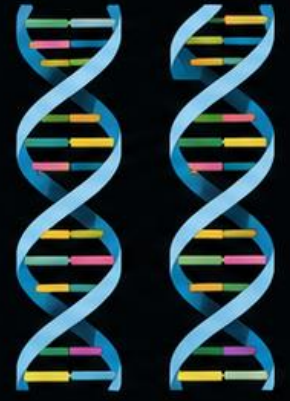
Original DNA



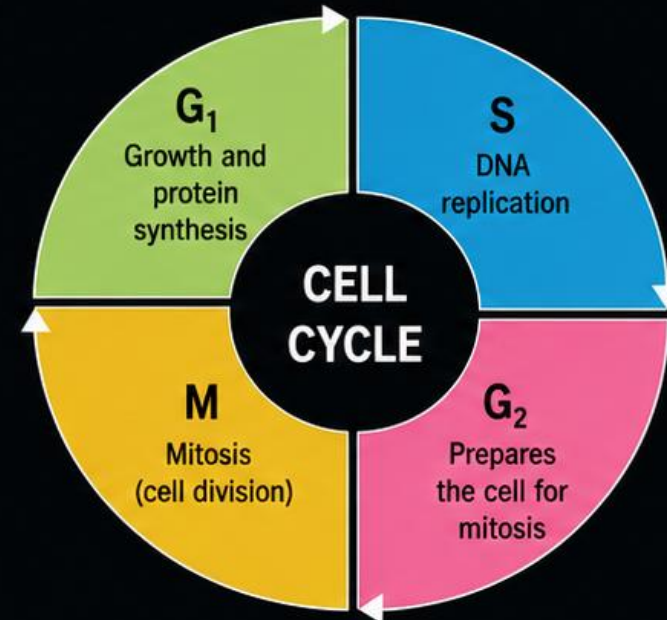
Replication



Result



Two sister chromatids
(identical copies)



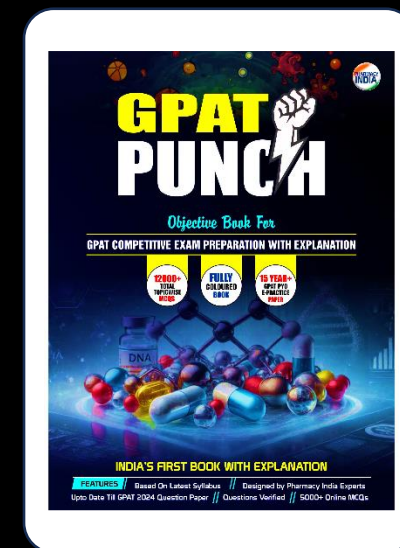


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02.

**RNA molecules having intrinsic catalytic activity
are called: [GPAT-2019]**

- (a) mRNAs
- (b) Ribozymes
- (c) snRNAs
- (d) rRNAs



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02.

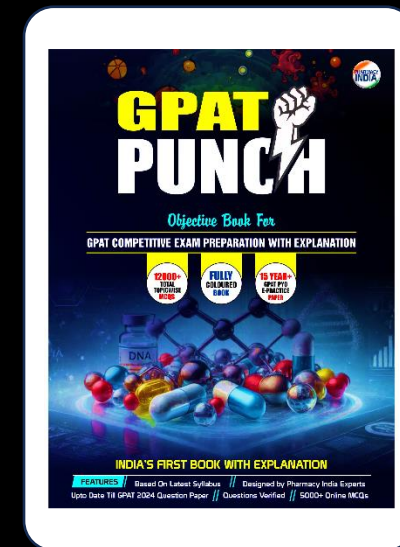
RNA molecules having intrinsic catalytic activity are called: [GPAT-2019]

(a) mRNAs

(b) Ribozymes

(c) snRNAs

(d) rRNAs



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Ribozymes - Catalytic RNA



Ribozymes are RNA molecules with enzyme-like catalytic activity.



They **catalyze** biochemical reactions.



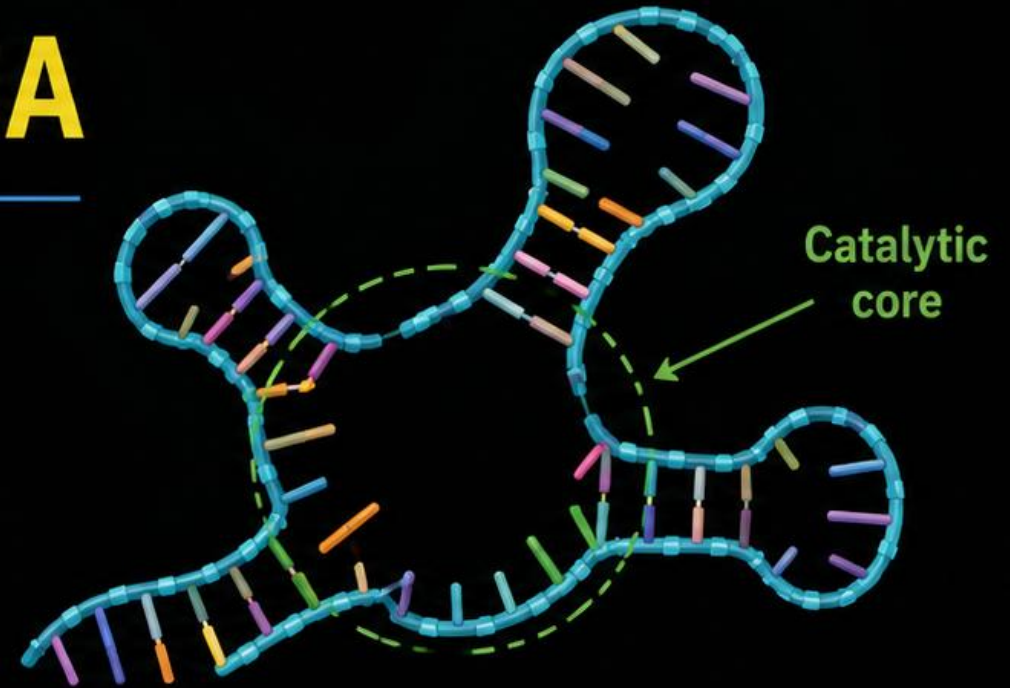
Some ribozymes take part in **RNA processing**.



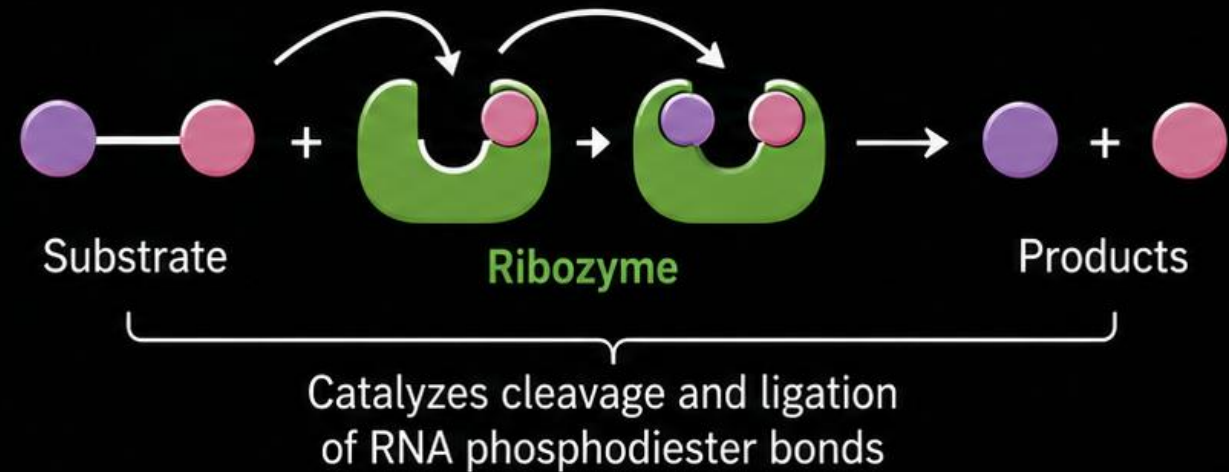
mRNA mainly carries genetic information for protein synthesis.



Therefore, catalytic RNA molecules are called **ribozymes**.



Ribozyme (catalytic RNA)



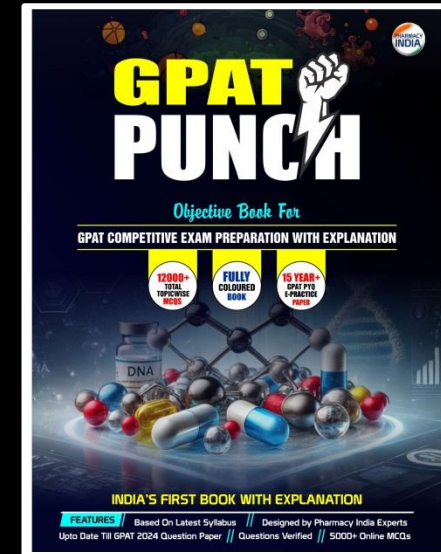


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03.

Which of the following statements is NOT true about prokaryotes? [GPAT-2018]

- (a) Nucleus is not bounded by nuclear membrane
- (b) Cell wall contains peptidoglycan
- (c) 80S ribosomes are distributed in cytoplasm
- (d) It is haploid in nature



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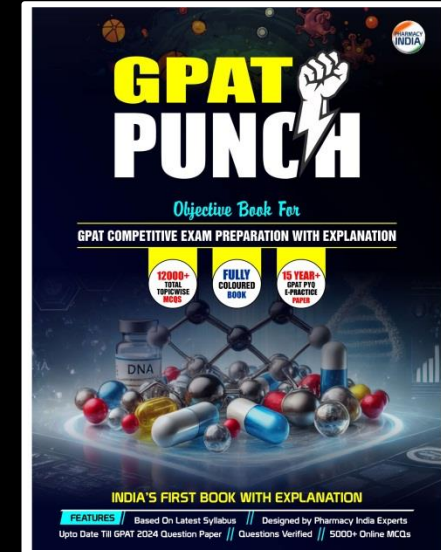
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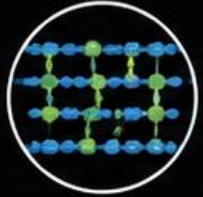
Prokaryotes - Key Facts



Prokaryotes **do not have** a true membrane-bound nucleus.



Their genetic material lies in the **nucleoid region**.



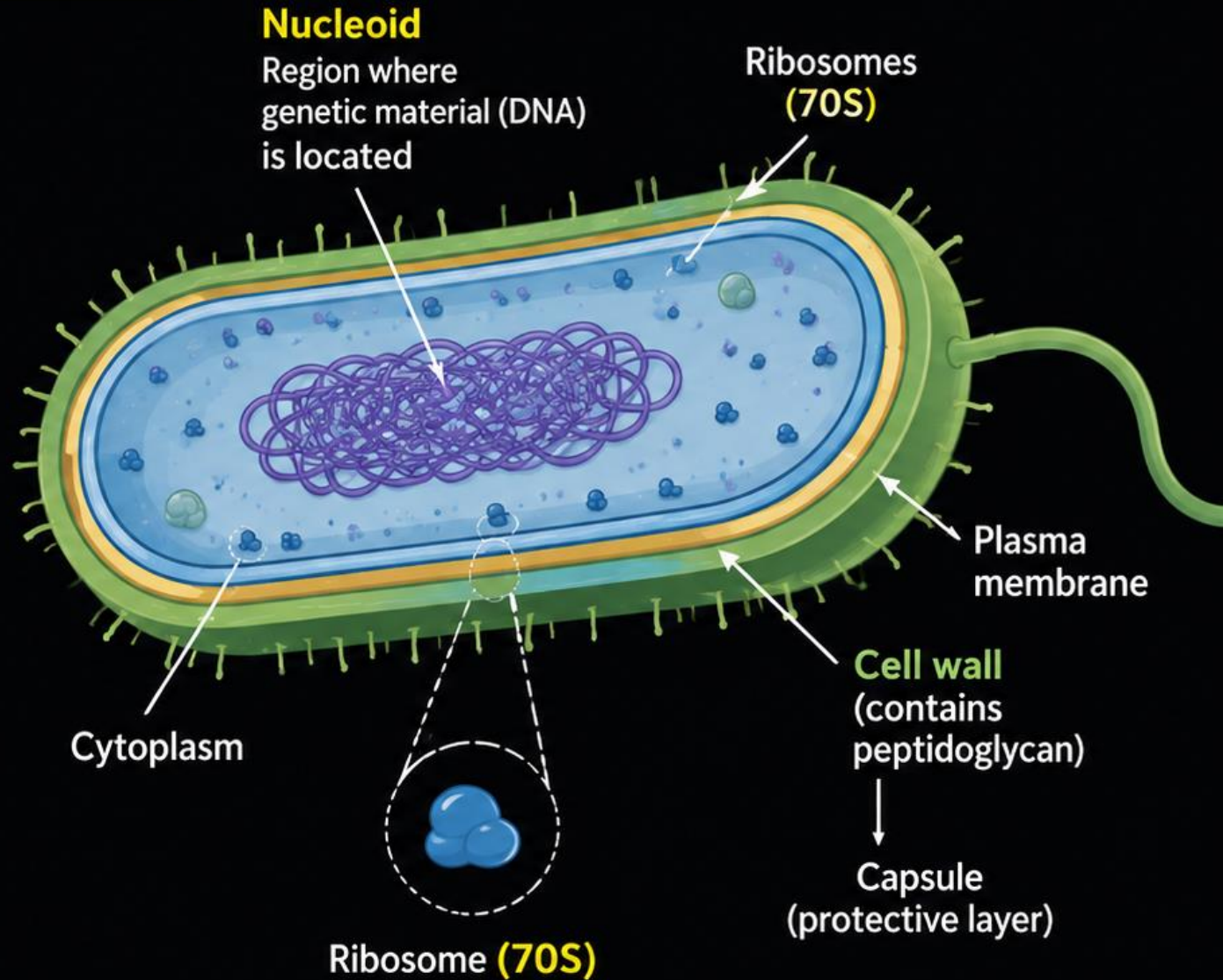
Bacterial cell wall commonly contains **peptidoglycan**.



Prokaryotes usually have **70S** ribosomes, not 80S.



80S ribosomes are found in eukaryotic cytoplasm.





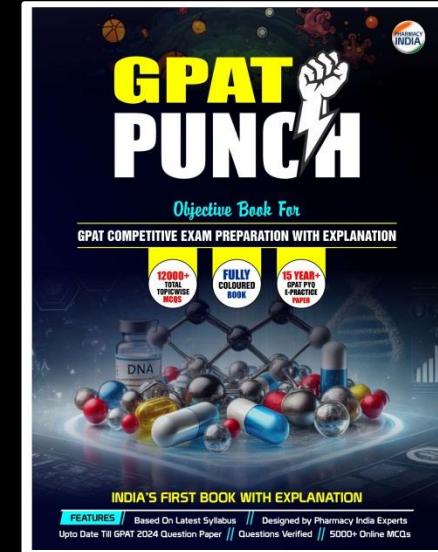
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04.

Which of the following statements is TRUE about the nucleus?

- (a) It is absent in prokaryotes
- (b) It is called the brain of the cell
- (c) It contains DNA and other genetic materials
- (d) All of the above



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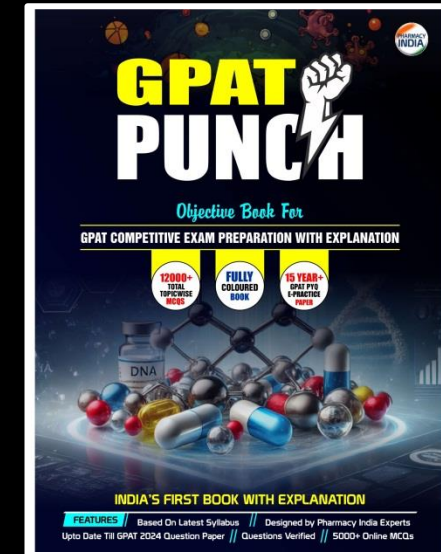
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04.

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- (a) It is absent in prokaryotes
- (b) It is called the brain of the cell
- (c) It contains DNA and other genetic materials
- (d) All of the above**



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Nucleus - Control Centre of the Cell



- Prokaryotes **lack a true membrane-bound nucleus.**



- The nucleus **controls** most cellular activities.



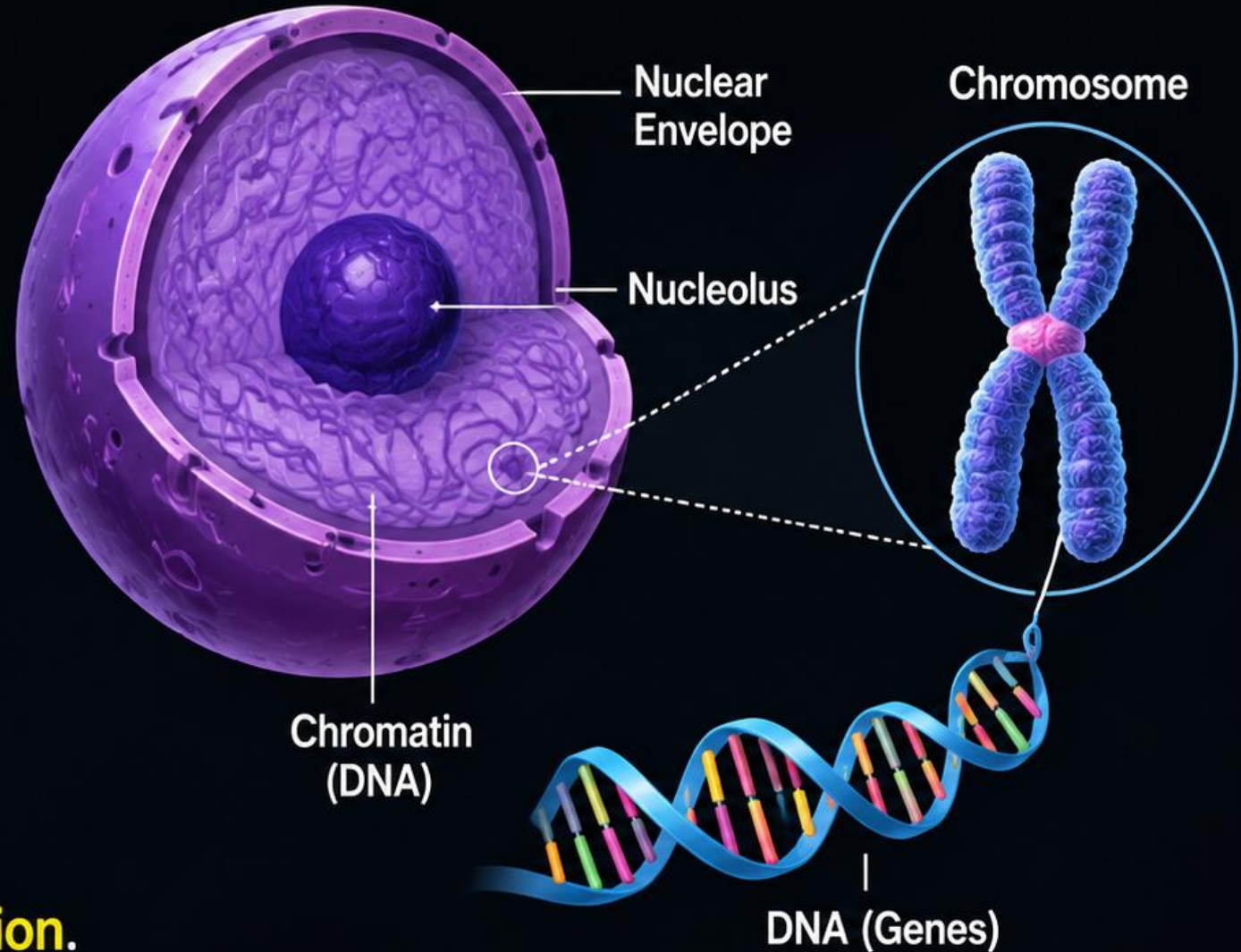
- It is called the **brain** or **control centre** of the cell.



- It contains **DNA**, **genes** and **chromosomes**.



- It regulates **growth**, **metabolism** and **reproduction**.



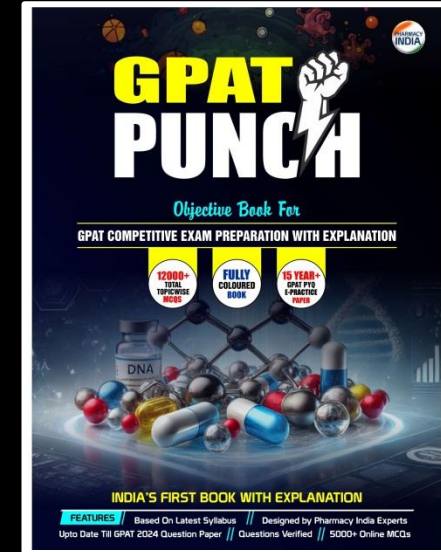


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05.

Lysosomes are known as “suicidal bags” because of their:

- (a) Parasitic activity
- (b) Presence of food vacuole
- (c) Hydrolytic activity
- (d) Catalytic activity



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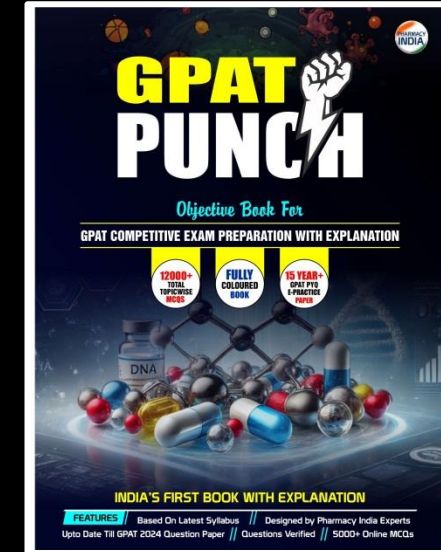
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Lysosomes - Suicidal Bags



Lysosomes are **membrane-bound sacs** that contain **hydrolytic digestive enzymes**.



These enzymes digest all kinds of biomolecules—**proteins, lipids and carbohydrates**.



Lysosomes remove and recycle **worn-out cell organelles** and cellular debris.

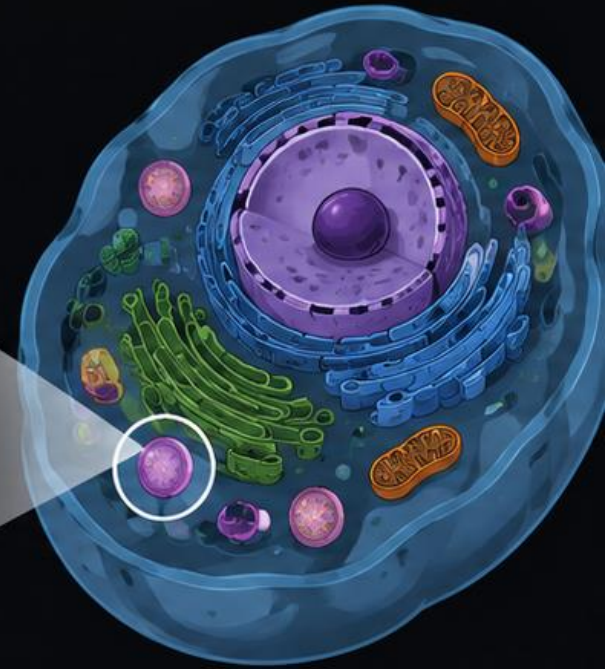
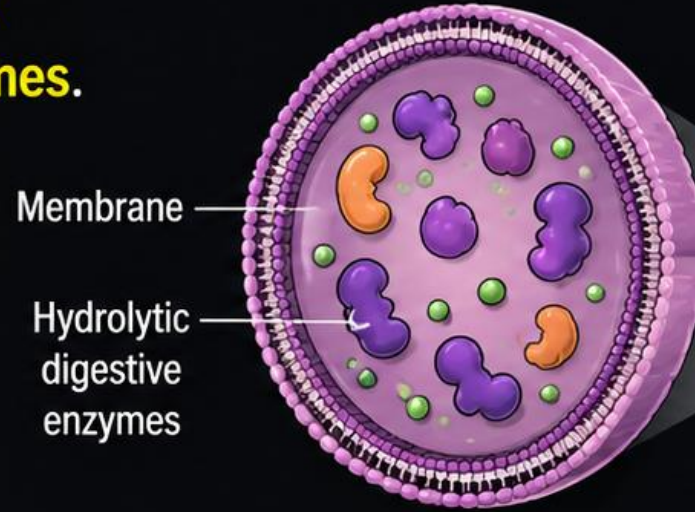


If lysosomes **rupture**, their enzymes may leak out and **digest cell components**.

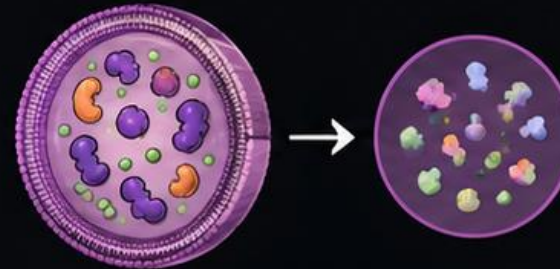


This **self-digestive** property gives lysosomes the name "**Suicidal Bags**".

LYSOSOME

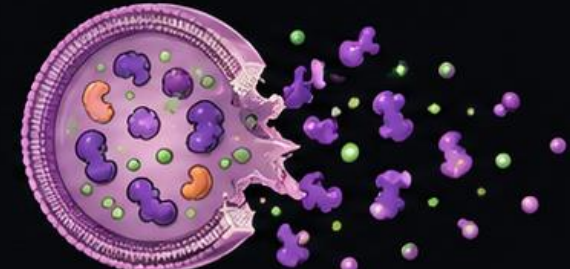


NORMAL FUNCTION



Digests worn-out organelles and debris

RUPTURED LYSOSOME



Enzymes leak out and digest cell components



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06.

Which cell organelle regulates the entry and exit of molecules to and from the cell?

- (a) Lysosomes
- (b) Golgi bodies
- (c) Cell membrane
- (d) Mitochondria



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06.

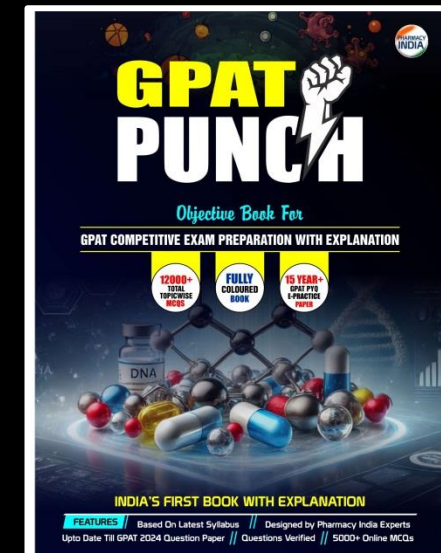
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(c) Cell membrane

(d) Mitochondria



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Cell Membrane - Selective Barrier



The cell membrane forms the **outer boundary** of the cell.



It is **selectively permeable**, allowing some substances to pass while blocking others.



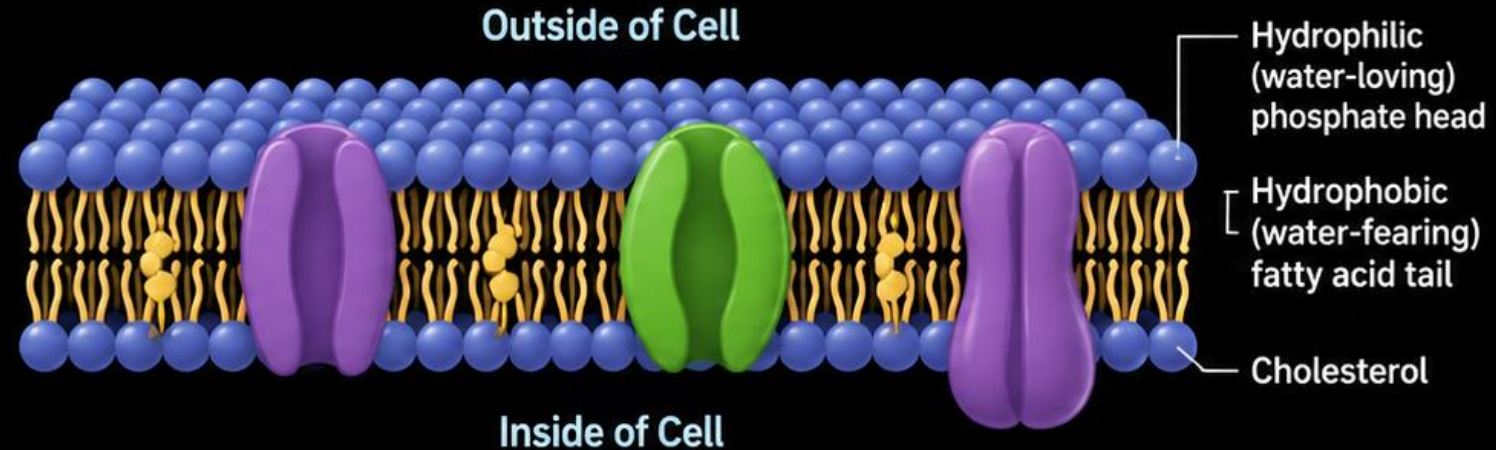
It controls the entry of **nutrients and ions** needed by the cell.



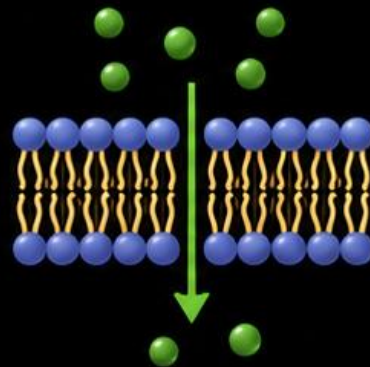
It helps remove **waste** materials and unwanted substances.



Movement of substances across the membrane occurs by **diffusion**, **osmosis** and **active transport**.

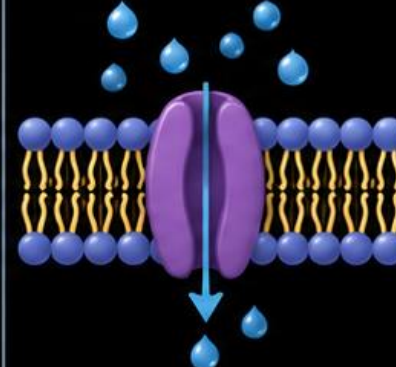


DIFFUSION



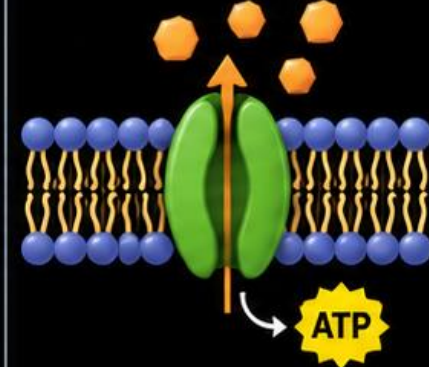
Movement of small nonpolar molecules from high to low concentration.

OSMOSIS



Movement of water across the membrane from high to low water concentration.

ACTIVE TRANSPORT



Movement of substances against the concentration gradient using energy (ATP).



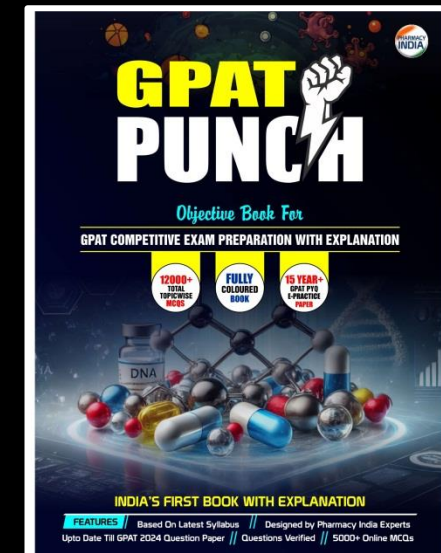
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07.

Which type of movement occurs when Na^+/K^+ pump is used?

- (a) Na^+ ions move out of the cell and K^+ ions move in
- (b) K^+ ions move out of the cell and Na^+ ions move in
- (c) Both Na^+ and K^+ ions move inside the cell
- (d) Both Na^+ and K^+ ions move out of the cell



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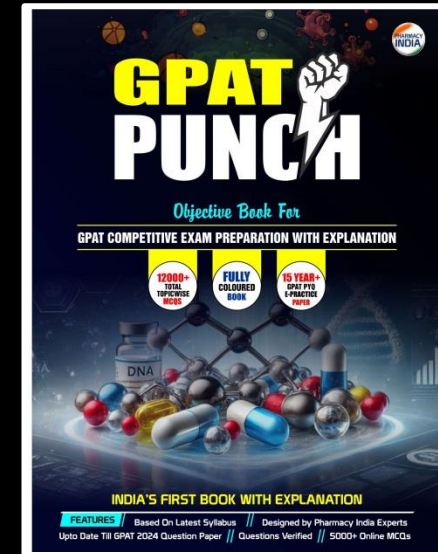
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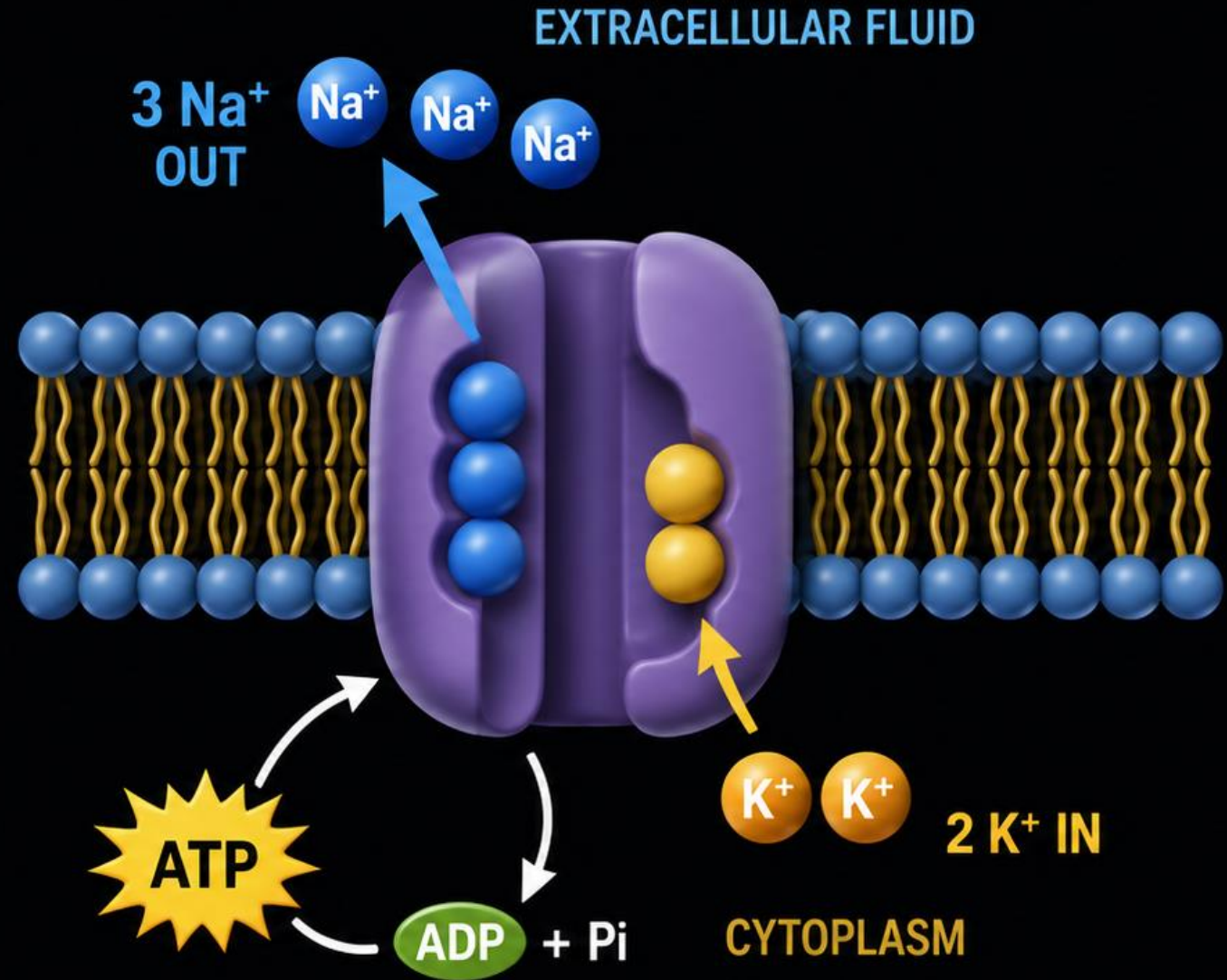
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Na⁺/K⁺ Pump - Active Transport

- **ACTIVE** The sodium-potassium pump is an **active transport** mechanism.
- **ATP** It uses **ATP** energy to move ions against their concentration gradients.
- **3 Na⁺** It moves **3 Na⁺** ions out of the cell.
- **2 K⁺** It moves **2 K⁺** ions into the cell.
- **⚡** This helps maintain the **resting membrane potential** and proper cell function.



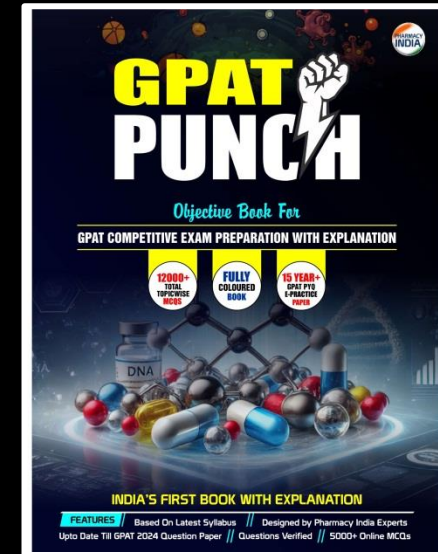


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08.

Which of the following signal molecules is not used for extracellular signaling?

- (a) Autocrine
- (b) Endocrine
- (c) Cyclic AMP
- (d) None of the above



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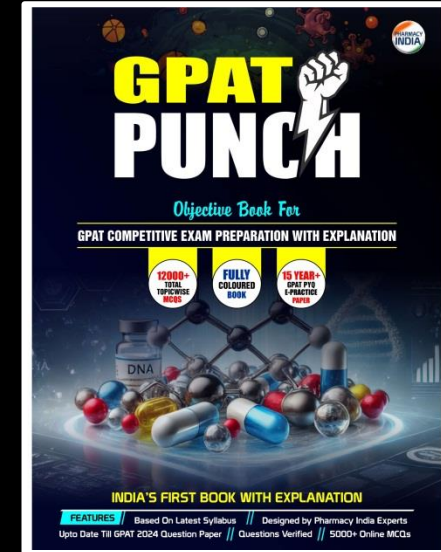
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cAMP - Second Messenger



Extracellular signaling includes **endocrine**, **autocrine** and **paracrine** signaling.



Cyclic AMP (cAMP) is mainly an **intracellular** second messenger.



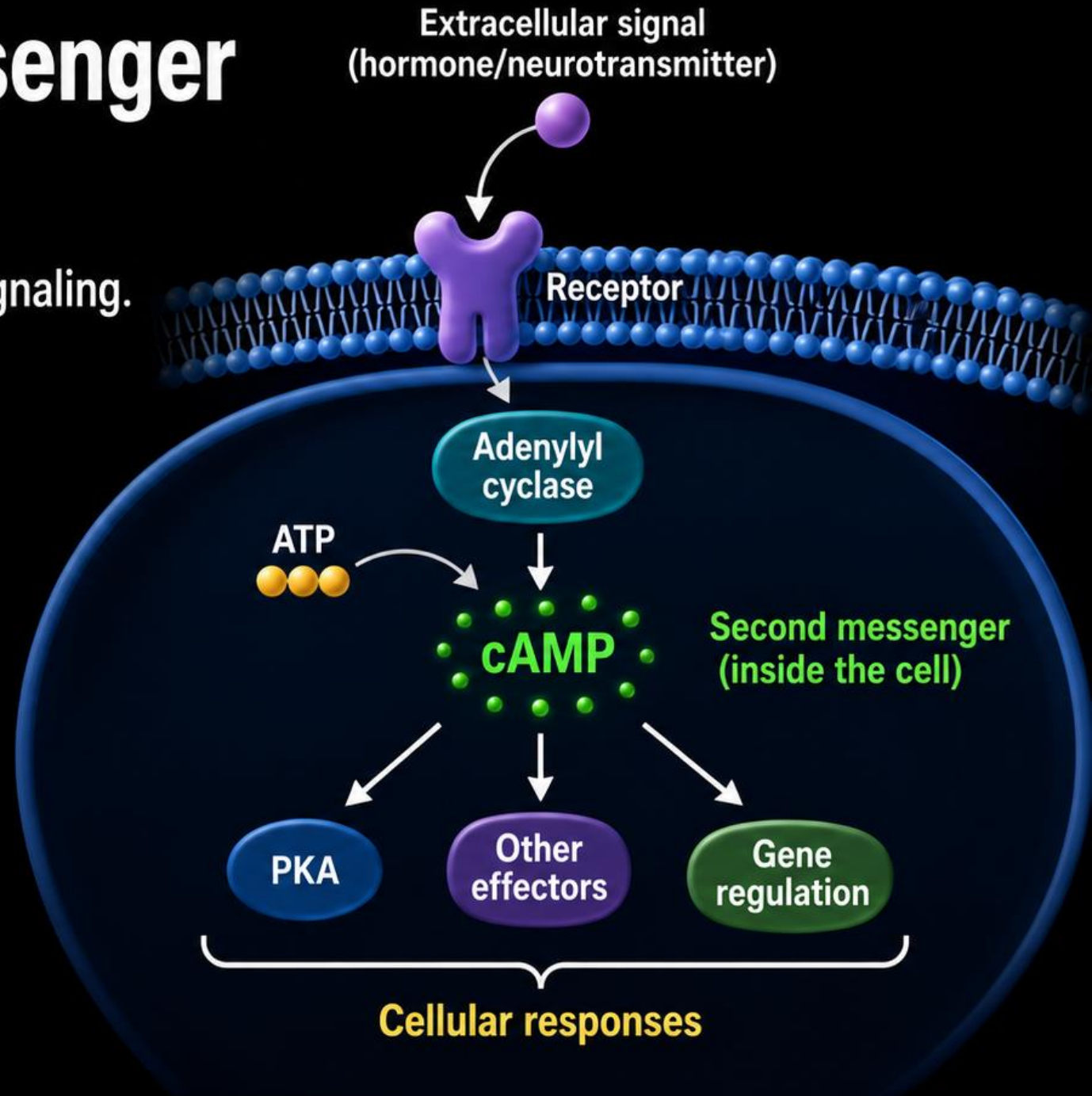
It works **inside the cell** after receptor activation.



cAMP relays signals **within the cell** to bring about a response.



Therefore, cAMP is **NOT** an **extracellular** signaling molecule.



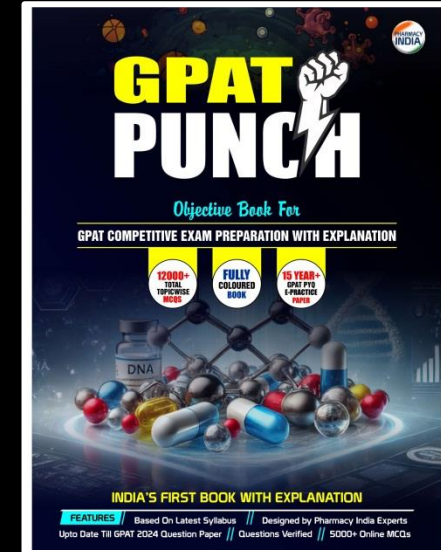


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09.

Which of the following phenomena is commonly referred to as “cell drinking”?

- (a) Pinocytosis
- (b) Exocytosis
- (c) Endocytosis
- (d) Phagocytosis



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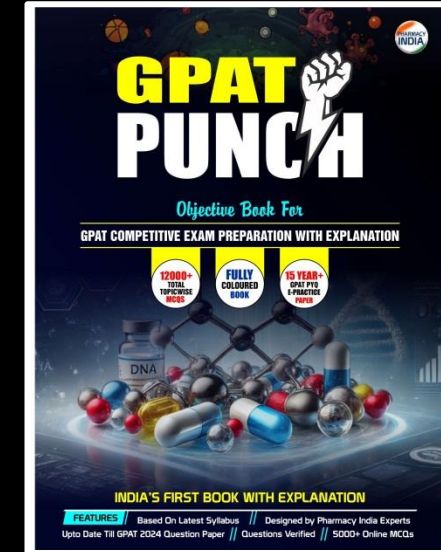
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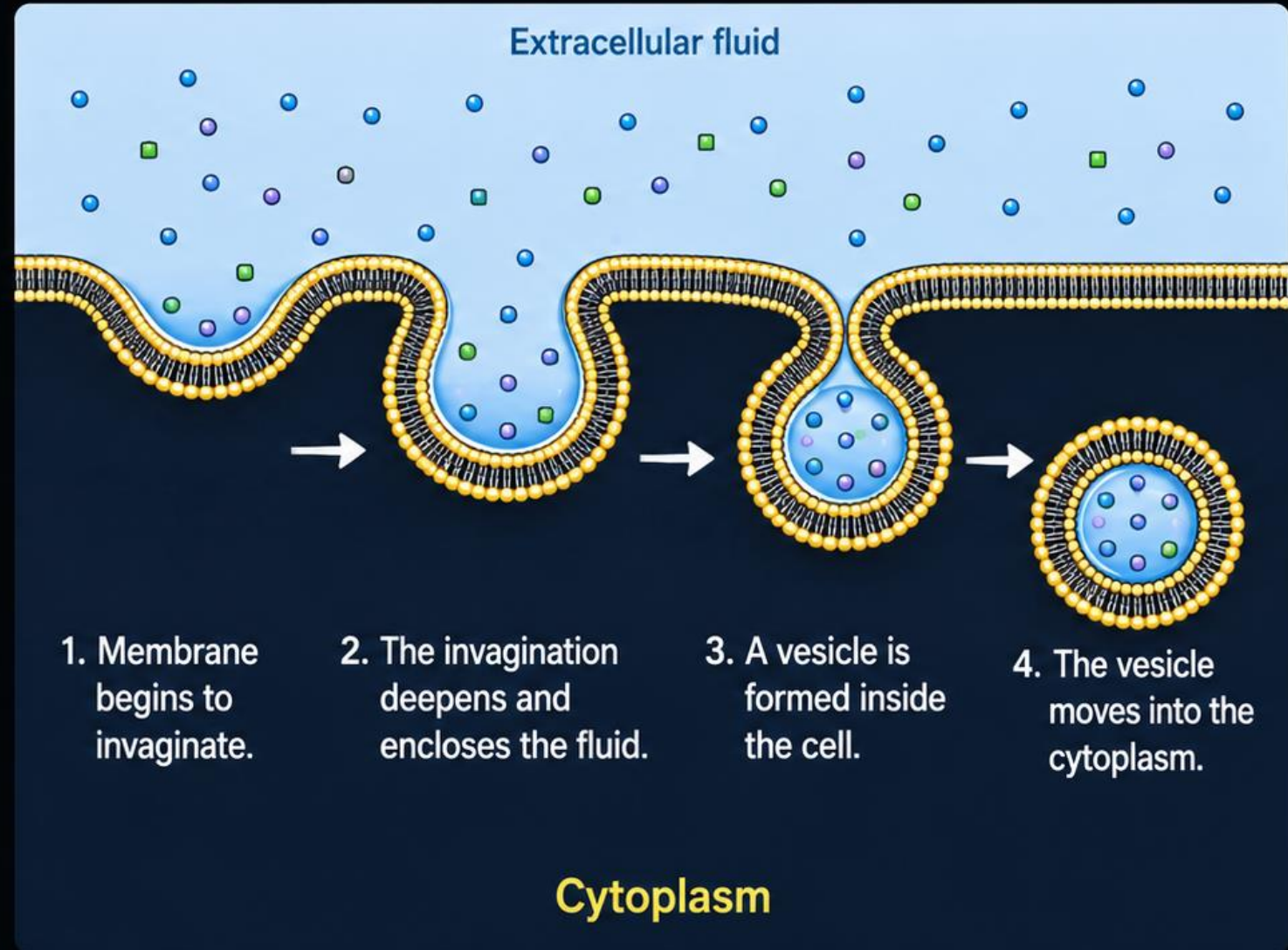
- (a) Pinocytosis
- (b) Exocytosis
- (c) Endocytosis
- (d) Phagocytosis



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Pinocytosis - Cell Drinking

- Pinocytosis is the **uptake of extracellular fluid** into the cell.
- It is called “**cell drinking**” because the cell takes in fluid from its surroundings.
- The plasma membrane invaginates and forms **small vesicles** around the fluid.
- Pinocytosis helps the cell internalize **dissolved substances** such as ions, nutrients, and proteins.
- Phagocytosis is “**cell eating**”, the uptake of solid particles.





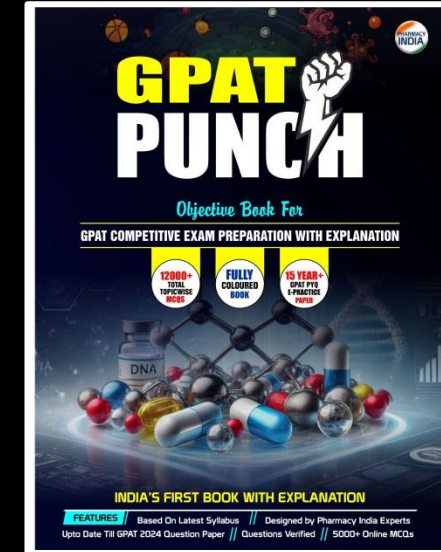
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10.

Which organelle functions in cellular respiration?

- (a) Mitochondria
- (b) Lysosome
- (c) Endoplasmic reticulum
- (d) Golgi apparatus



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10.

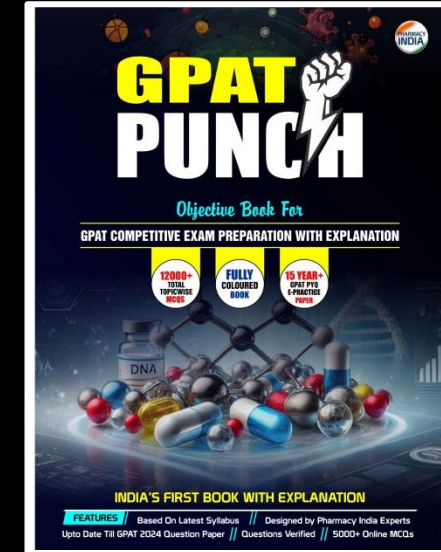
Which organelle functions in cellular respiration?

(a) Mitochondria

(b) Lysosome

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(d) Golgi apparatus



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Mitochondria - Cellular Respiration



Mitochondria are the **main site** of **cellular respiration**.



They produce **ATP** by **oxidative phosphorylation**.



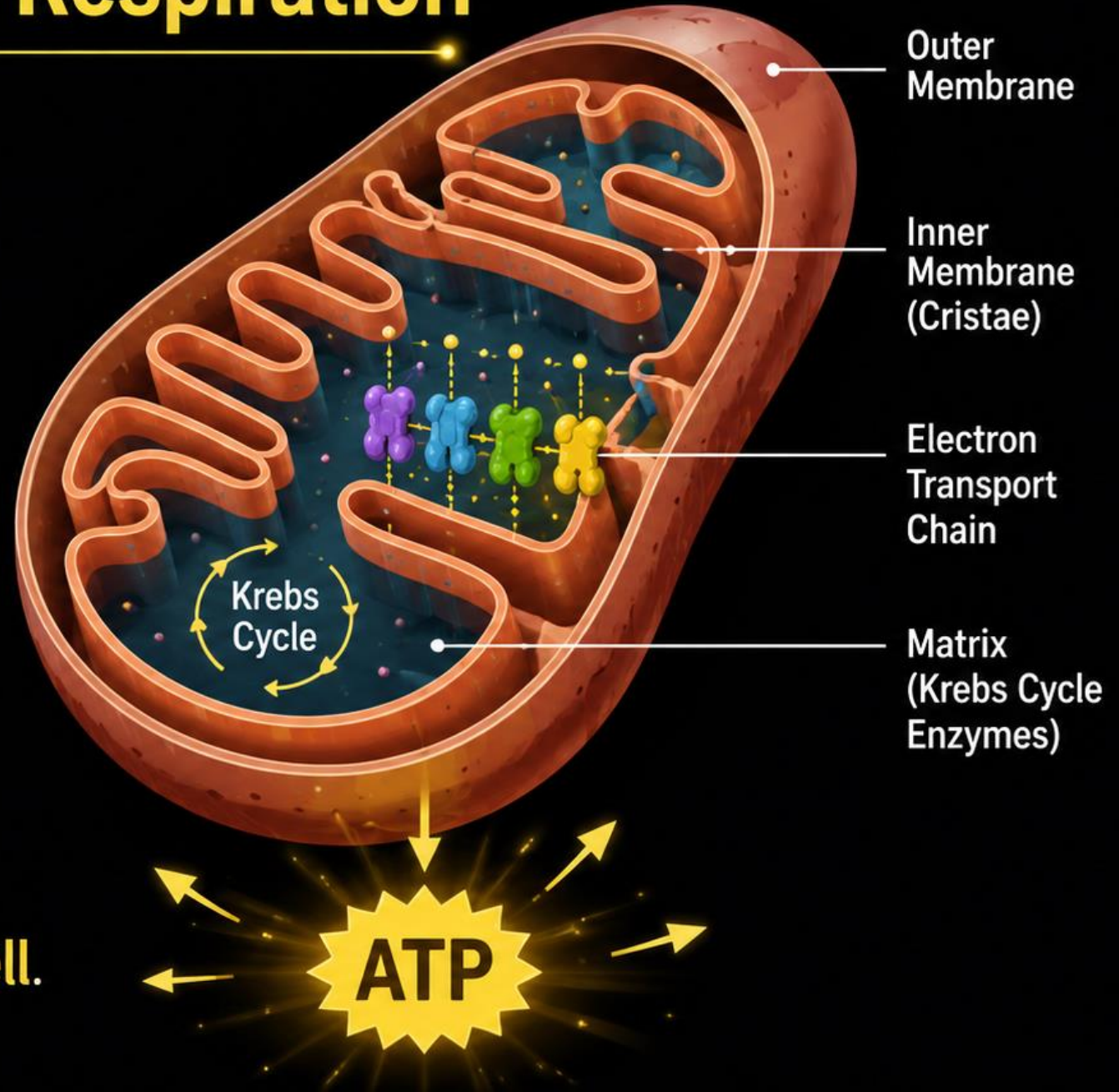
The inner membrane contains the **electron transport chain**.



The matrix contains enzymes of the **Krebs cycle**.



Therefore, mitochondria are called the **powerhouse of the cell**.





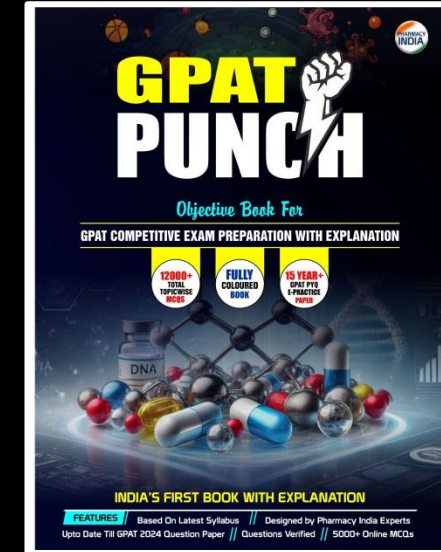
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11.

Mitochondrial DNA is usually:

- (a) Single-stranded and linear
- (b) Single-stranded and circular
- (c) Double-stranded and linear
- (d) Double-stranded and circular



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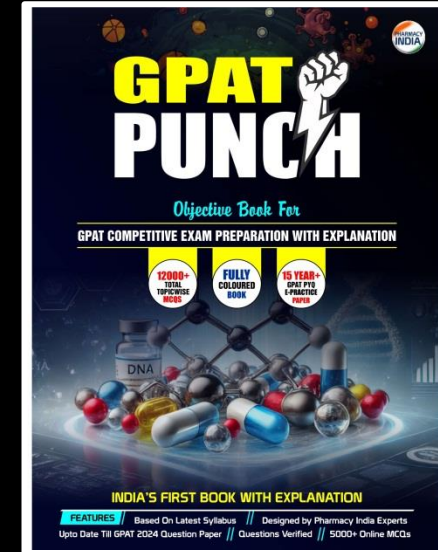
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- (b) Single-stranded and circular
- (c) Double-stranded and linear
- (d) Double-stranded and circular**



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Mitochondrial DNA

Double-Stranded & Circular



1. Mitochondria contain their own DNA.



2. Mitochondrial DNA is **double-stranded**.



3. It is **circular**, like bacterial DNA, and lacks histones.

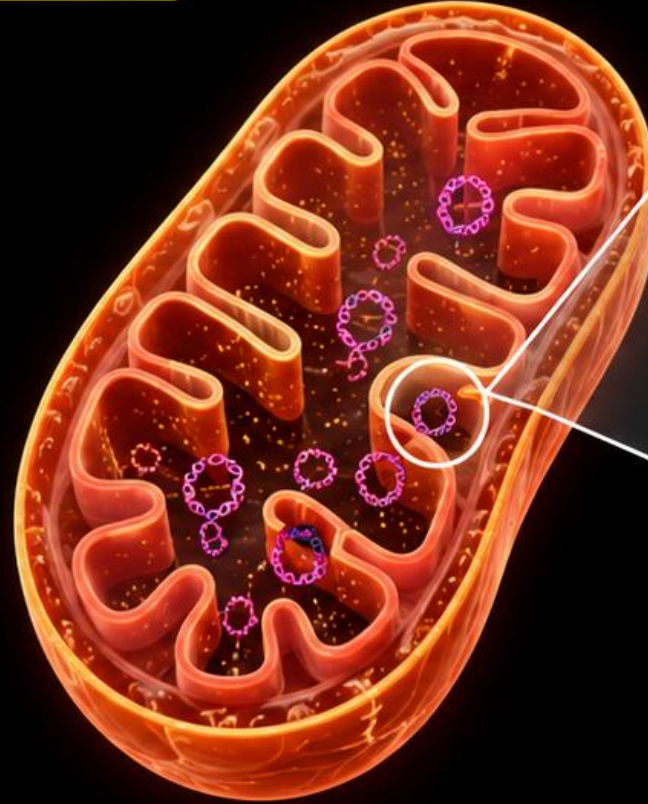


4. This supports the **endosymbiotic origin theory**—mitochondria evolved from ancient bacteria.



5. It **codes for some mitochondrial proteins**, rRNAs, and tRNAs essential for mitochondrial function.

MITOCHONDRION



MITOCHONDRIAL DNA
(mtDNA)

CIRCULAR
DOUBLE-STRANDED
DNA

- ✓ Closed circular molecule
- ✓ Double-stranded
- ✓ Similar to bacterial DNA
- ✓ ~16.5 kb in humans



Key Takeaway: Mitochondrial DNA is double-stranded and circular, reflecting its bacterial ancestry and vital role in cellular energy production.





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12.

Which organelle is called the powerhouse of the cell?

- (a) Ribosome
- (b) Mitochondria
- (c) Golgi apparatus
- (d) Lysosome



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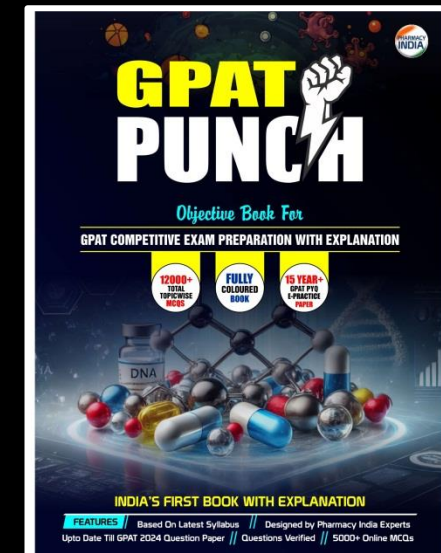
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Which organelle is called the powerhouse of the cell?

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- (c) Golgi apparatus
- (d) Lysosome



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⚡ Powerhouse of the Cell ⚡

Mitochondria are called the **powerhouse of the cell** because they produce the energy the cell needs to function.



1. Generates ATP for Cellular Activities

Mitochondria produce ATP (adenosine triphosphate), which powers all cellular functions.



2. ATP is the Energy Currency

ATP stores and transfers energy that cells use for growth, movement, transport, and other vital processes.



3. Energy Production: Oxidative Phosphorylation

ATP is mainly produced by oxidative phosphorylation in the inner mitochondrial membrane using oxygen, glucose, and other fuels.



4. More Active Cells Have More Mitochondria

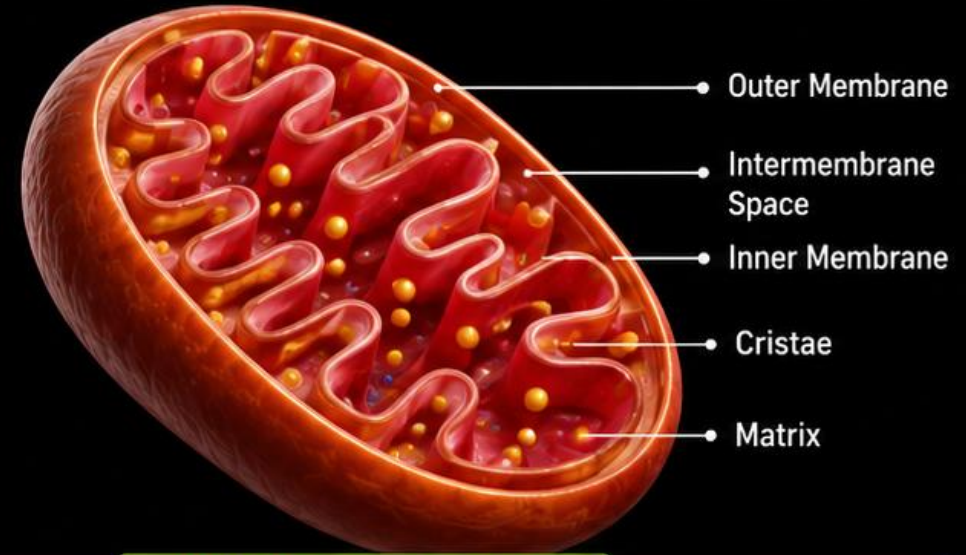
Cells with higher energy demands contain a greater number of mitochondria.



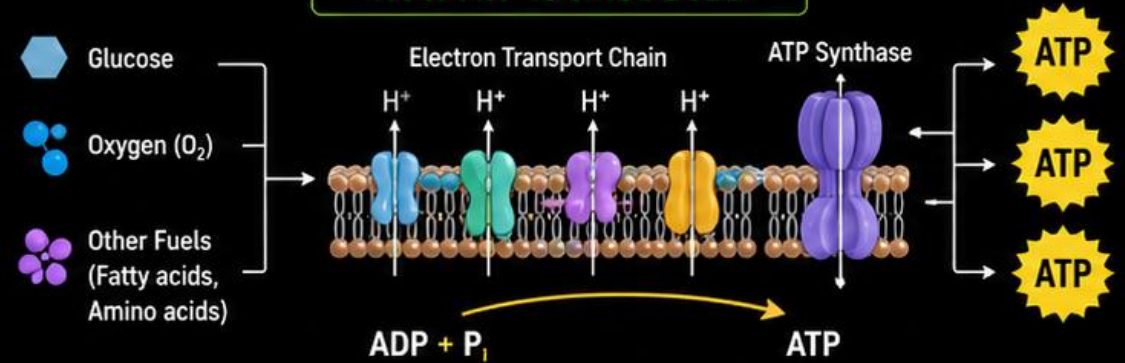
5. Essential for High-Energy Cells

Muscle cells (contraction) and nerve cells (signal transmission) require a continuous high supply of ATP.

MITOCHONDRION – THE POWERHOUSE



HOW ATP IS PRODUCED



ATP POWERS:



Movement



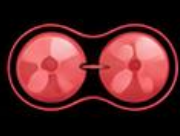
Active Transport



Biosynthesis



Nerve Impulses



Cell Division



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13.

The basic structural and functional unit of life is:

- (a) Tissue
- (b) Organ
- (c) Cell
- (d) Organ system



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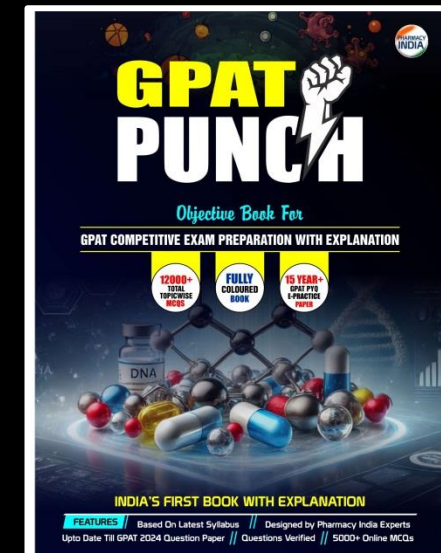
The basic structural and functional unit of life is:

(a) Tissue

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(c) Cell

(d) Organ system



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Cell: Basic Unit of Life



The cell is the **smallest living unit** of the body.



It performs **basic life processes** such as nutrition, respiration, growth, excretion and reproduction.



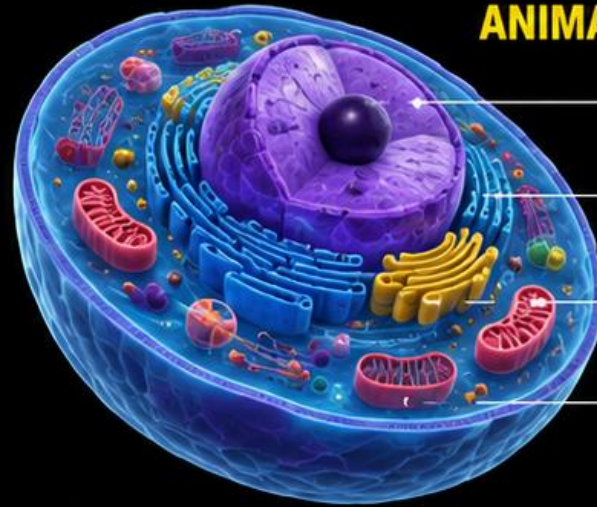
Tissues are formed by groups of similar cells working together.



Organs are formed by different tissues that work together for a specific function.

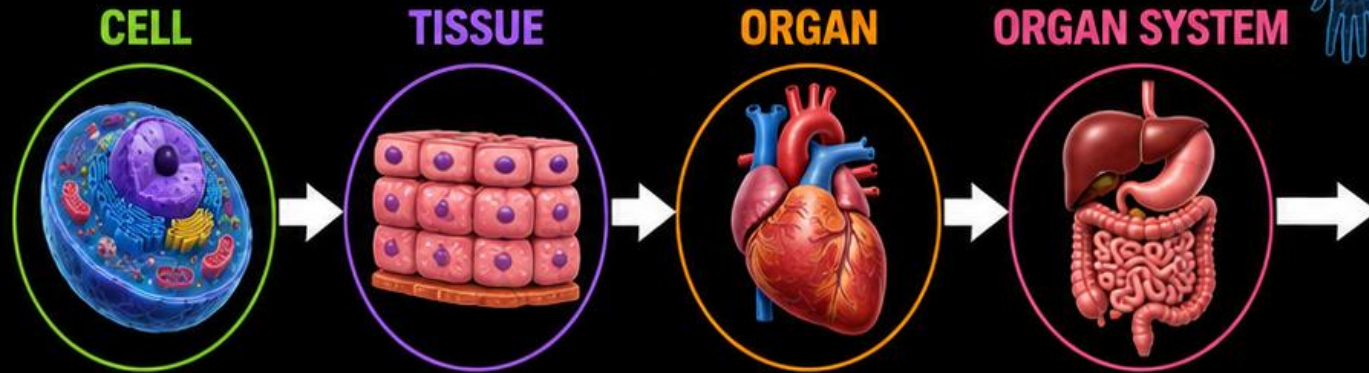


Organ systems are formed by related organs that work together to perform major functions of the body.



ANIMAL CELL

- Nucleus (Control center)
- Cytoplasm (Site of reactions)
- Mitochondria (Energy producer)
- Cell Membrane (Protective boundary)



Basic structural and functional unit of life

Group of similar cells working together

Different tissues working together for a specific function

Related organs working together to perform major body functions



Together, organ systems sustain life and maintain the body's functions.



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14.

Which organelle is directly involved in protein synthesis?

- (a) Ribosome
- (b) Lysosome
- (c) Peroxisome
- (d) Centriole



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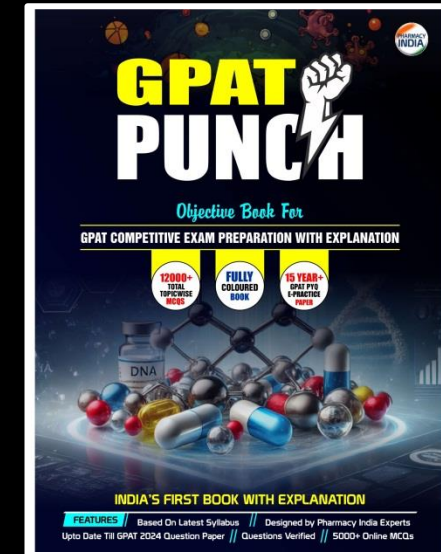


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14.

Which organelle is directly involved in protein synthesis?

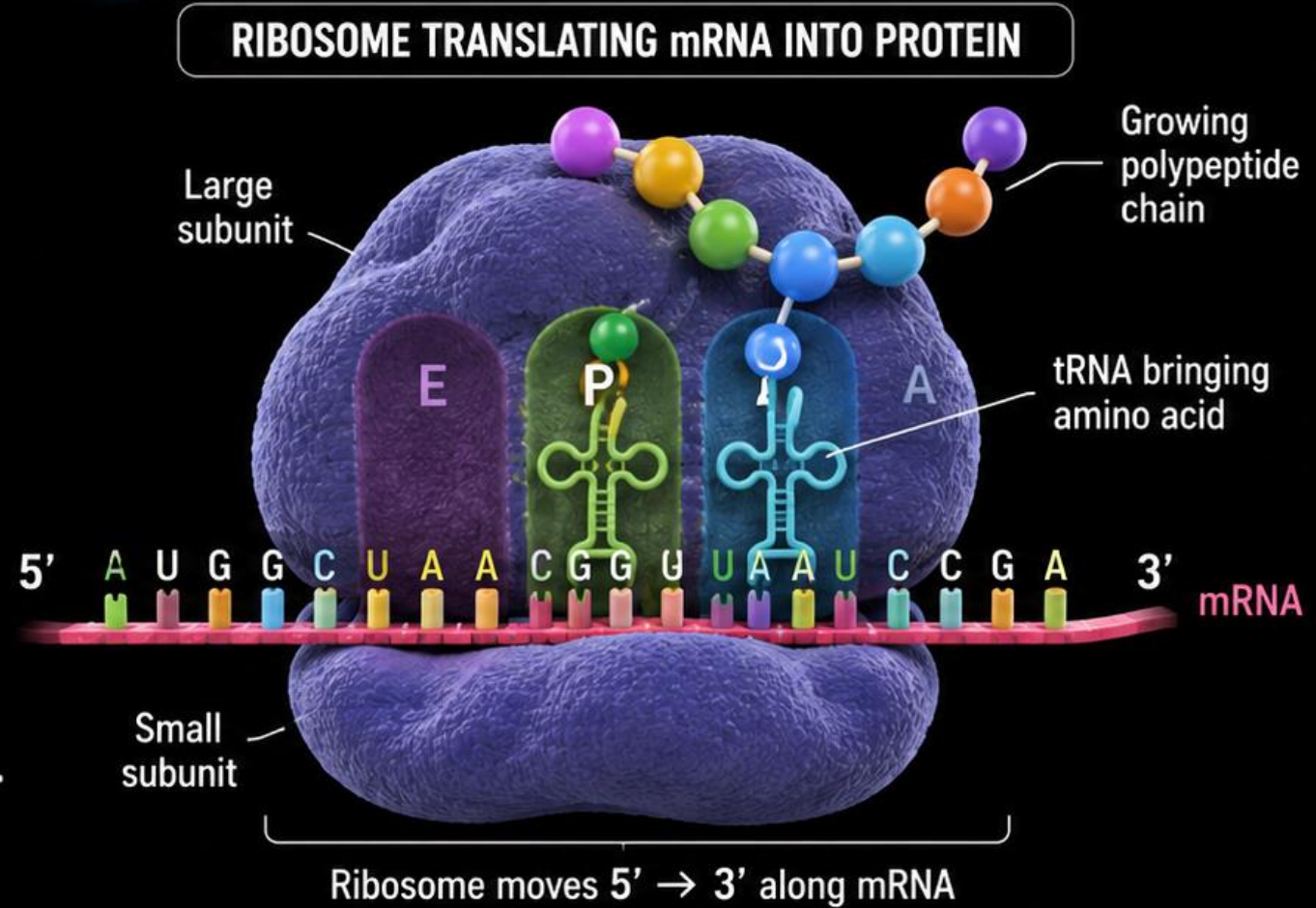
- (a) Ribosome
- (b) Lysosome
- (c) Peroxisome
- (d) Centriole



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Ribosomes & Protein Synthesis

- 1  Ribosomes are **the site of protein synthesis**.
- 2  They **translate mRNA** into polypeptide chains.
- 3  **Free ribosomes** synthesize cytoplasmic proteins.
- 4  **Bound ribosomes** synthesize secretory and membrane proteins.
- 5  Ribosomes are **not membrane-bound** organelles.



Ribosomes read the **genetic code** on mRNA and assemble amino acids in the correct order to form **proteins**.



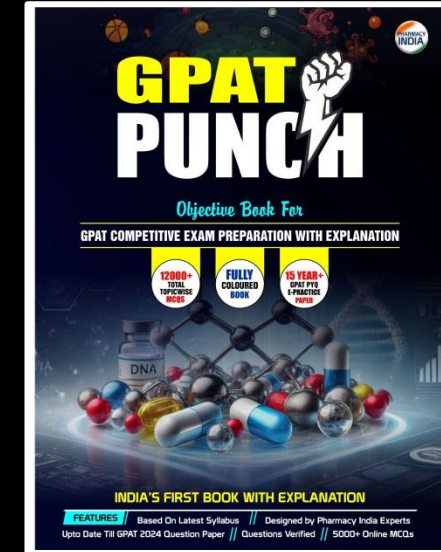
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15.

Ribosomes present in eukaryotic cytoplasm are:

- (a) 50S
- (b) 60S
- (c) 70S
- (d) 80S



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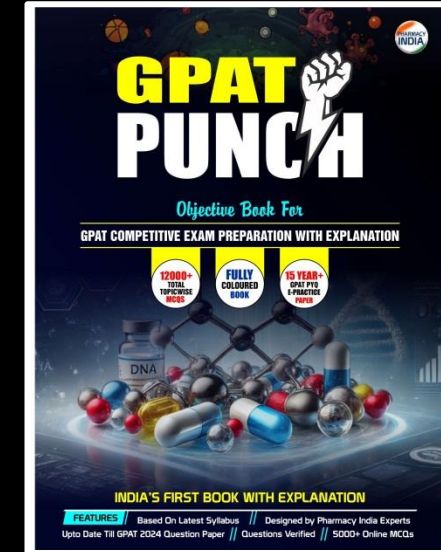
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15.

Ribosomes present in eukaryotic cytoplasm are:

- (a) 50S
- (b) 60S
- (c) 70S
- (d) 80S



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80S Ribosomes

The protein factories of the cell



1. Eukaryotic cytoplasmic ribosomes are **80S**.



2. They are made of two subunits: **60S** (large) and **40S** (small).



3. Prokaryotic ribosomes are **70S**.

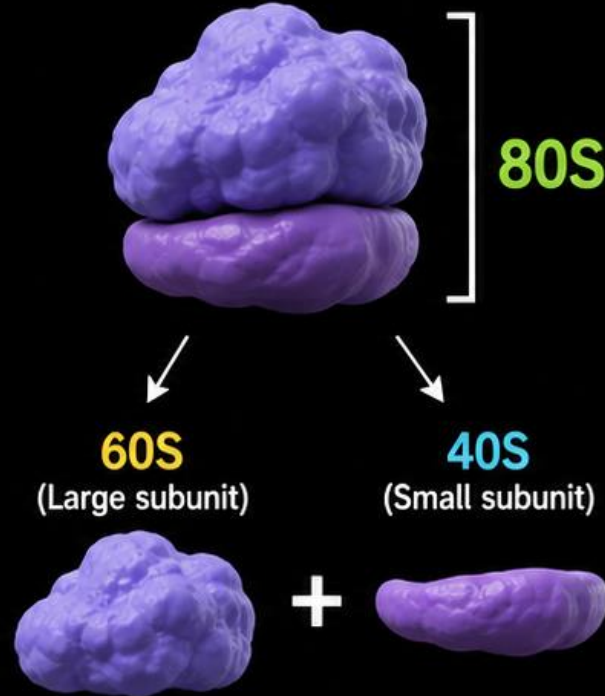


4. Mitochondria (and chloroplasts) contain **70S-like** ribosomes.



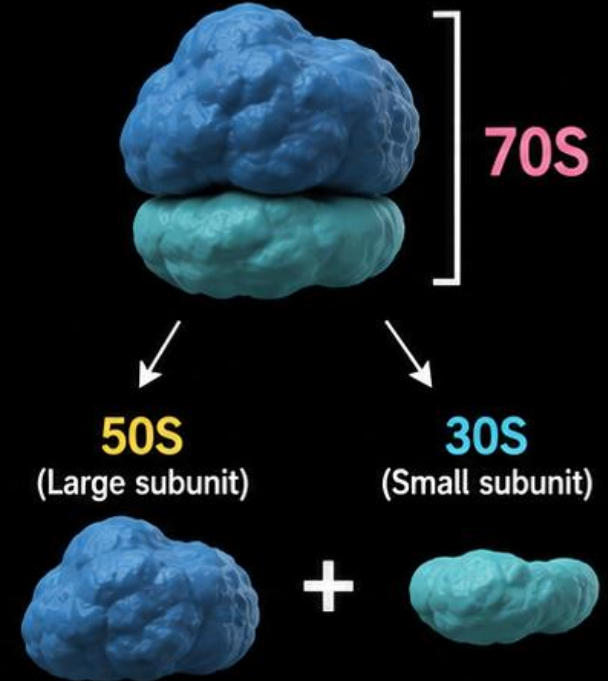
5. Ribosome size is measured by **sedimentation coefficient** (Svedberg, S) using ultracentrifugation.

EUKARYOTIC CYTOPLASMIC RIBOSOME (80S)



Location: Cytoplasm of eukaryotic cells (free or bound to rough ER)

PROKARYOTIC RIBOSOME (70S)



Location: Prokaryotic cytoplasm (e.g., bacteria)
Also in **mitochondria and chloroplasts (70S-like)**



S Value (Svedberg Unit): Indicates how fast a particle sediments in ultracentrifugation.
Higher S value = larger size and shape.



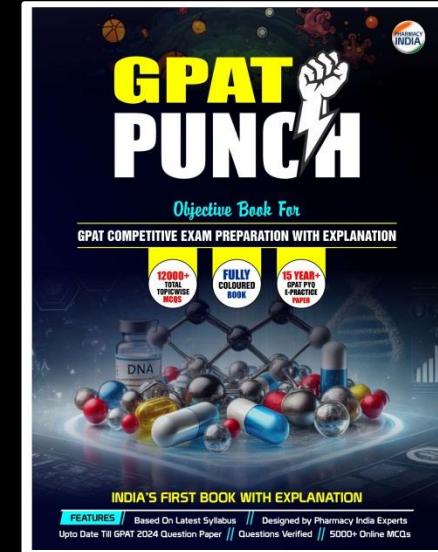
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16.

Which organelle contains ribosomes on its surface?

- (a) Smooth endoplasmic reticulum
- (b) Rough endoplasmic reticulum
- (c) Golgi apparatus
- (d) Lysosome



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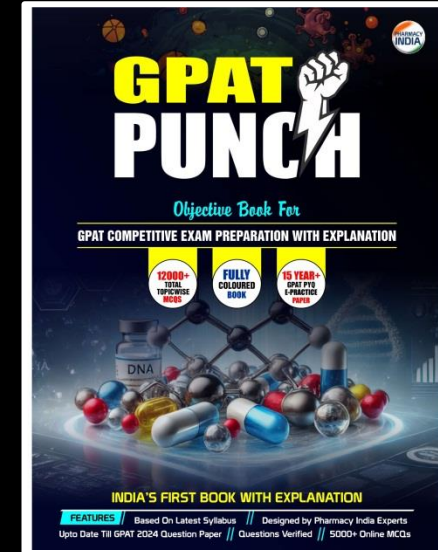
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16.

Which organelle contains ribosomes on its surface?

- (a) Smooth endoplasmic reticulum
- (b) Rough endoplasmic reticulum**
- (c) Golgi apparatus
- (d) Lysosome



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Rough Endoplasmic Reticulum

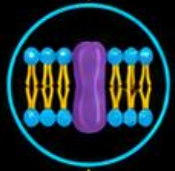
Rough ER has ribosomes on its surface and plays a major role in protein synthesis and processing.



1. Rough ER has **ribosomes attached** on its surface.



2. It synthesizes **secretory proteins** destined for export from the cell.



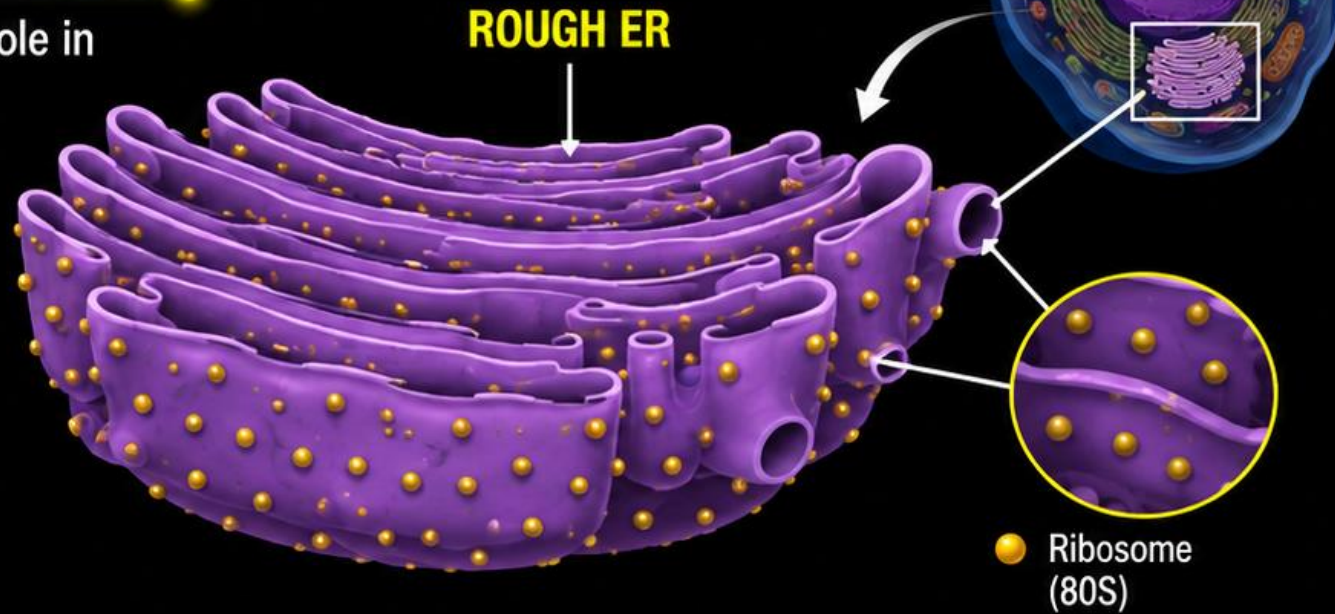
3. It also synthesizes **membrane proteins** that are inserted into cellular membranes.



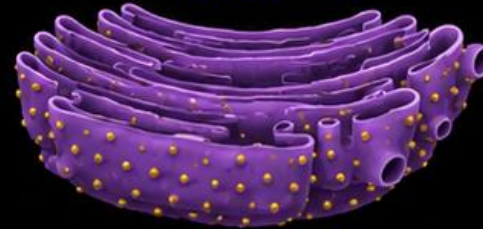
4. Ribosomes give the **rough ER** a **rough appearance** under the microscope.



5. Smooth ER **lacks ribosomes** and appears smooth under the microscope.



ROUGH ER



- ✓ Ribosomes present on surface
- ✓ Involved in protein synthesis
- ✓ Appears rough under microscope

VS

SMOOTH ER



- ✓ No ribosomes on surface
- ✓ Involved in lipid synthesis, detoxification, Ca^{2+} storage
- ✓ Appears smooth under microscope



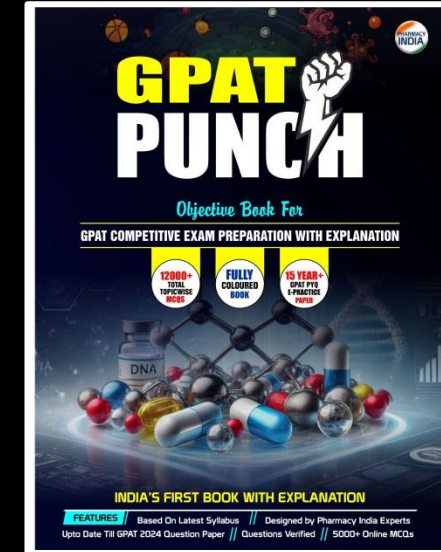
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17.

Smooth endoplasmic reticulum is mainly associated with:

- (a) Lipid synthesis and detoxification
- (b) Protein digestion
- (c) Ribosomal RNA synthesis
- (d) Chromosome separation



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17.

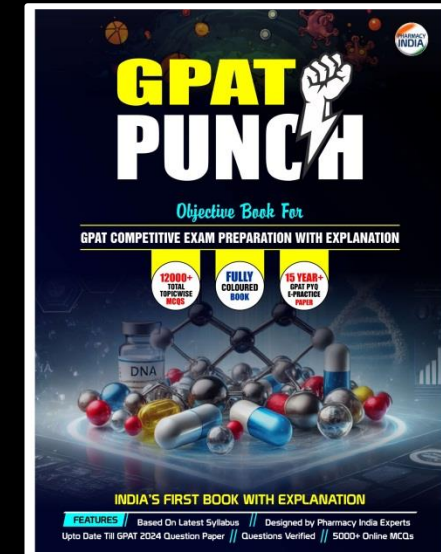
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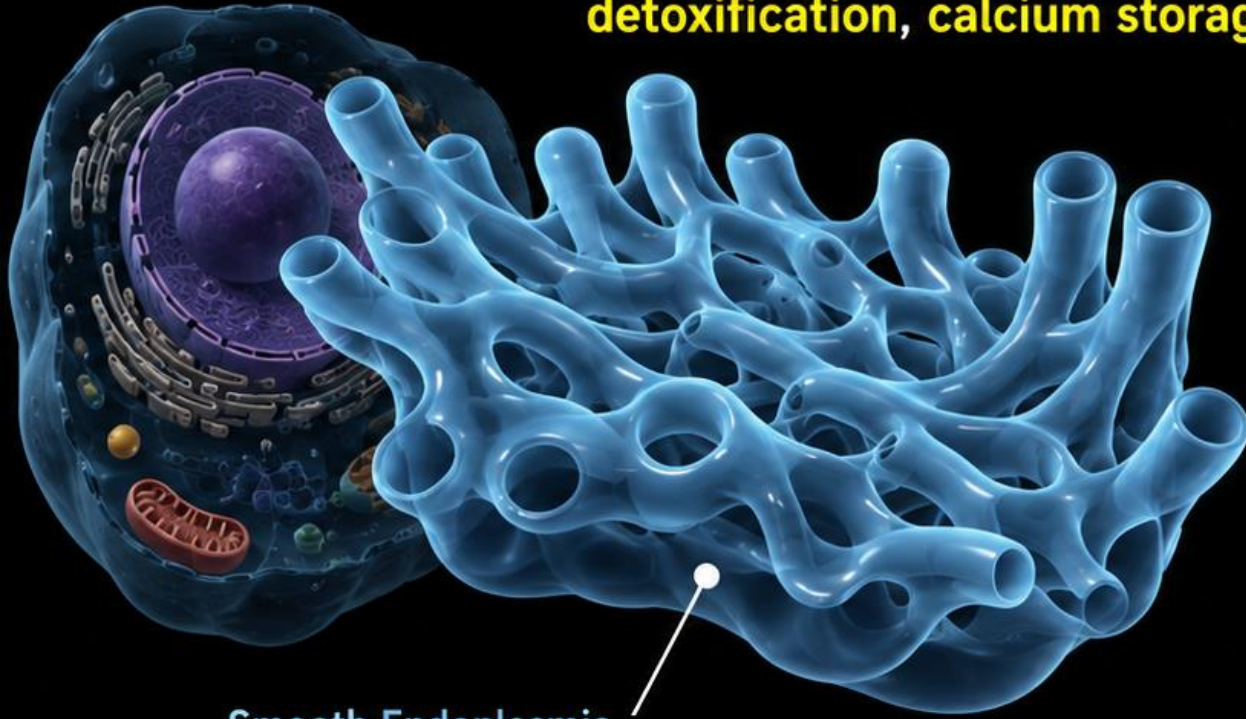
(d) Chromosome separation



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Smooth Endoplasmic Reticulum

A network of smooth, tubular membranes involved in **lipid synthesis**, **detoxification**, **calcium storage**, and other **metabolic functions**.



Smooth Endoplasmic Reticulum (SER)



1. LACKS RIBOSOMES

Smooth ER has no ribosomes attached to its surface.



2. SYNTHESIZES LIPIDS & STEROID HORMONES

Produces phospholipids, cholesterol, and steroid hormones.



3. DETOXIFIES DRUGS & TOXINS

Especially in liver cells, it breaks down and neutralizes harmful substances.



4. STORES CALCIUM IONS

In muscle cells (sarcoplasmic reticulum), it stores Ca^{2+} for muscle contraction.



5. NOT INVOLVED IN PROTEIN SYNTHESIS

Since it lacks ribosomes, it does not synthesize proteins directly.



LIPID SYNTHESIS

Phospholipids, cholesterol, steroid hormones



DETOXIFICATION

Breaks down drugs and toxins in liver cells



CALCIUM STORAGE

Stores Ca^{2+} for muscle contraction



NOT FOR PROTEIN SYNTHESIS

No ribosomes, so no direct protein synthesis



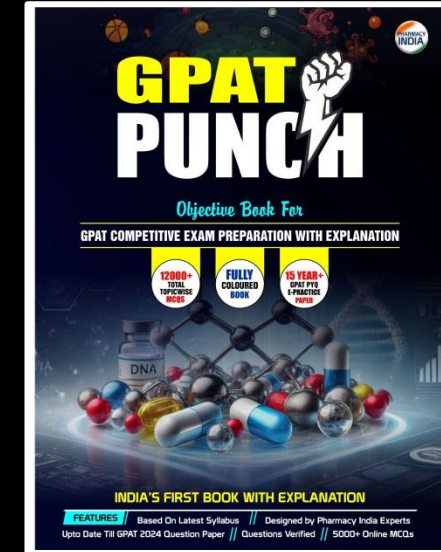
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18.

The nucleolus is mainly responsible for:

- (a) ATP synthesis
- (b) Ribosomal RNA synthesis and ribosome assembly
- (c) Lipid synthesis
- (d) Intracellular digestion



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18.

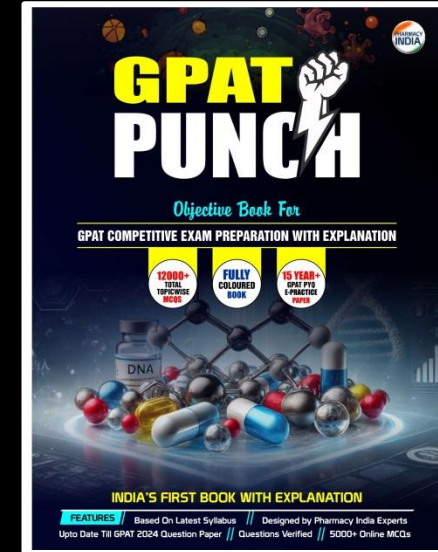
The nucleolus is mainly responsible for:

(a) ATP synthesis

(b) Ribosomal RNA synthesis and ribosome assembly

(c) Lipid synthesis

(d) Intracellular digestion



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Nucleolus

The Site of rRNA Synthesis and Ribosome Assembly



1. Dense Region Inside the Nucleus

The nucleolus is a dark, dense, spherical region within the nucleus.



2. Synthesizes Ribosomal RNA (rRNA)

It transcribes rRNA genes (in the nucleolar organizer regions) to produce rRNA.



3. Assembles Ribosomal Subunits

rRNA combines with ribosomal proteins to form the large and small ribosomal subunits.



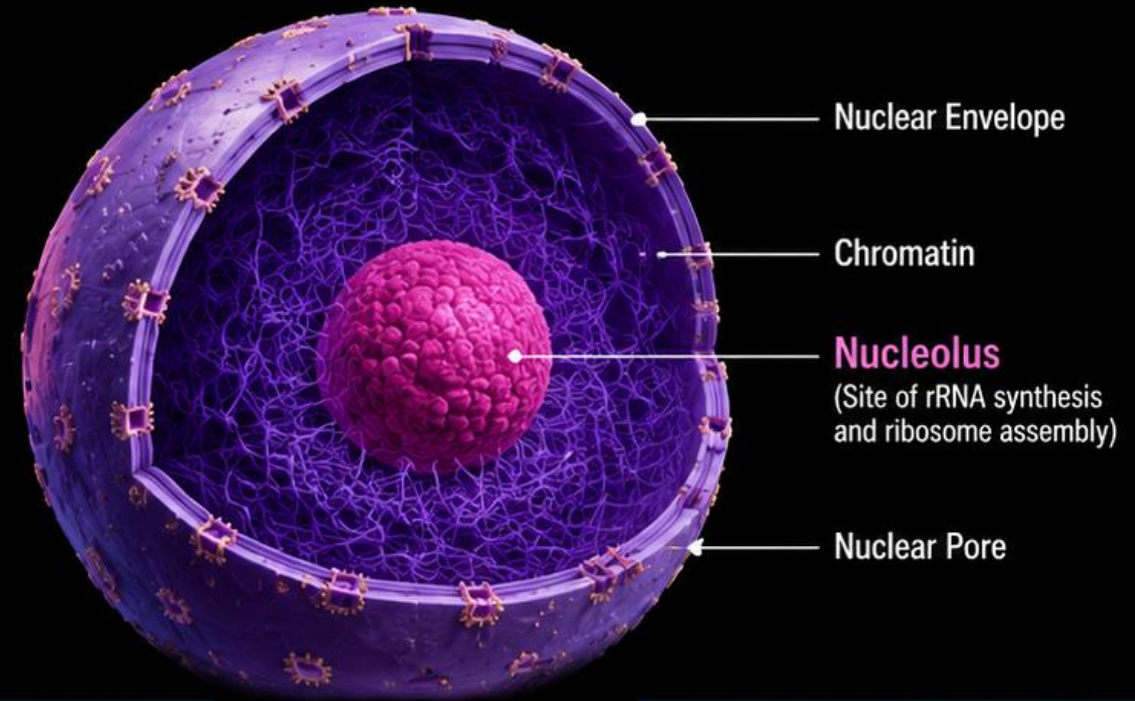
4. Subunits Move to Cytoplasm

The assembled subunits are exported through nuclear pores to the cytoplasm, where they join to form functional ribosomes.

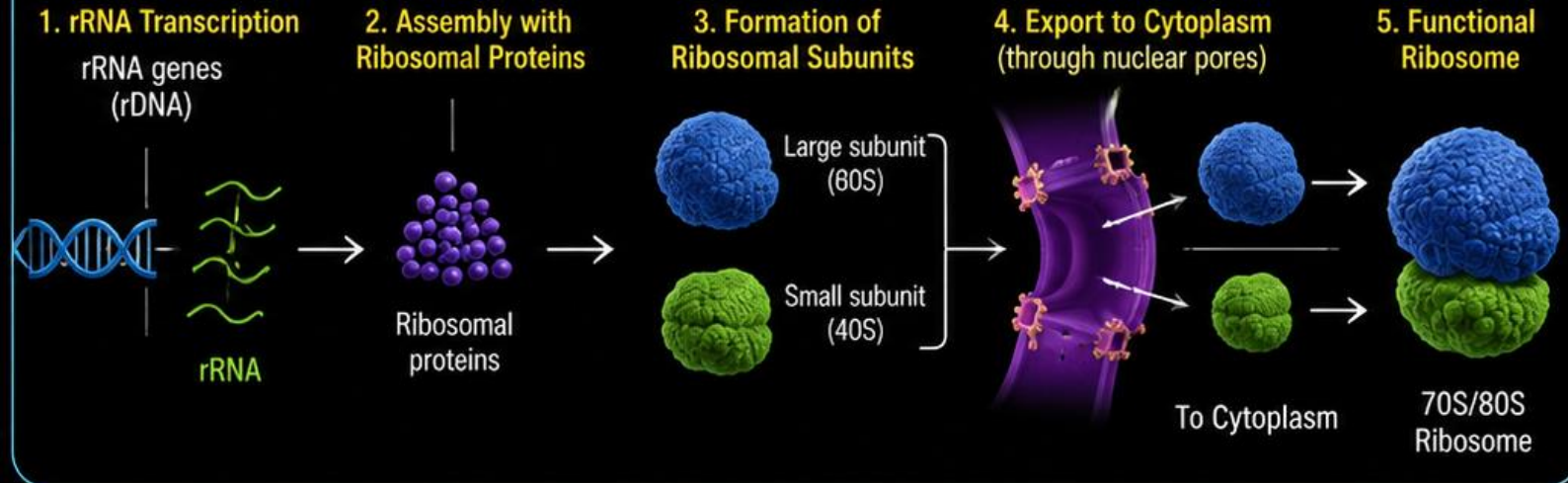


5. Not Membrane-Bound

The nucleolus is not surrounded by a membrane; it is a non-membranous nuclear structure.



FROM rRNA TO RIBOSOME



The **nucleolus** is the cell's ribosome factory—synthesizing **rRNA** and assembling **ribosomes** essential for **protein synthesis**.

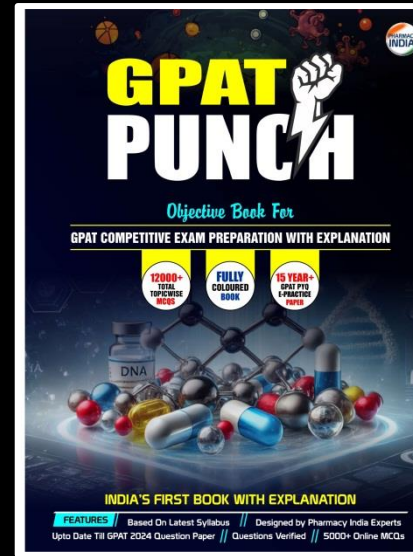


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19.

Which organelle modifies, packages and sorts proteins?

- (a) Golgi apparatus
- (b) Mitochondria
- (c) Lysosome
- (d) Nucleus



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19.

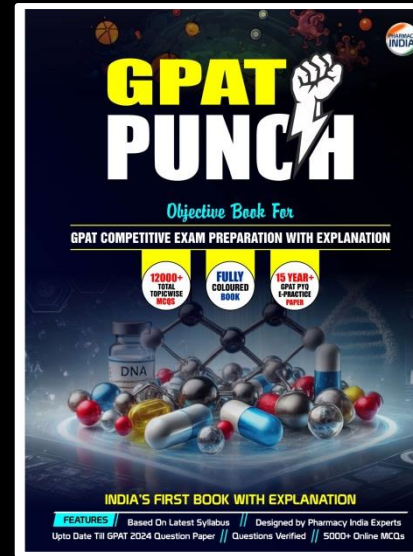
Which organelle modifies, packages and sorts proteins?

(a) Golgi apparatus

(b) Mitochondria

(c) Lysosome

(d) Nucleus



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Golgi Apparatus

Modifies, Packages, and Sorts Proteins



1. Receives Proteins from ER

Transport vesicles carrying proteins bud from the rough ER and fuse with the **cis** face of Golgi.



2. Modifies Proteins

Proteins undergo **glycosylation** and other modifications (sulfation, phosphorylation, proteolytic processing, etc.).



3. Sorts Proteins to Their Destinations

Golgi acts as a **sorting station**, directing proteins based on their final location in the cell or outside.



4. Packages into Secretory Vesicles

Modified proteins are packaged into vesicles that bud from the **trans** face for transport to the plasma membrane or secretion.

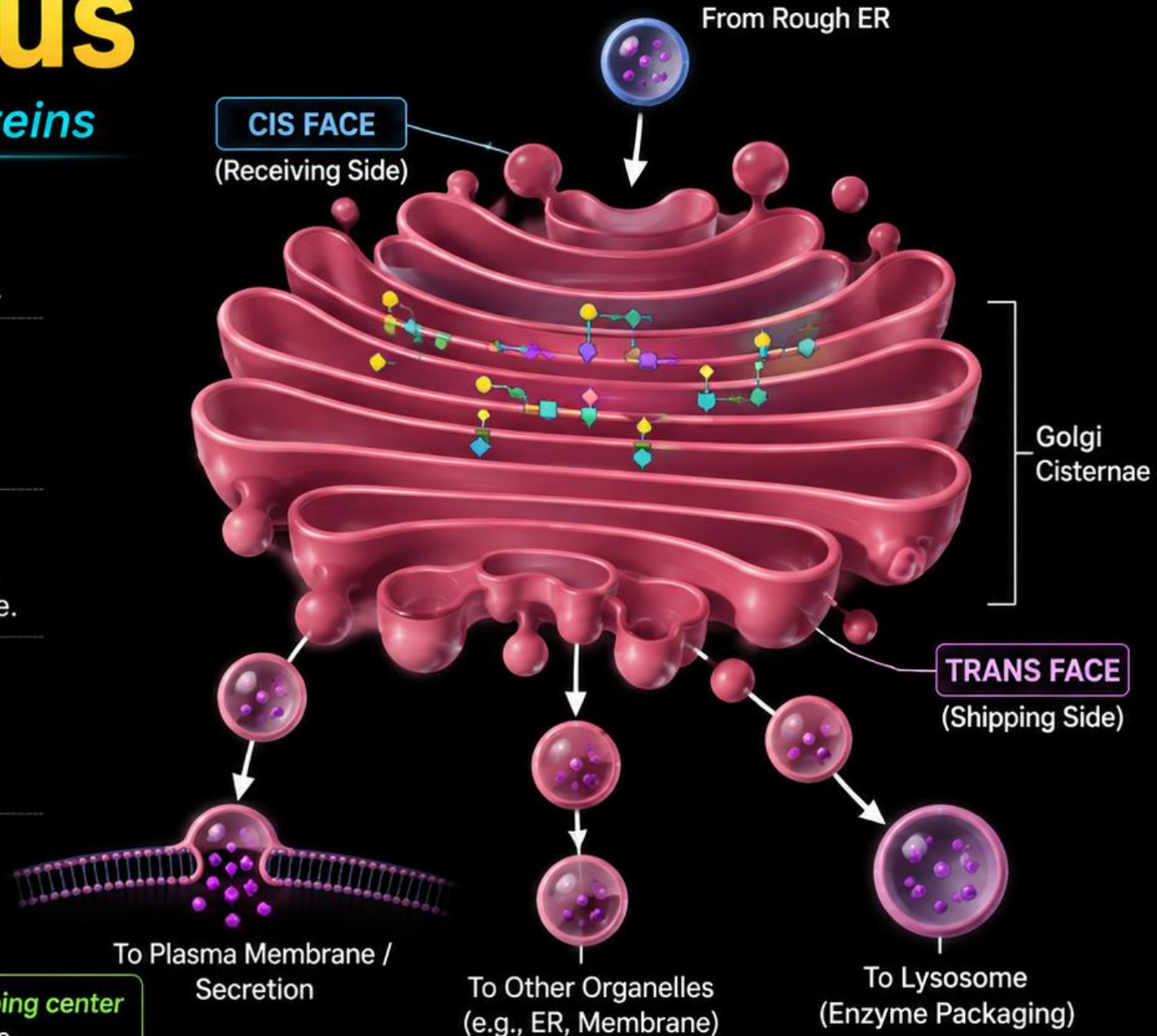


5. Contributes to Lysosome Formation

Golgi forms primary **lysosomes** by packaging hydrolytic enzymes into vesicles.



The Golgi apparatus is the cell's **processing, sorting, and shipping center** ensuring the right proteins reach the right place at the right time.





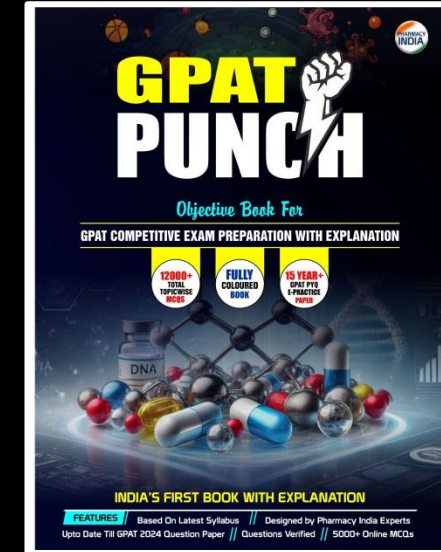
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20.

Which organelle is mainly involved in intracellular digestion?

- (a) Lysosome
- (b) Ribosome
- (c) Mitochondria
- (d) Centriole



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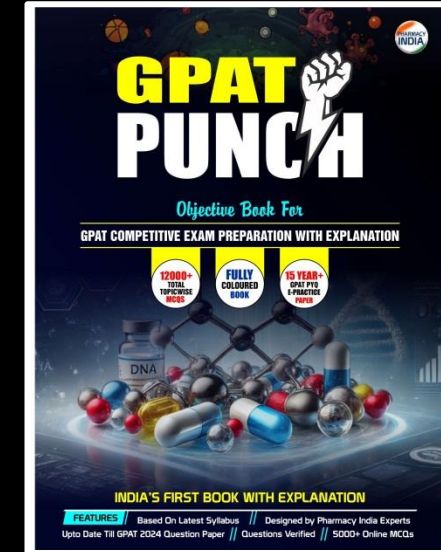
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20.

Which organelle is mainly involved in intracellular digestion?

- (a) Lysosome
- (b) Ribosome
- (c) Mitochondria
- (d) Centriole



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Lysosome & Intracellular Digestion

Lysosomes are the cell's recycling and waste disposal system.



Contain Acid Hydrolase Enzymes

Lysosomes are membrane-bound sacs filled with acid hydrolase enzymes.



Digest Cellular Waste

These enzymes break down macromolecules and cellular waste into simple substances that can be reused.



Break Down Old Organelles (Autophagy)

Lysosomes digest aged or damaged organelles and recycle their components.



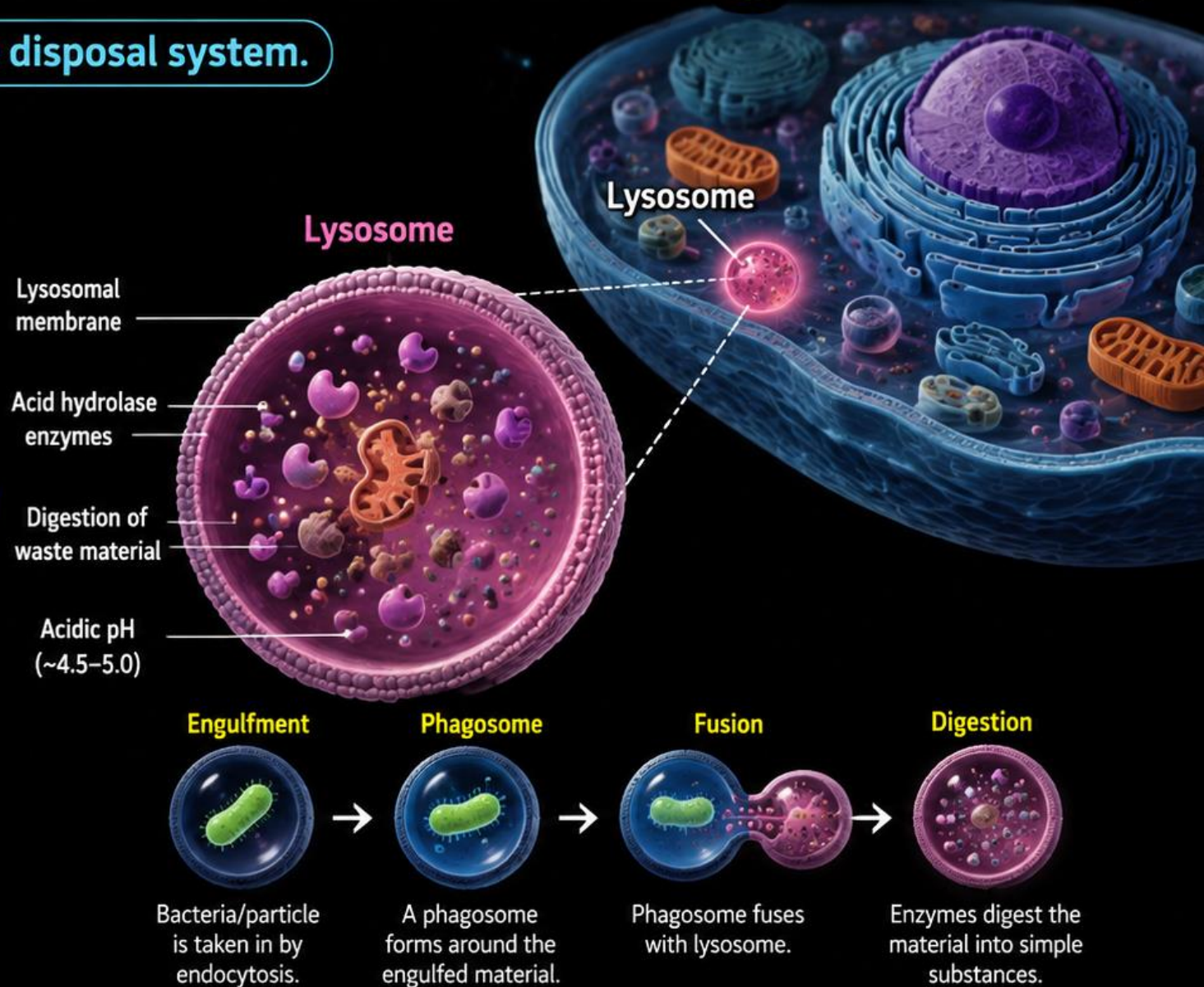
Digest Engulfed Bacteria and Particles

They fuse with phagosomes to destroy engulfed pathogens and foreign particles.



Acidic Internal pH

The internal pH is ~4.5–5.0, optimal for the activity of acid hydrolase enzymes.





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21.

The cell membrane is mainly composed of:

- (a) Cellulose and starch
- (b) Phospholipid bilayer with proteins
- (c) Chitin and glycogen
- (d) Peptidoglycan only



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21.

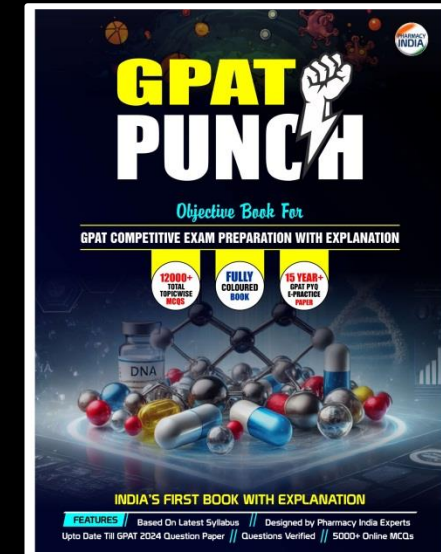
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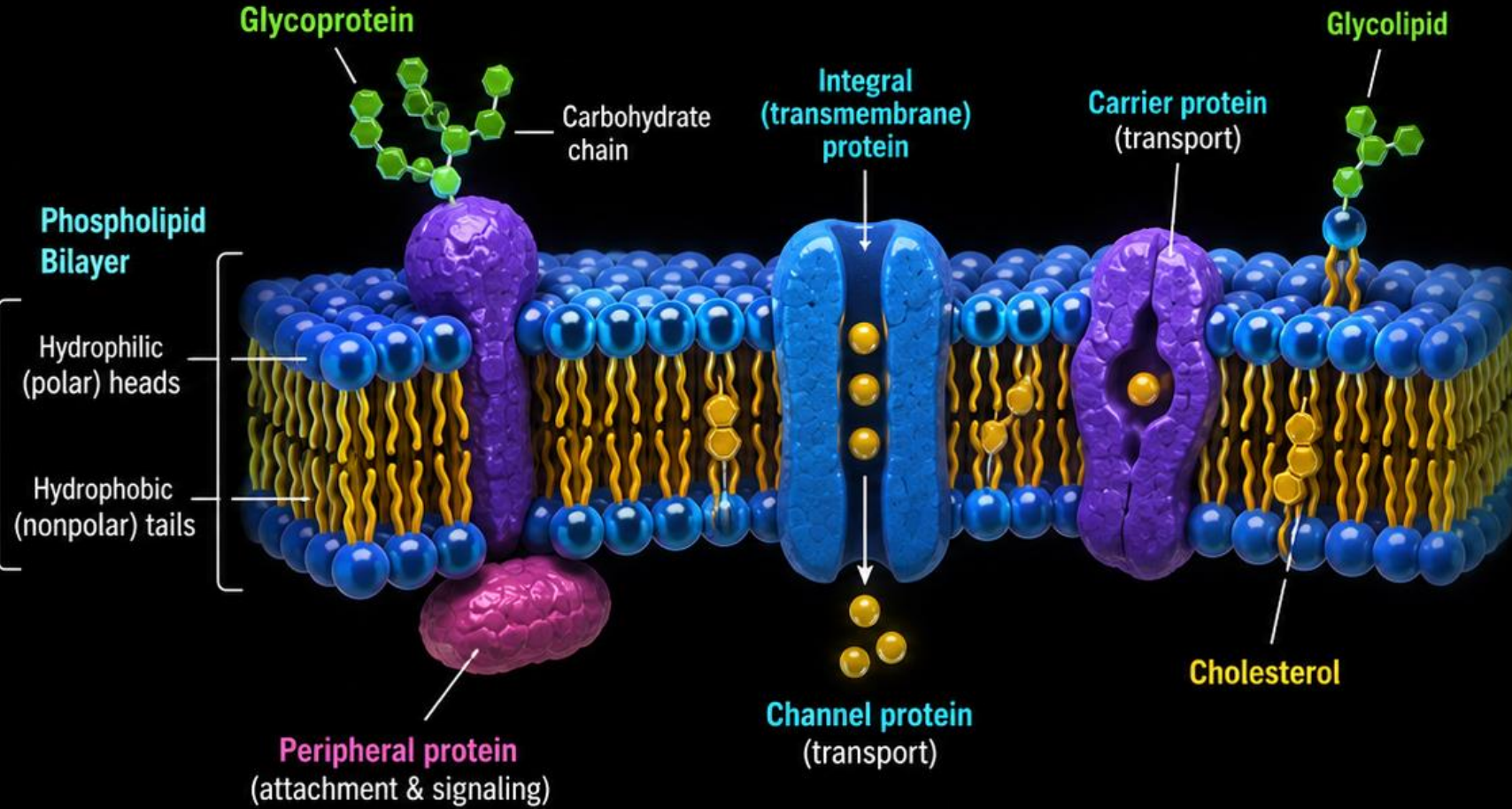
(d) Peptidoglycan only



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CELL MEMBRANE COMPOSITION

The cell membrane is a dynamic structure that regulates movement, communication, and recognition.



1. FLUID MOSAIC MEMBRANE

Components move laterally, giving the membrane flexibility.



2. PHOSPHOLIPID BILAYER

The phospholipid bilayer is the basic framework.



3. PROTEINS

Proteins are embedded or attached and help in transport, signaling, and other functions.



4. CHOLESTEROL

Maintains membrane fluidity and stability in animal cells.



5. CARBOHYDRATES

Occur as glycoproteins and glycolipids for cell recognition and communication.



SUMMARY: Phospholipids form the structure, proteins provide function, cholesterol regulates fluidity, and carbohydrates mediate recognition.



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22.

The fluid mosaic model describes the structure of:

- (a) Nucleus
- (b) Cell membrane
- (c) Ribosome
- (d) Centriole



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22.

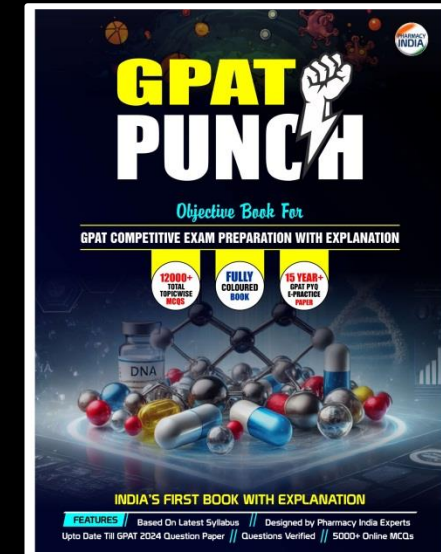
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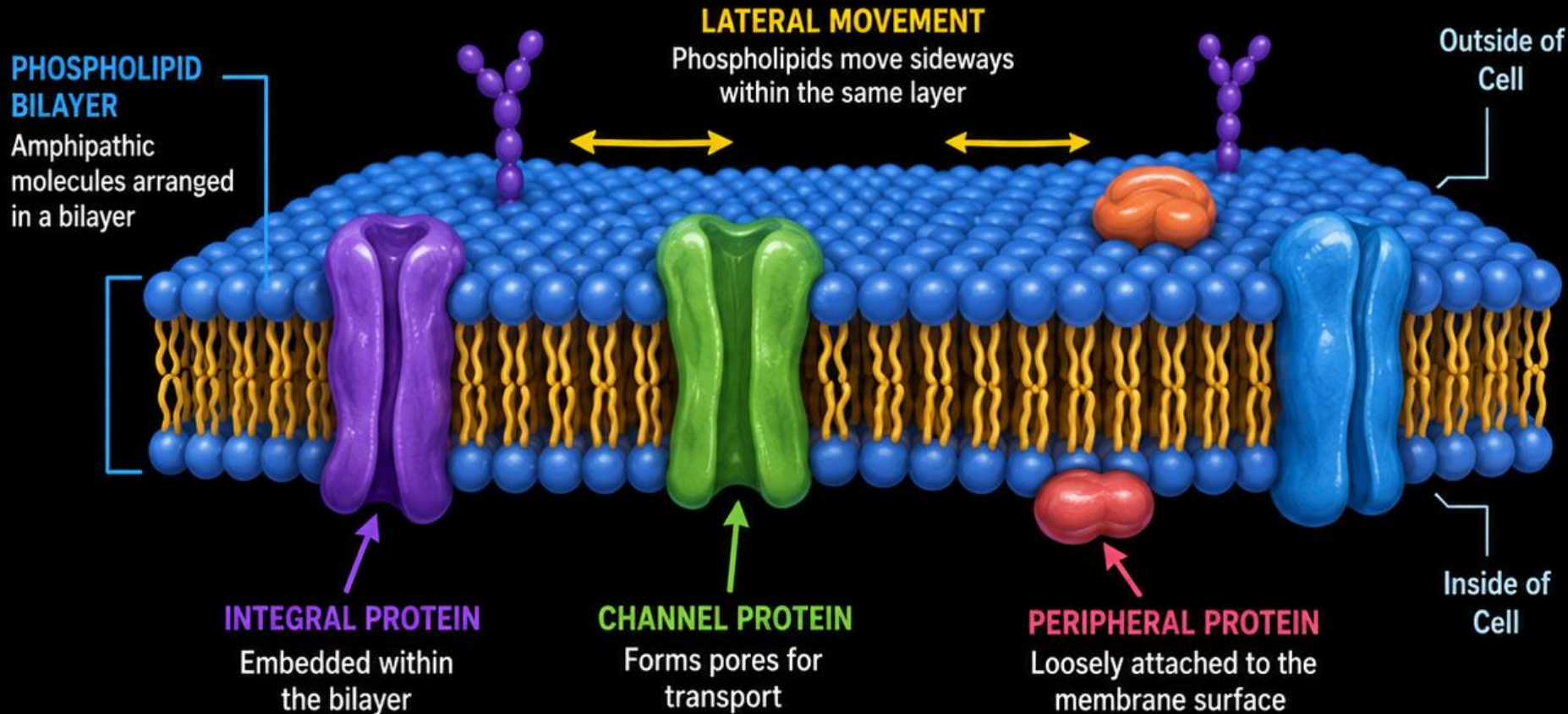
(d) Centriole



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FLUID MOSAIC MODEL

DYNAMIC STRUCTURE OF THE PLASMA MEMBRANE



KEY POINTS



EXPLAINS PLASMA MEMBRANE STRUCTURE

A phospholipid bilayer with proteins and carbohydrates



PHOSPHOLIPID BILAYER IS FLUID

Phospholipids move laterally within their layer



PROTEINS FLOAT WITHIN OR ON THE BILAYER

Integral proteins span the bilayer; peripheral proteins sit on the surface



MEMBRANE COMPONENTS MOVE Laterally

Phospholipids and proteins diffuse sideways within the membrane



HELPS EXPLAIN SELECTIVE PERMEABILITY

Dynamic membrane regulates what enters and leaves the cell

★ A FLUID, DYNAMIC MOSAIC THAT ENABLES LIFE.



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23.

Passive transport across the cell membrane occurs:

- (a) Against concentration gradient using ATP
- (b) Along concentration gradient without ATP
- (c) Only through sodium-potassium pump
- (d) Only during mitosis



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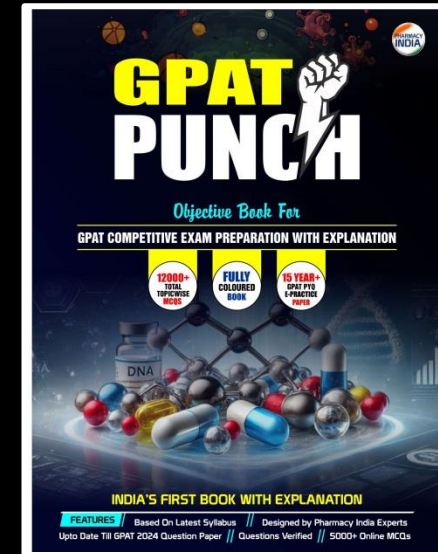
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23.

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- (a) Against concentration gradient using ATP
- (b) Along concentration gradient without ATP**
- (c) Only through sodium-potassium pump
- (d) Only during mitosis



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PASSIVE TRANSPORT

Movement of substances across the cell membrane from **HIGH CONCENTRATION** to **LOW CONCENTRATION**.



NO ATP

NO ENERGY REQUIRED

KEY POINTS



Movement is **ALONG** the concentration gradient.



No energy (ATP) required.



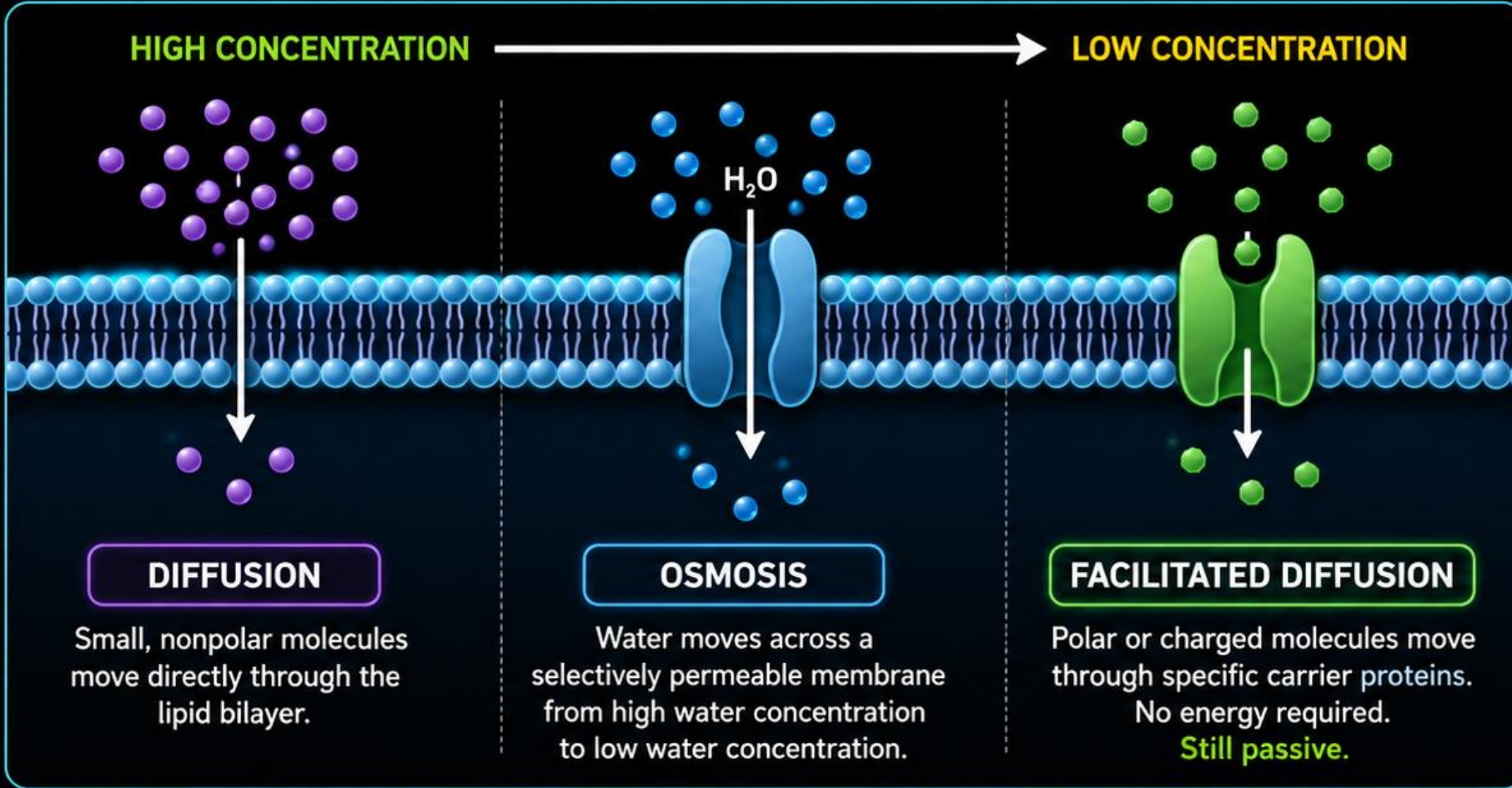
Includes **diffusion** and **osmosis**.



Facilitated diffusion is carrier-mediated but **still passive**.



Opposite of **active transport** (which requires energy).



PASSIVE TRANSPORT MOVES SUBSTANCES NATURALLY, **WITHOUT ENERGY**, FROM **HIGH CONCENTRATION** TO **LOW CONCENTRATION**.



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24.

Movement of water across a selectively permeable membrane is called:

- (a) Diffusion
- (b) Osmosis
- (c) Filtration
- (d) Phagocytosis



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24.

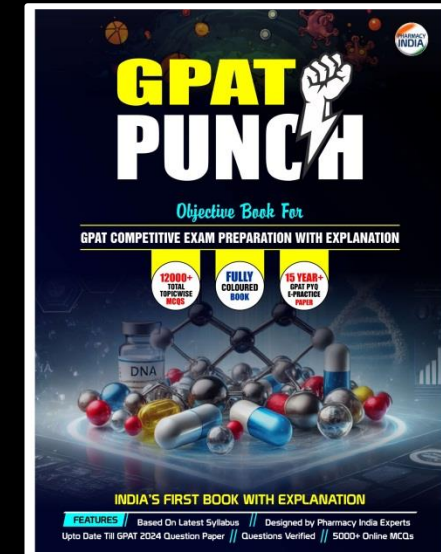
Movement of water across a selectively permeable membrane is called:

(a) Diffusion

(b) Osmosis

(c) Filtration

(d) Phagocytosis



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OSMOSIS



MOVEMENT OF WATER
ACROSS A SELECTIVELY
PERMEABLE MEMBRANE



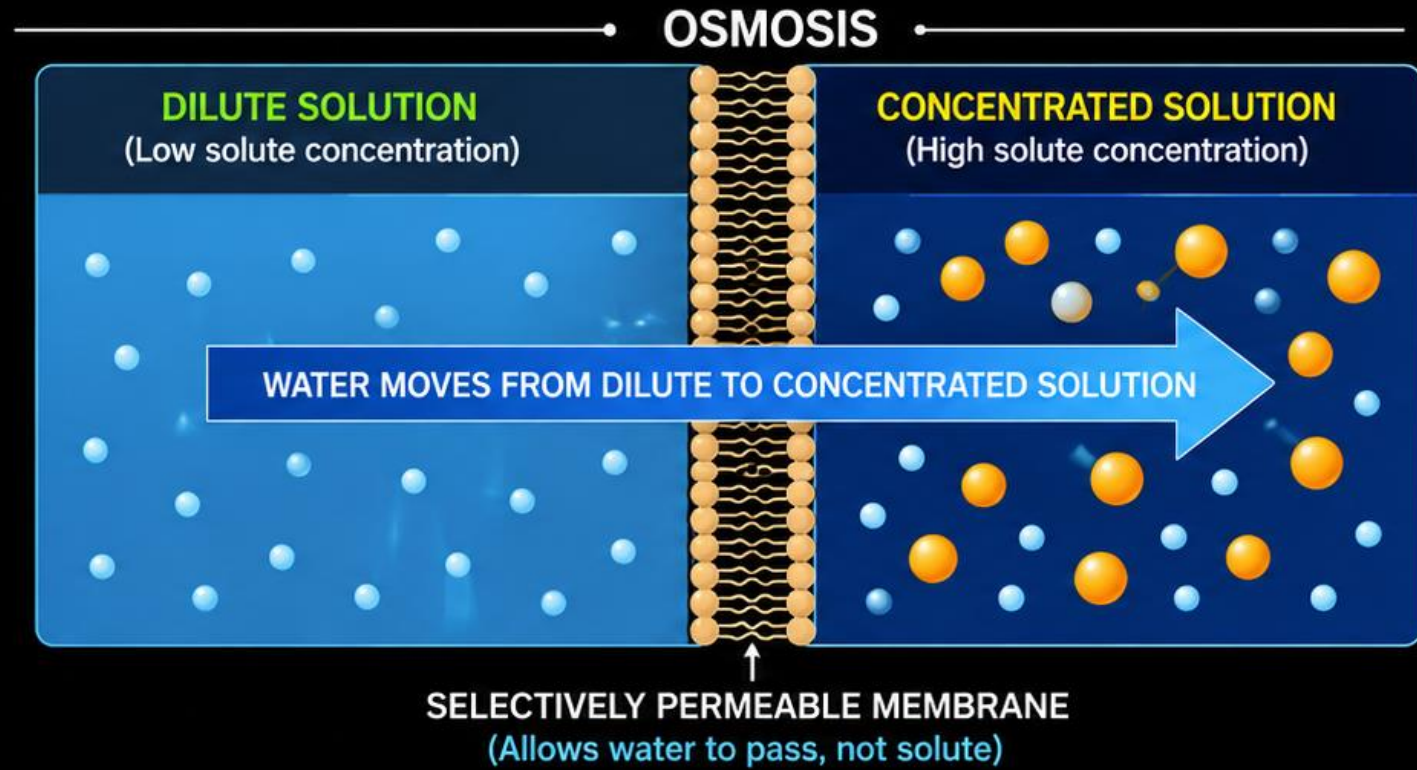
WATER MOVES FROM
DILUTE SOLUTION TO
CONCENTRATED SOLUTION



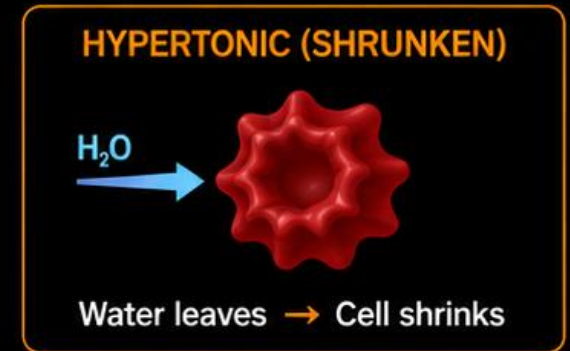
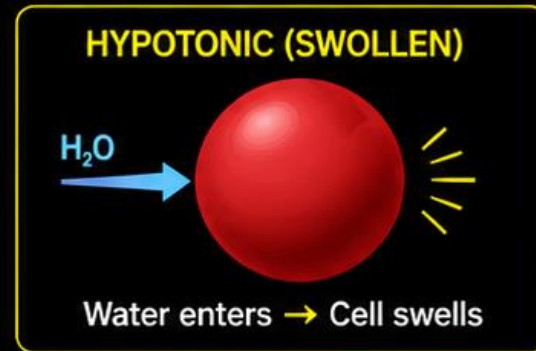
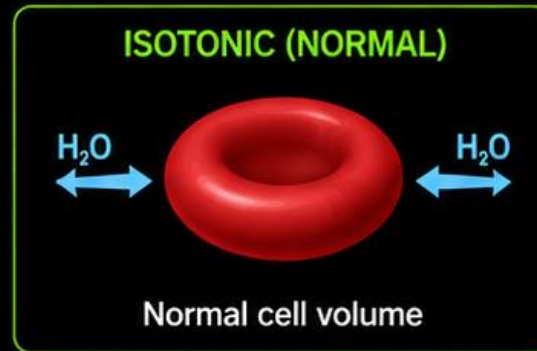
MAINTAINS **CELL VOLUME**
AND **FLUID BALANCE**



CELLS MAY **SWELL** OR
SHRINK DEPENDING ON
SURROUNDINGS



EFFECT OF OSMOSIS ON RED BLOOD CELLS (RBCs)



OSMOSIS IS ESSENTIAL FOR MAINTAINING **CELL VOLUME** AND THE BALANCE OF **BODY FLUIDS**.



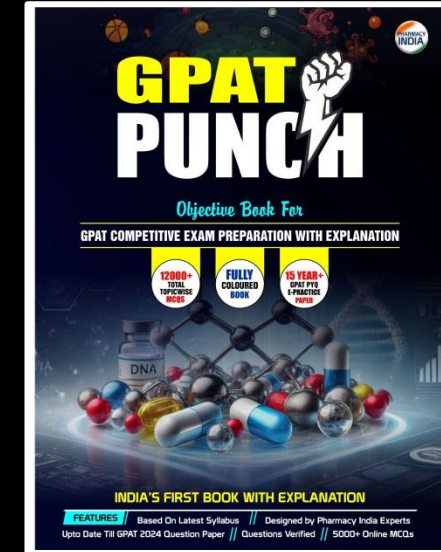
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25.

Phagocytosis is commonly known as:

- (a) Cell drinking
- (b) Cell eating
- (c) Cell division
- (d) Cell secretion



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25.

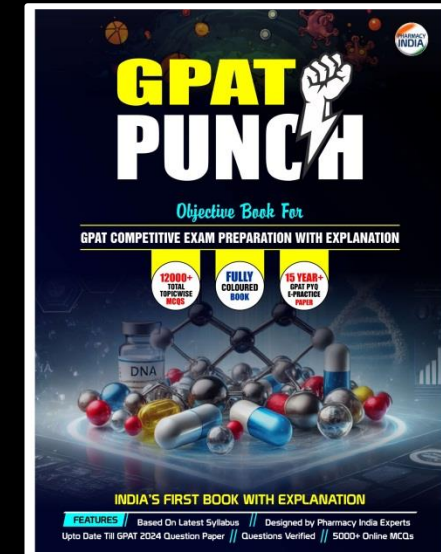
Phagocytosis is commonly known as:

(a) Cell drinking

(b) Cell eating

(c) Cell division

(d) Cell secretion



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PHAGOCYTOSIS

Cell eating



PHAGOCYTOSIS
means cell
eating.



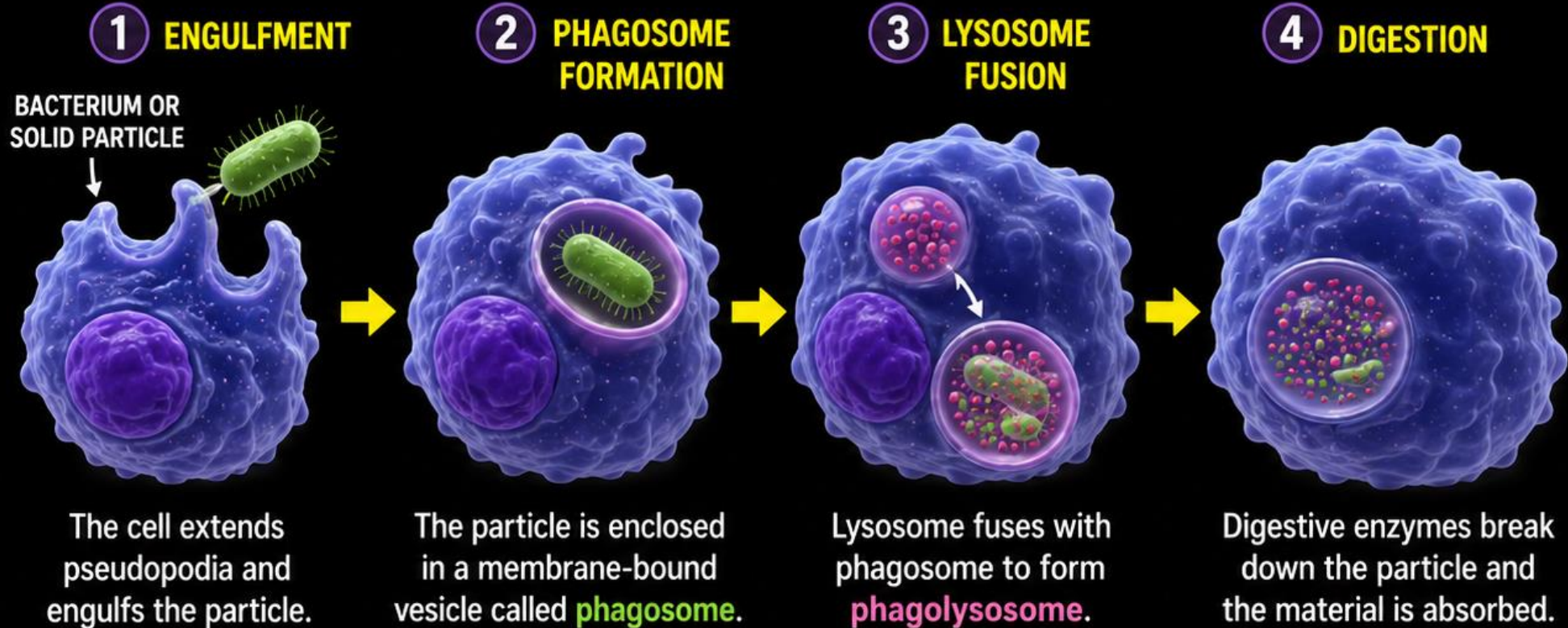
UPTAKE OF
solid
particles.



SEEN IN
macrophages
and neutrophils.



LYSOSOMES
digest the
engulfed material.



PHAGOCYTOSIS IS A KEY DEFENSE MECHANISM OF THE **INNATE IMMUNE SYSTEM**.

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26.

Exocytosis is the process by which cells:

- (a) Take in fluid droplets
- (b) Take in solid particles
- (c) Release substances outside the cell
- (d) Divide into two daughter cells



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26.

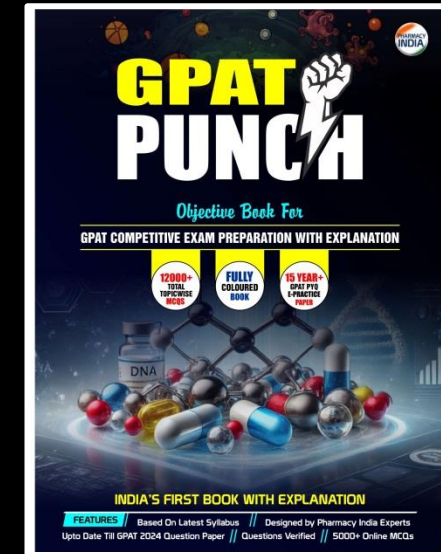
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(d) Divide into two daughter cells



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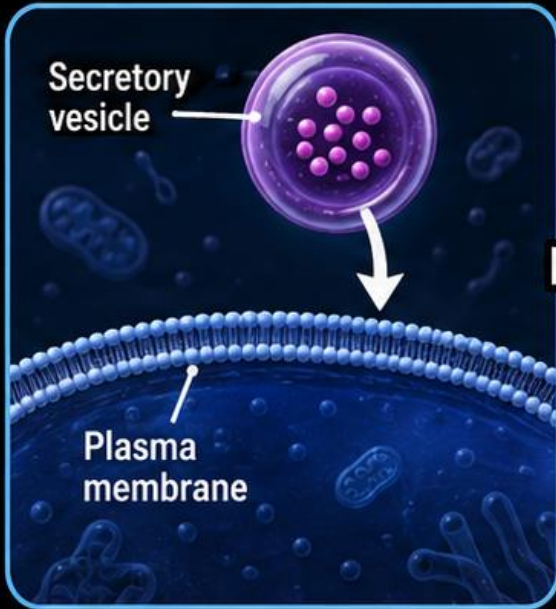
EXOCYTOSIS

Exocytosis releases substances outside the cell.

1

MOVE

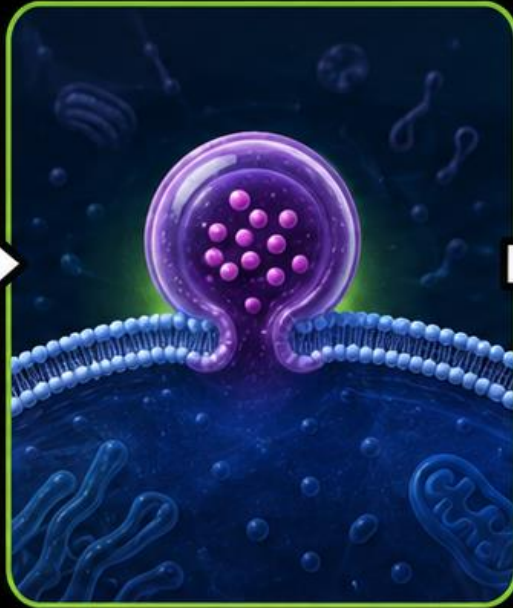
Secretory vesicle moves toward the plasma membrane.



2

FUSE

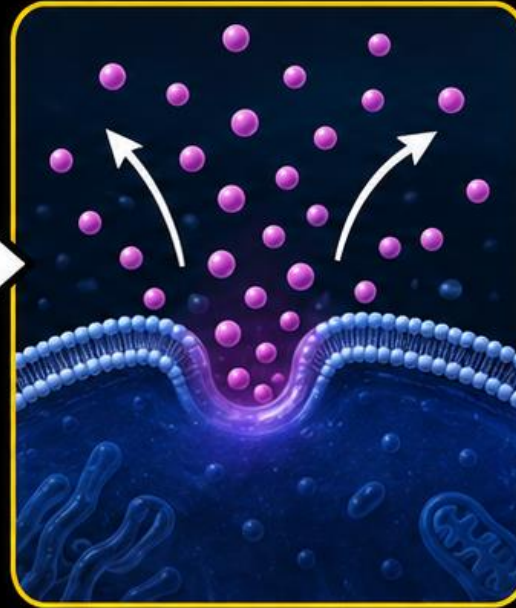
Vesicle fuses with the plasma membrane.



3

RELEASE

Contents are released outside the cell.



WHAT IS EXOCYTOSIS?

Exocytosis releases substances outside the cell.



USED FOR

Hormones, enzymes, and neurotransmitters.



WHY IT MATTERS

Important for secretion and membrane renewal.



VESICLE MOVES → FUSES → RELEASES CONTENTS OUTSIDE THE CELL

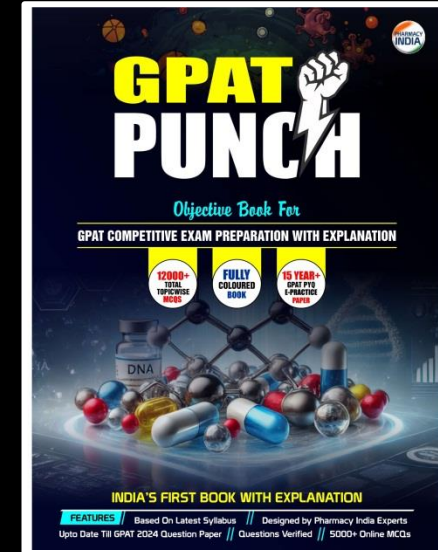


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27.

Which structure provides shape and internal support to the cell?

- (a) Cytoskeleton
- (b) Nucleolus
- (c) Lysosome
- (d) Chromatin



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27.

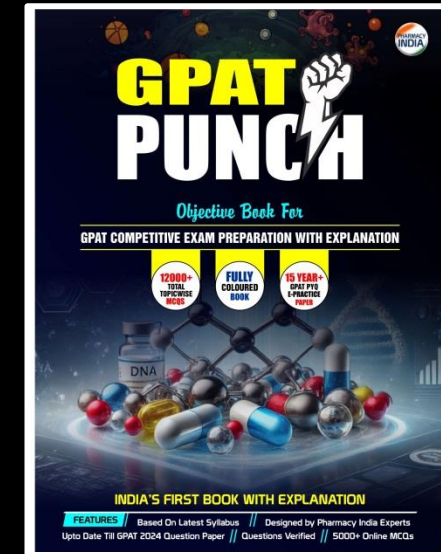
Which structure provides shape and internal support to the cell?

(a) Cytoskeleton

(b) Nucleolus

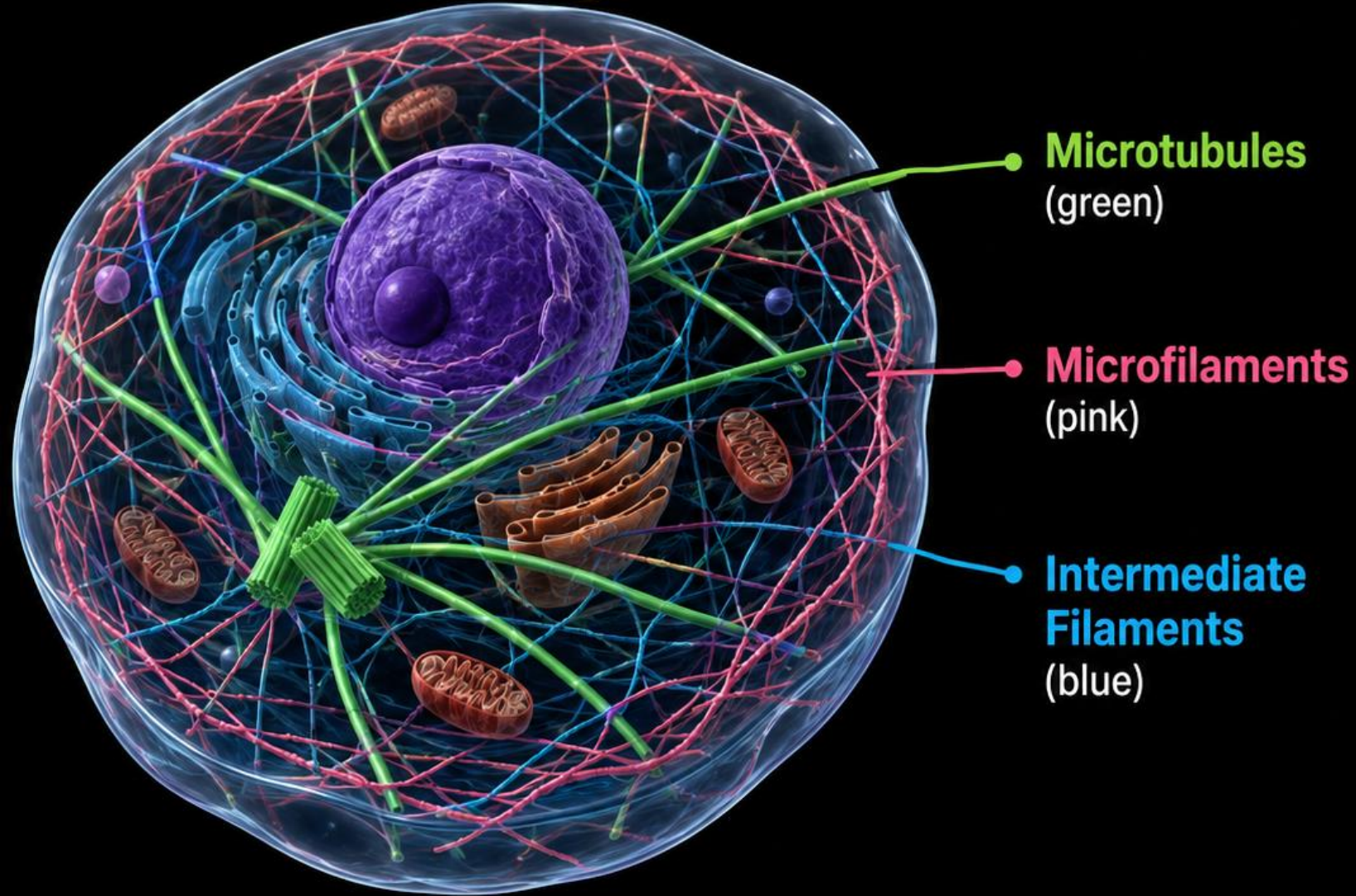
(c) Lysosome

(d) Chromatin



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Cytoskeleton



Internal framework of the cell



Maintains shape



Provides support



Helps intracellular transport



Involved in cell movement and division



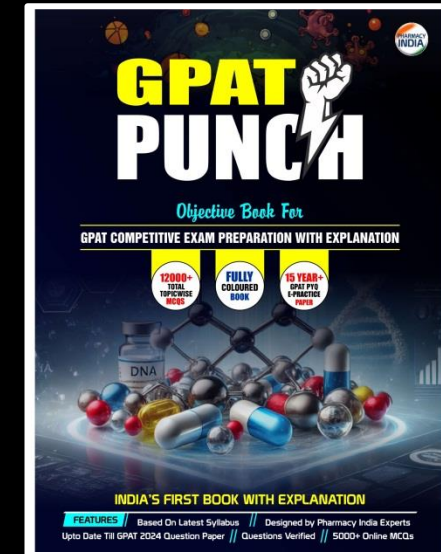
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28.

Microtubules are mainly made up of:

- (a) Actin
- (b) Tubulin
- (c) Myosin
- (d) Keratin



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28.

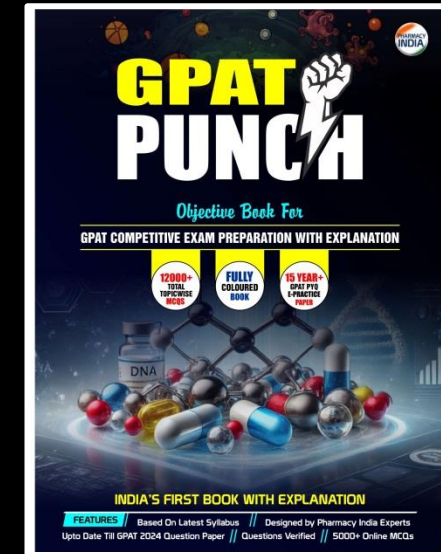
Microtubules are mainly made up of:

(a) Actin

(b) Tubulin

(c) Myosin

(d) Keratin



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MICROTUBULES

DYNAMIC CYTOSKELETAL STRUCTURES



HOLLOW CYLINDERS

with a central lumen



MADE OF TUBULIN

Built from α -tubulin (green) and β -tubulin (purple) dimers



FUNCTIONS

Provide structure, tracks for transport, and build cellular machines



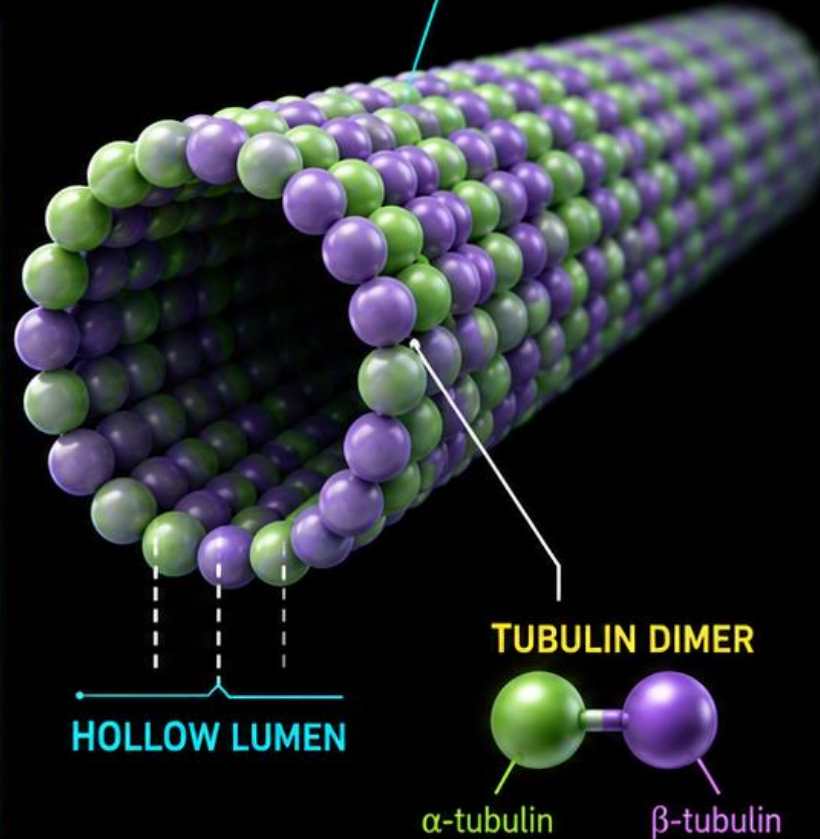
DYNAMIC NATURE

Continuously grow and shrink, enabling cellular organization and movement



MICROTUBULES: HOLLOW CYLINDERS MADE OF TUBULIN THAT BUILD CELLULAR MACHINES, ENABLE MOVEMENT, TRANSPORT, AND PROVIDE STRUCTURE AND SUPPORT.

MICROTUBULE

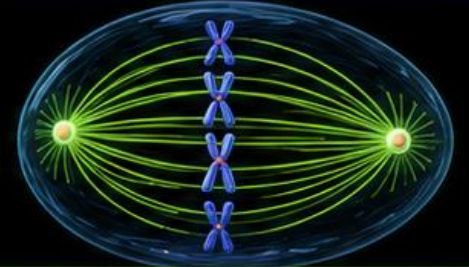


KEY ROLES OF MICROTUBULES



FORM SPINDLE FIBERS DURING CELL DIVISION

Attach to chromosomes and ensure their accurate segregation.



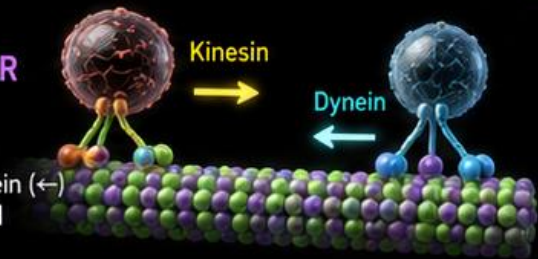
PRESENT IN CILIA AND FLAGELLA

The core axoneme (9+2 arrangement) enables beating and movement.



HELP IN INTRACELLULAR TRANSPORT

Serve as tracks for kinesin ($\rightarrow$) and dynein ($\leftarrow$) to move vesicles and organelles.



PROVIDE CELL SUPPORT

Maintain cell shape, organize internal components, and resist mechanical stress.





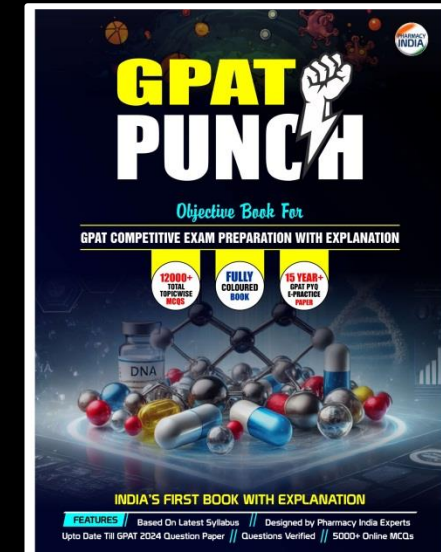
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29.

Microfilaments are mainly composed of:

- (a) Actin
- (b) Tubulin
- (c) Collagen
- (d) Elastin



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29.

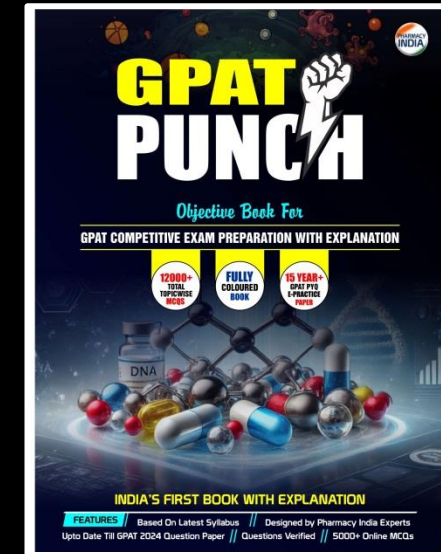
Microfilaments are mainly composed of:

(a) Actin

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(c) Collagen

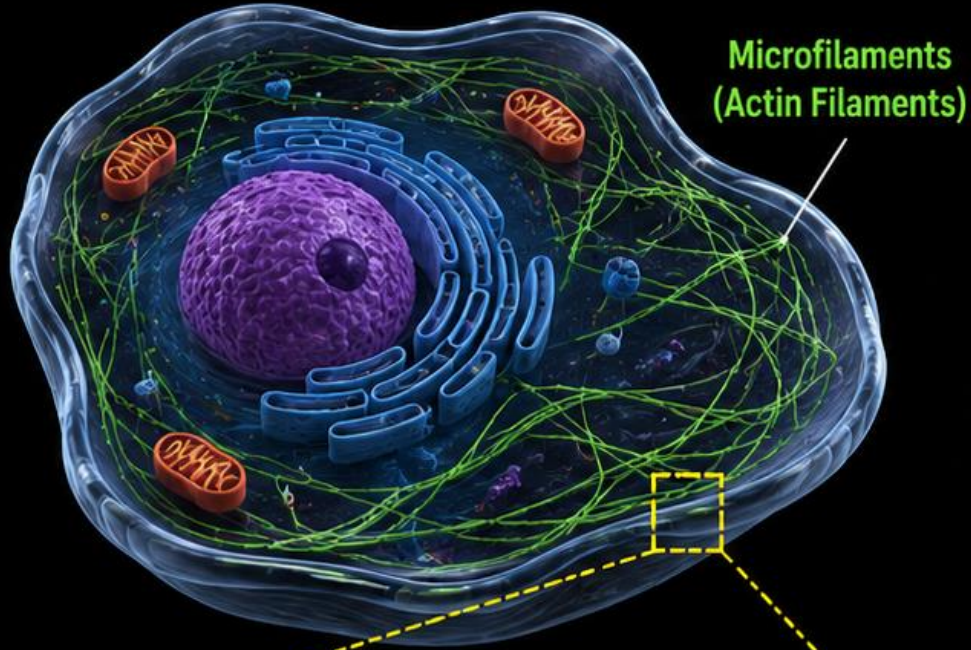
(d) Elastin



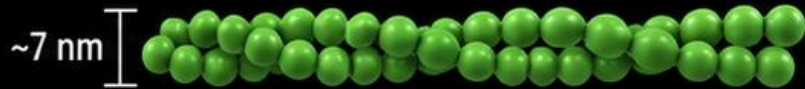
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Microfilaments

THIN ACTIN FILAMENTS IN A CELL



ACTIN FILAMENT (MICROFILAMENT)



Made of Actin Proteins



THINNEST
CYTOSKELETAL
FIBERS



MADE OF
ACTIN



MAINTAIN
CELL SHAPE



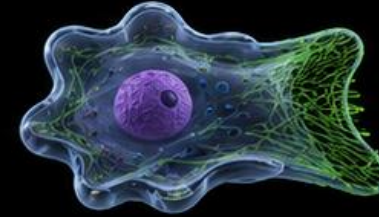
HELP IN
MOVEMENT AND
CONTRACTION



IMPORTANT IN
CYTOKINESIS

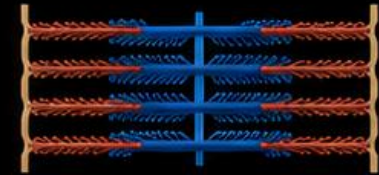
KEY FUNCTIONS

CELL MOVEMENT



Actin filaments push the cell membrane forward to move.

MUSCLE CONTRACTION



Actin filaments (thin)



Slide past myosin filaments to shorten muscle.

CYTOKINESIS



Actin filaments form a contractile ring that tightens to divide the cell.



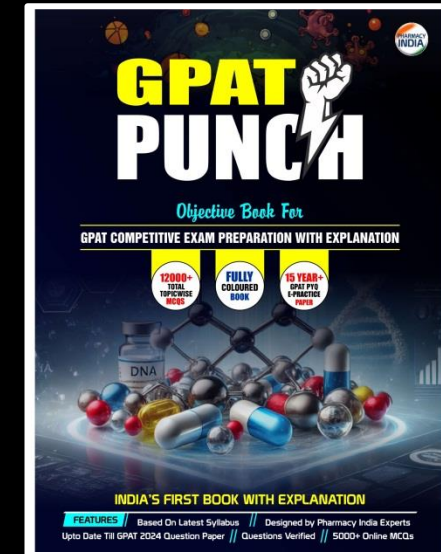
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30.

Centrioles are mainly involved in:

- (a) Protein digestion
- (b) Formation of spindle fibers during cell division
- (c) ATP production
- (d) Secretion of enzymes



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30.

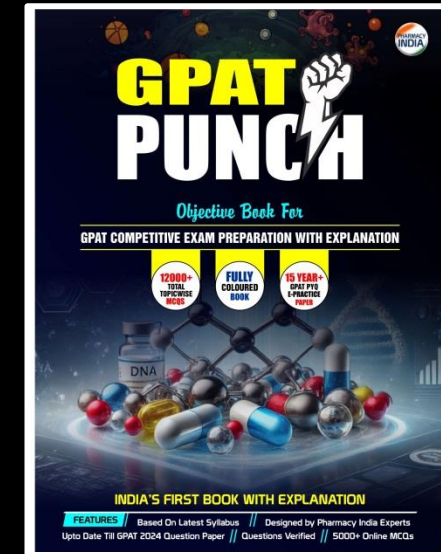
Centrioles are mainly involved in:

(a) Protein digestion

(b) Formation of spindle fibers during cell division

(c) ATP production

(d) Secretion of enzymes



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Centrioles



Cylindrical structures

Made of microtubule triplets arranged in a cylinder.



Part of the centrosome

Centrioles occur as a pair in the centrosome near the nucleus.



Organize spindle fibers

Centrioles nucleate and organize spindle fibers during cell division.



Spindle fibers separate chromosomes

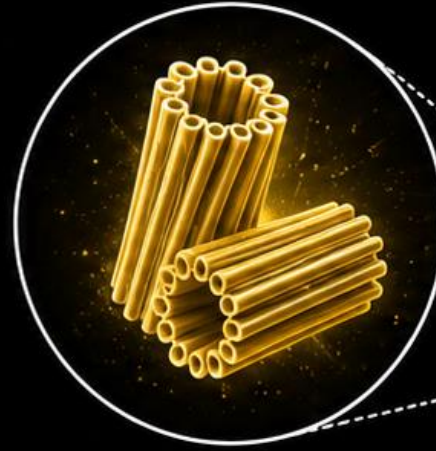
Spindle fibers attach to chromosomes and pull sister chromatids to opposite poles in mitosis.



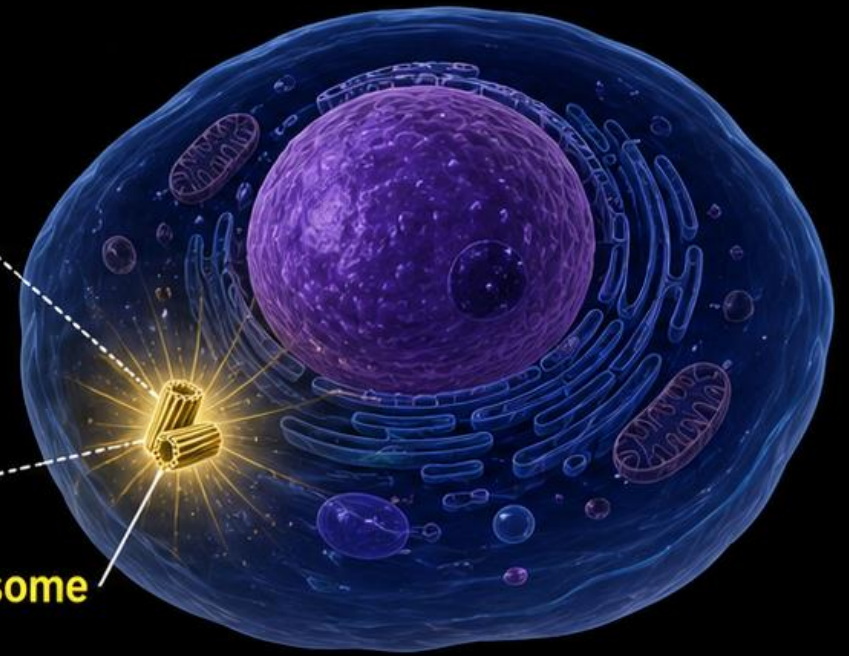
Related to basal bodies of cilia

Centrioles form basal bodies that anchor and organize cilia.

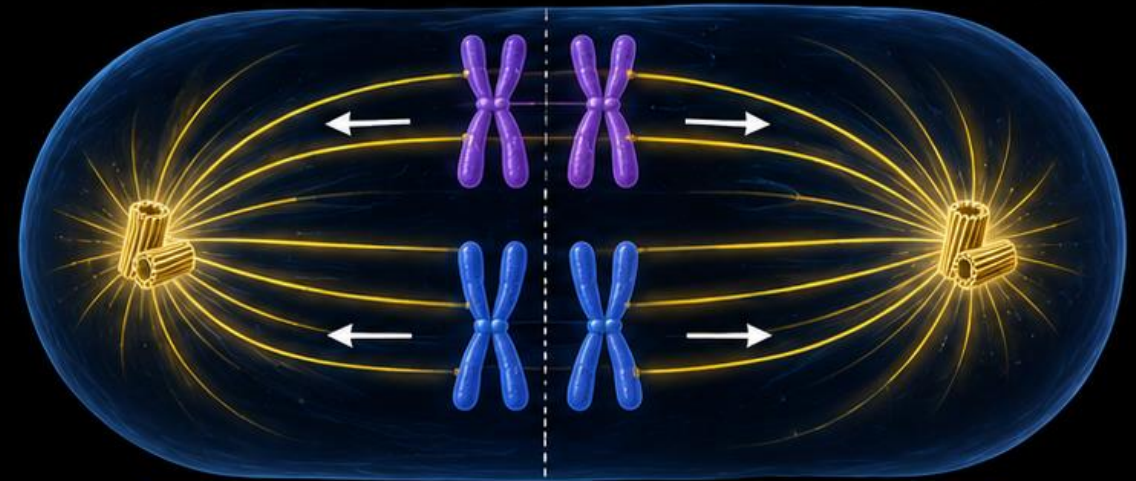
Pair of Centrioles



Centrosome



MITOTIC CELL (METAPHASE-ANAPHASE)



Spindle fibers pull sister chromatids to opposite poles during mitosis.

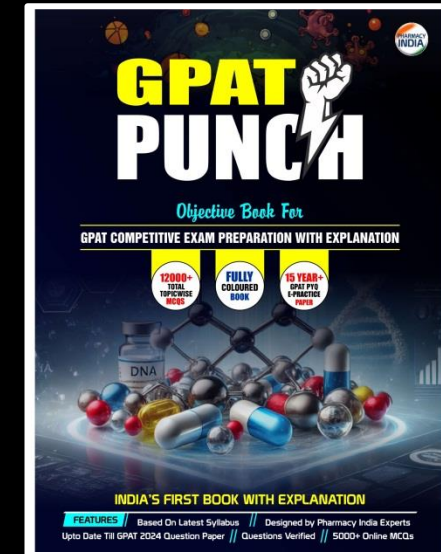


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31.

Which phase of mitosis shows alignment of chromosomes at the equatorial plate?

- (a) Prophase
- (b) Metaphase
- (c) Anaphase
- (d) Telophase



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31.

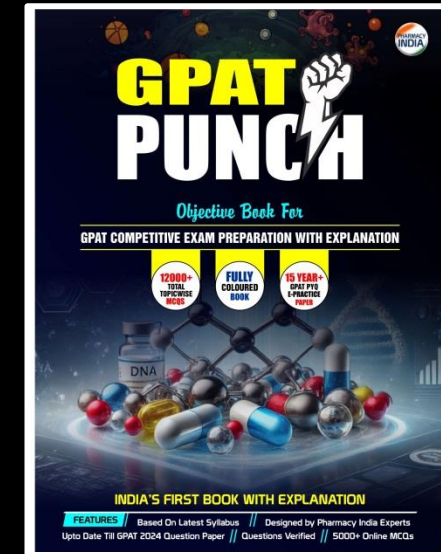
Which phase of mitosis shows alignment of chromosomes at the equatorial plate?

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(c) Anaphase

(d) Telophase



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METAPHASE



KEY POINTS

1



CHROMOSOMES
LINE UP AT THE
CELL EQUATOR.

2



EQUATORIAL
PLANE IS THE
METAPHASE PLATE.

3



SPINDLE FIBERS
ATTACH AT
CENTROMERES /
KINETOCHORES
FROM OPPOSITE POLES.

4

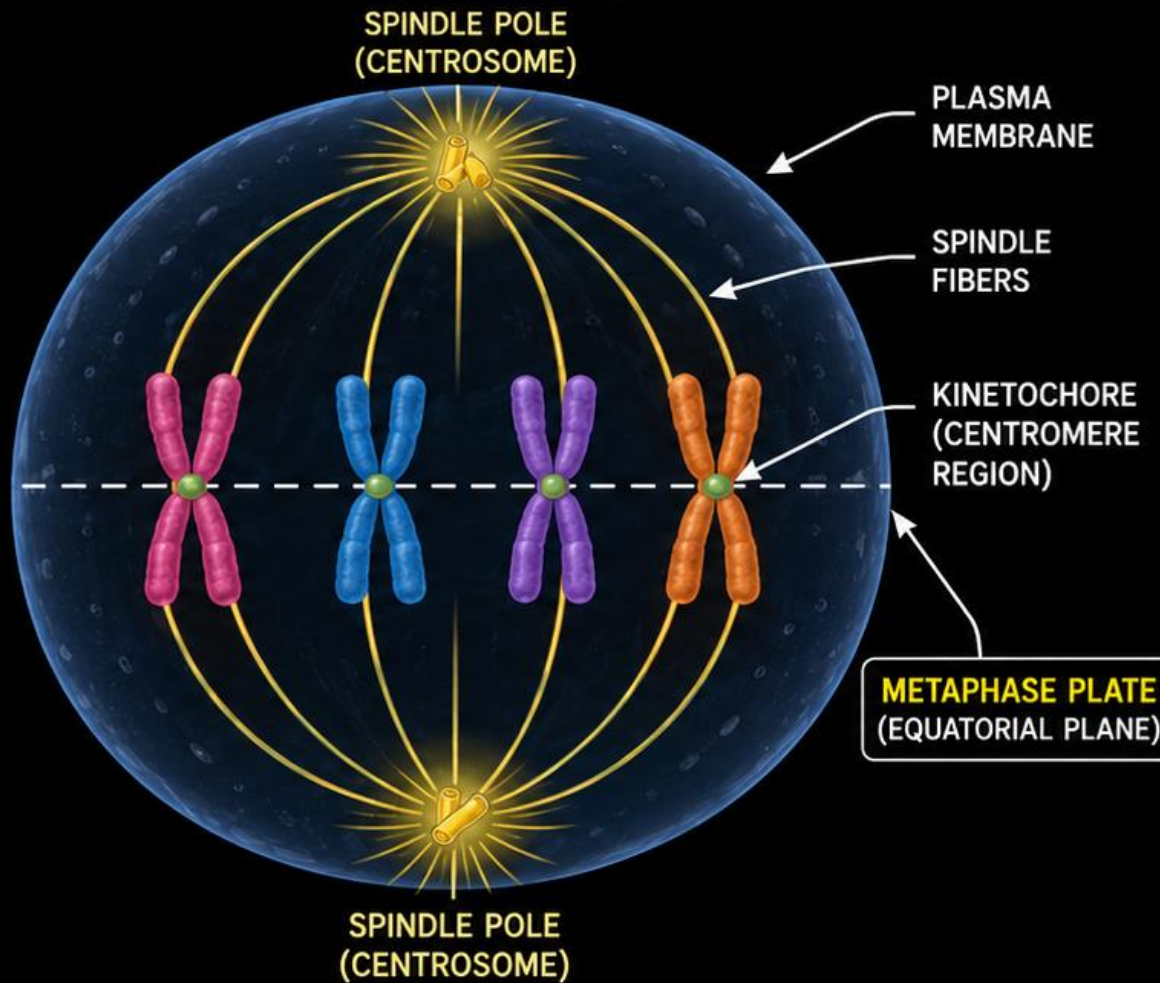


PROPER ALIGNMENT
ENSURES EQUAL
CHROMOSOME
DISTRIBUTION.

5



ANAPHASE
FOLLOWS
METAPHASE.



SIGNIFICANCE



PRECISE ALIGNMENT
AT THE **METAPHASE PLATE**
ENSURES EACH DAUGHTER
CELL RECEIVES AN **EQUAL**
SET OF **CHROMOSOMES**.

SEQUENCE



PROPHASE



METAPHASE



ANAPHASE



METAPHASE = **ALIGNMENT** + **ATTACHMENT** + **ACCURATE SEGREGATION**



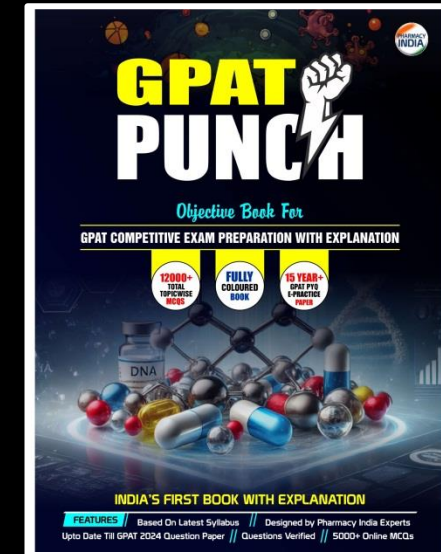
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32.

Separation of sister chromatids occurs during:

- (a) Prophase
- (b) Metaphase
- (c) Anaphase
- (d) Interphase



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32.

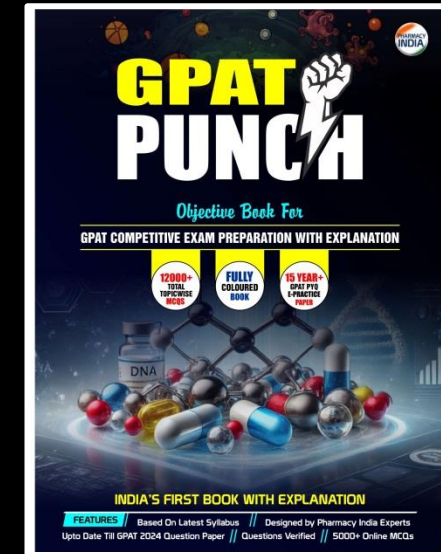
Separation of sister chromatids occurs during:

(a) Prophase

(b) Metaphase

(c) Anaphase

(d) Interphase



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KEY POINTS



1 THIRD STAGE
OF MITOSIS



2 SISTER CHROMATIDS
SEPARATE AT
CENTROMERES



3 CHROMATIDS MOVE
TO OPPOSITE
POLES



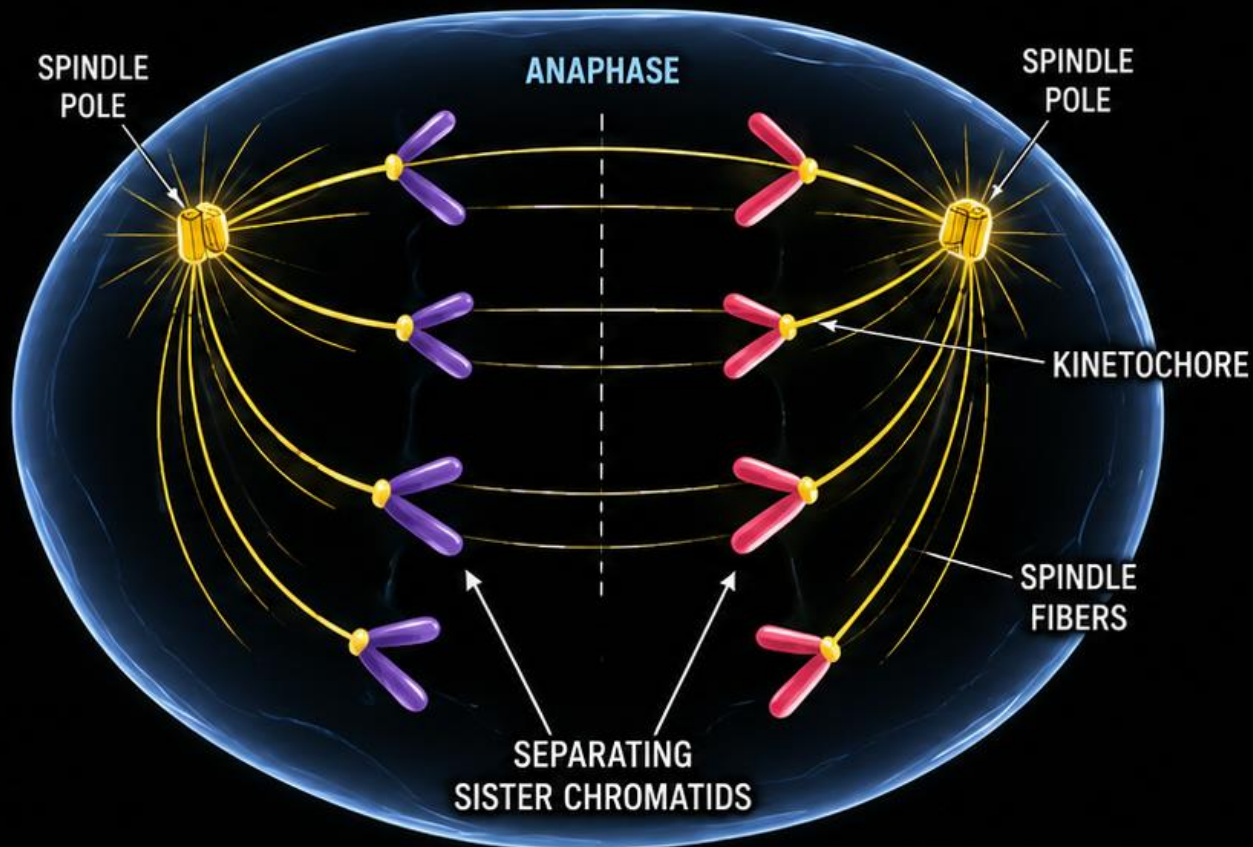
4 SPINDLE FIBERS
SHORTEN



5 EQUAL GENETIC
MATERIAL REACHES
DAUGHTER CELLS

ANAPHASE

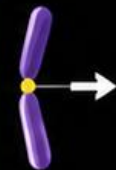
SISTER CHROMATIDS SEPARATE AND MOVE TO OPPOSITE POLES



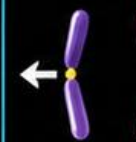
WHAT'S HAPPENING



SISTER CHROMATIDS
ATTACHED AT
CENTROMERE



CENTROMERE SPLITS
AND SISTER
CHROMATIDS
SEPARATE



CHROMATIDS MOVE
TO OPPOSITE
POLES



EQUAL GENETIC
MATERIAL REACHES
EACH POLE



OUTCOME: EQUAL AND IDENTICAL GENETIC MATERIAL IS DISTRIBUTED TO OPPOSITE POLES,
ENSURING GENETIC CONSISTENCY IN DAUGHTER CELLS.



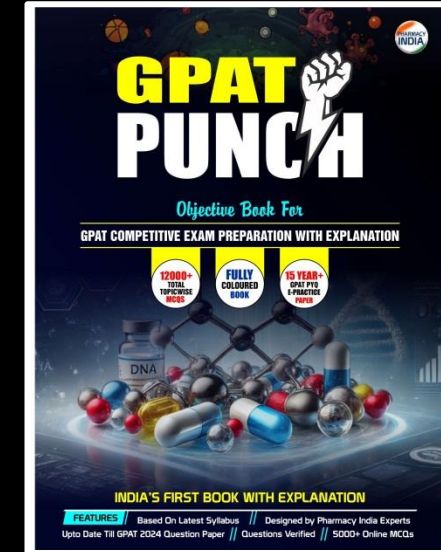
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33.

Chromatin is mainly composed of:

- (a) DNA and proteins
- (b) RNA and lipids
- (c) Carbohydrates and proteins only
- (d) Phospholipids only



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33.

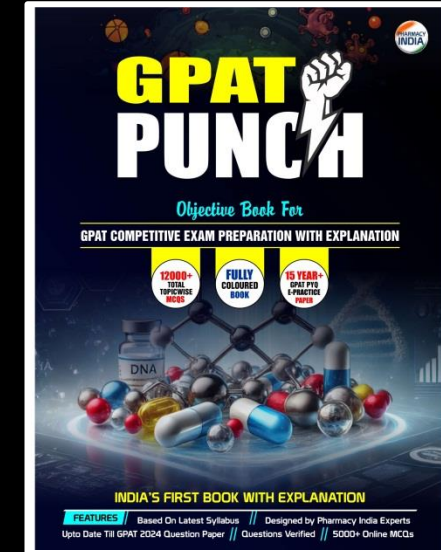
Chromatin is mainly composed of:

(a) DNA and proteins

(b) RNA and lipids

(c) Carbohydrates and proteins only

(d) Phospholipids only



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CHROMATIN

From DNA to Chromosome



KEY POINTS



1. Chromatin is the **genetic material** in the nucleus.



2. It is mainly made of **DNA** and **histone** proteins.



3. Histones package DNA into **nucleosomes**.



4. Chromatin **condenses into chromosomes** during cell division.



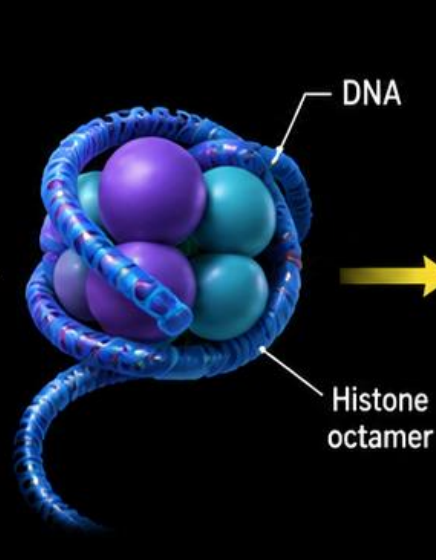
5. It is important in **gene expression** and **replication**.

1. DNA DOUBLE HELIX



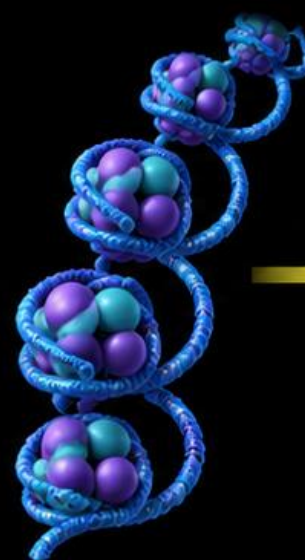
DNA, the genetic blueprint.

2. NUCLEOSOME



DNA wraps around histone octamer to form a **nucleosome** ("bead").

3. CHROMATIN FIBER



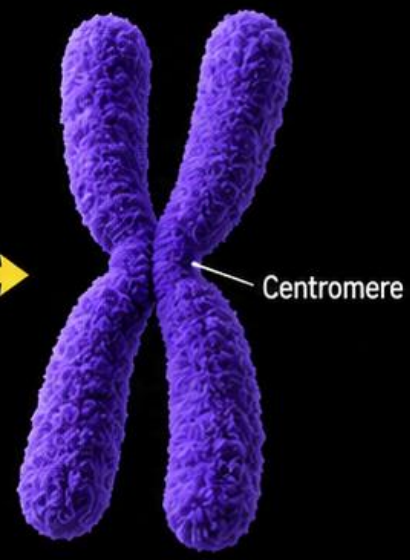
Nucleosomes coil and fold into **chromatin fiber**.

4. HIGHER ORDER COMPACTION



Fiber further condenses into **compact chromatin**.

5. CHROMOSOME



During cell division, chromatin condenses to form a visible **chromosome**.



DNA

Carries genetic information.



HISTONES

Basic proteins that package DNA.



NUCLEOSOME

Fundamental unit of chromatin ("bead").



CHROMATIN

Dynamic structure that organizes the genome.



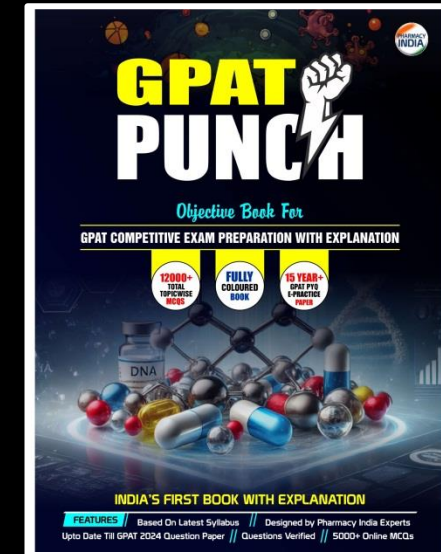
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34.

The nuclear membrane is absent during which stage of mitosis?

- (a) Late prophase/prometaphase
- (b) Interphase
- (c) Cytokinesis only
- (d) G1 phase



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34.

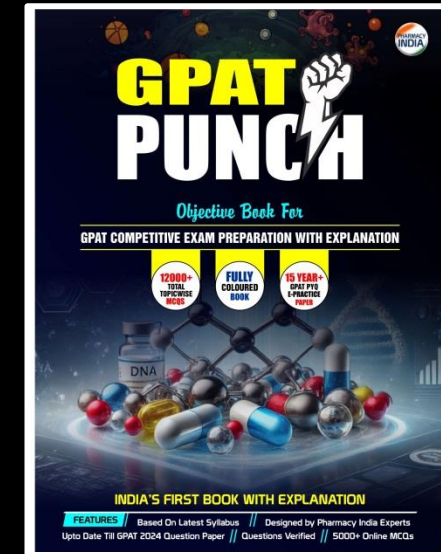
The nuclear membrane is absent during which stage of mitosis?

(a) Late prophase/prometaphase

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(d) G1 phase



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LATE PROPHASE / PROMETAPHASE



KEY POINTS



1. **NUCLEAR ENVELOPE BREAKS DOWN** in late prophase / prometaphase.



2. **SPINDLE FIBERS GAIN ACCESS** to chromosomes.



3. **CHROMOSOMES ARE CONDENSED** and visible.

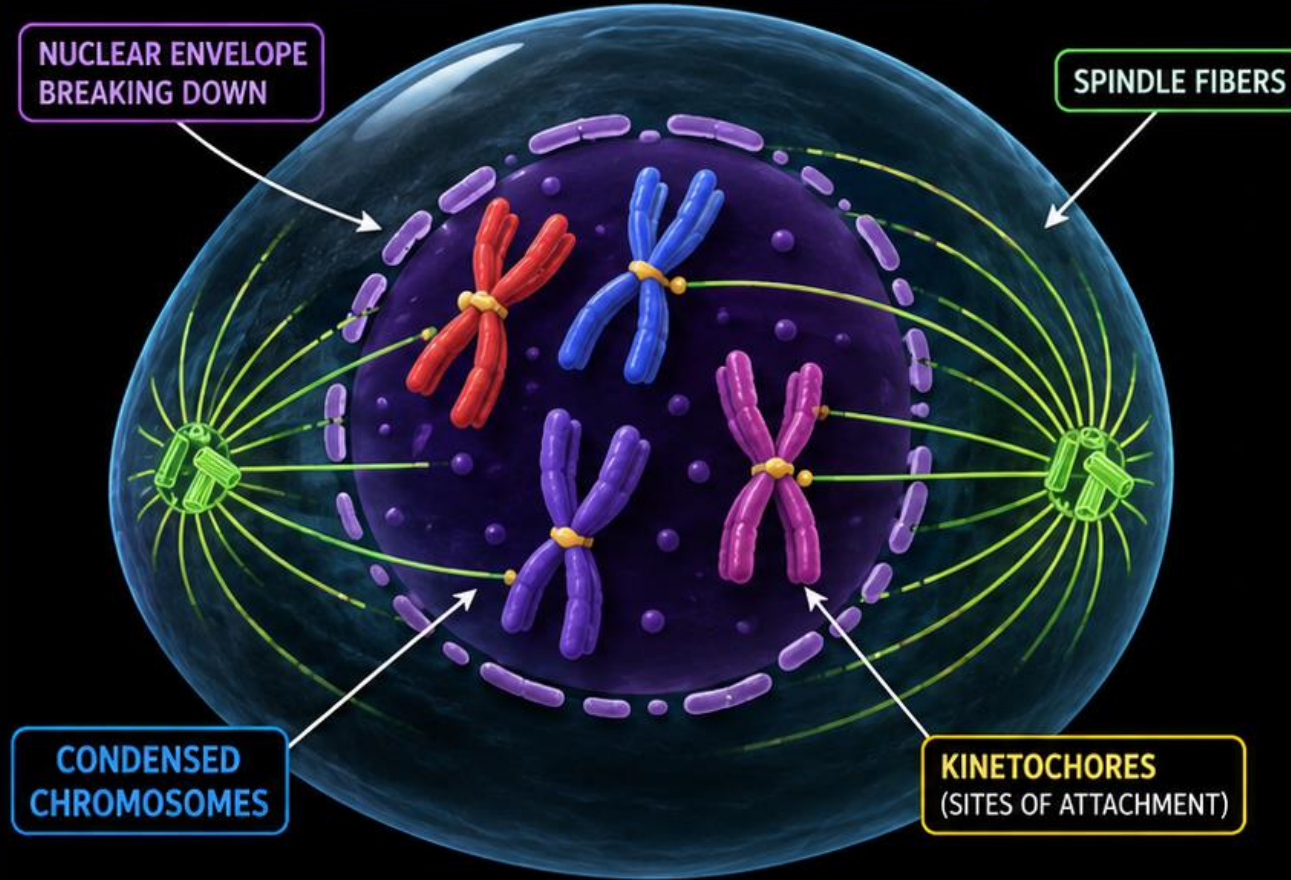


4. **THIS PREPARES FOR METAPHASE** alignment.



5. **NUCLEAR MEMBRANE REFORMS IN TELOPHASE.**

LATE PROPHASE / PROMETAPHASE



KEY STRUCTURES



Fragmenting nuclear envelope



Condensed chromosomes



Kinetochores



Spindle fibers (microtubules)

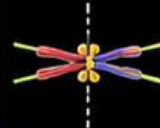


Centrosomes (spindle poles)

OUTCOME



SPINDLE ATTACHMENT TO CHROMOSOMES



PREPARES FOR METAPHASE ALIGNMENT



NUCLEAR MEMBRANE REFORMS IN TELOPHASE



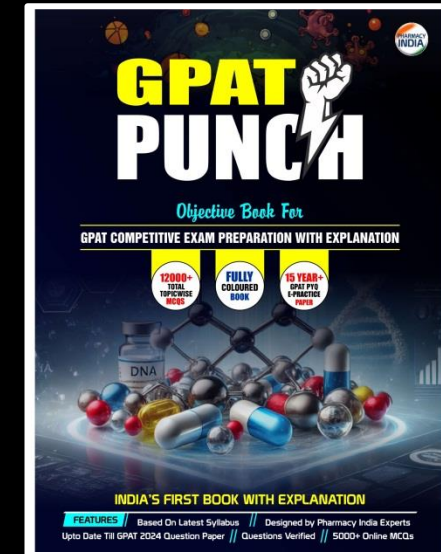
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35.

Which organelle is mainly responsible for detoxification of drugs in liver cells?

- (a) Rough endoplasmic reticulum
- (b) Smooth endoplasmic reticulum
- (c) Lysosome
- (d) Nucleolus



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35.

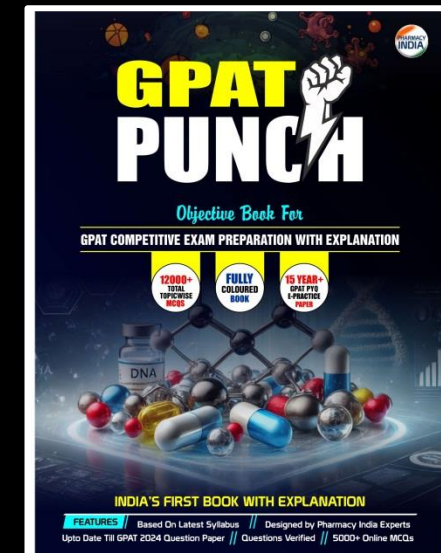
Which organelle is mainly responsible for detoxification of drugs in liver cells?

(a) Rough endoplasmic reticulum

(b) Smooth endoplasmic reticulum

(c) Lysosome

(d) Nucleolus



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KEY POINTS



1. LACKS RIBOSOMES

No ribosomes on its surface.



2. ABUNDANT IN LIVER CELLS

Especially well developed in hepatocytes.



3. DETOXIFIES DRUGS & TOXINS

Protects cells by detoxification.



4. CONTAINS CYTOCHROME P450 ENZYME SYSTEMS

Key enzymes for oxidative detoxification.

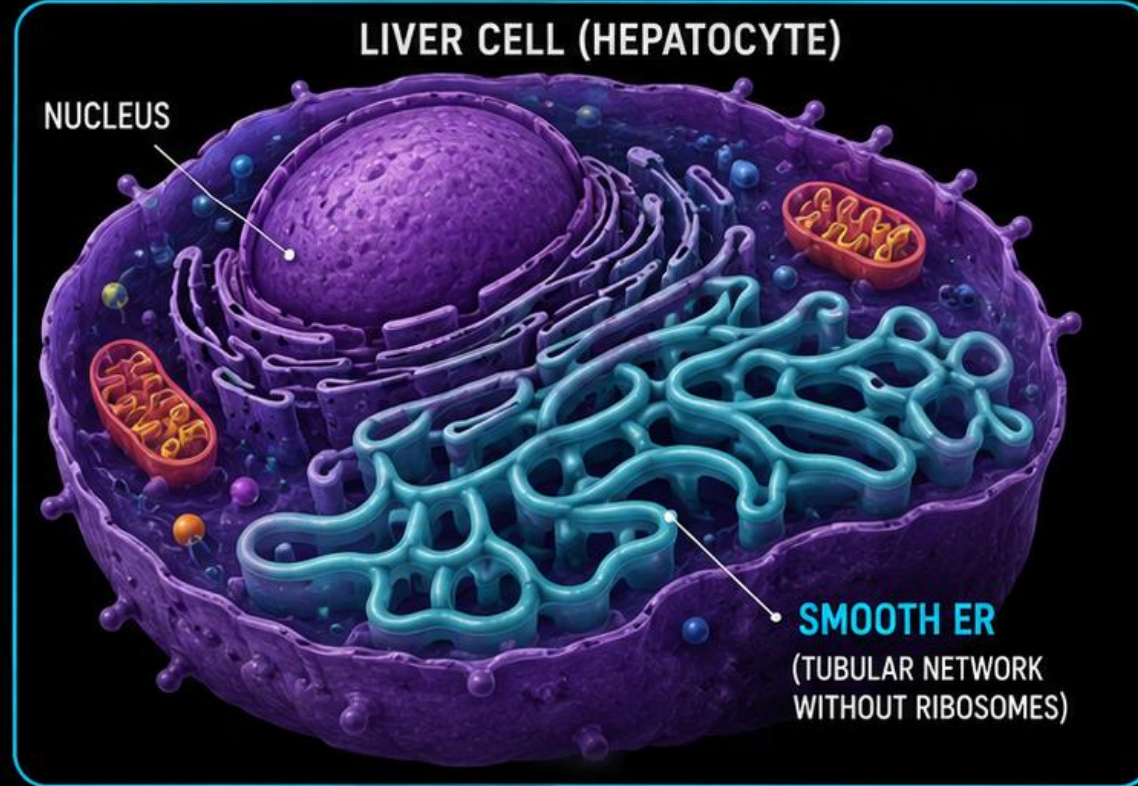


5. ALSO SYNTHESIZES LIPIDS

Synthesizes phospholipids, cholesterol and steroids.

SMOOTH ER

STRUCTURE • LOCATION • FUNCTIONS



DETOXIFICATION ROLE

DRUGS / TOXINS



CYTOCHROME P450 ENZYMES
Introduce -OH groups (oxidation).

WATER-SOLUBLE PRODUCTS

Easier to excrete



EXCRETION

Via bile or urine

LIPID SYNTHESIS FUNCTIONS



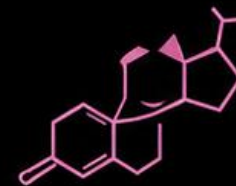
PHOSPHOLIPIDS

For membrane formation



CHOLESTEROL

For membranes, bile acids, hormones



STEROIDS

Hormones (e.g. cortisol, aldosterone, sex hormones)

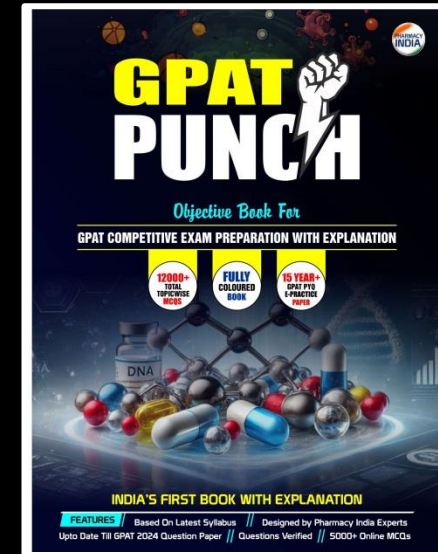


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36.

Which organelle is mainly responsible for formation of lysosomes?

- (a) Golgi apparatus
- (b) Mitochondria
- (c) Nucleolus
- (d) Cell membrane



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36.

Which organelle is mainly responsible for formation of lysosomes?

- (a) Golgi apparatus
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- (c) Nucleolus
- (d) Cell membrane

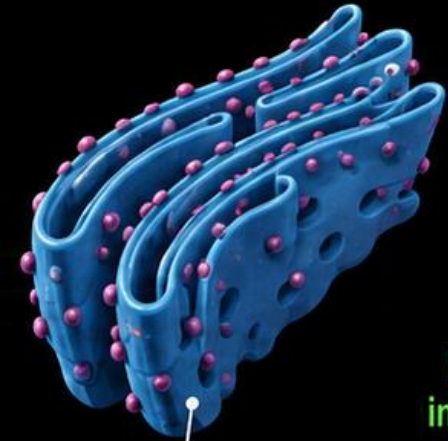


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GOLGI APPARATUS & LYSOSOMES

1. ROUGH ER

synthesizes
lysosomal enzymes



Ribosomes
(protein synthesis)

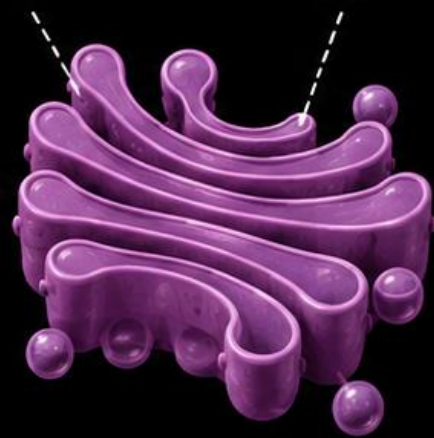
2. GOLGI APPARATUS

modifies enzymes

cis face
(receiving side)

trans face
(shipping side)

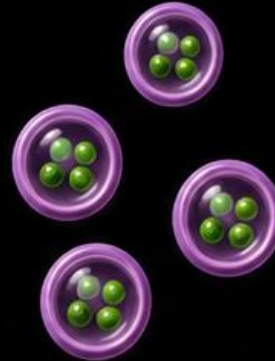
Enzymes
in transport
vesicles



Enzymes are
modified (e.g., glycosylation)

3. PACKAGING

Golgi packages enzymes
into vesicles



Transport vesicles
with lysosomal
enzymes

4. PRIMARY LYSOSOME

vesicles become
primary lysosomes



Primary lysosome
(single membrane
vesicle containing
hydrolytic enzymes)

KEY POINTS



1. LYSOSOMAL ENZYMES
are synthesized in
rough ER.



2. GOLGI MODIFIES
the enzymes
(e.g., glycosylation).



3. GOLGI PACKAGES
enzymes into
transport vesicles.



4. VESICLES BECOME
primary lysosomes
(enzyme-filled vesicles).



5. GOLGI APPARATUS
is linked with
lysosome formation.



GOLGI APPARATUS IS DIRECTLY LINKED WITH LYSOSOME FORMATION



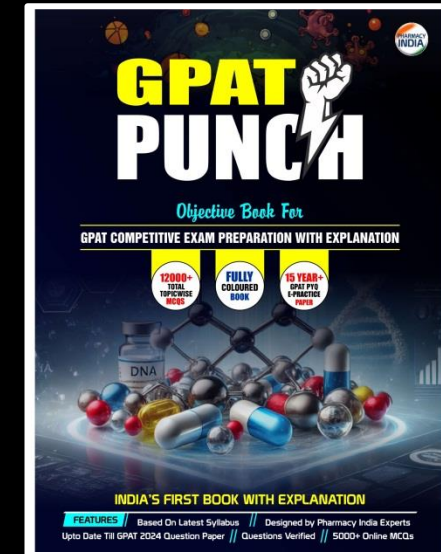
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37.

Peroxisomes contain which enzyme for breakdown of hydrogen peroxide?

- (a) Amylase
- (b) Catalase
- (c) Pepsin
- (d) Trypsin



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37.

Peroxisomes contain which enzyme for breakdown of hydrogen peroxide?

- (a) Amylase
- (b) Catalase
- (c) Pepsin
- (d) Trypsin



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PEROXISOMES

SMALL ORGANELLES, BIG PROTECTION

KEY POINTS

1



PERFORM OXIDATIVE REACTIONS

Peroxisomes contain enzymes that carry out oxidative metabolic reactions.

2



HYDROGEN PEROXIDE MAY BE GENERATED

Oxidative reactions can produce hydrogen peroxide (H_2O_2).

3



CATALASE BREAKS H_2O_2 INTO WATER AND OXYGEN

Catalase rapidly converts H_2O_2 into H_2O and O_2 .

4



PROTECTS CELLS FROM OXIDATIVE DAMAGE

Detoxifies hydrogen peroxide and prevents harm to cellular components.

5



HELPS IN FATTY ACID OXIDATION

Peroxisomes play a key role in the β -oxidation of very long-chain fatty acids.

PEROXISOME

HYDROGEN PEROXIDE IS GENERATED

CATALASE BREAKS H_2O_2 INTO WATER AND OXYGEN

BROKEN DOWN INTO WATER AND OXYGEN

OXIDATIVE REACTIONS

H_2O_2
(Hydrogen Peroxide)

CATALASE

H_2O
(Water)

O_2
(Oxygen)

HYDROGEN PEROXIDE

CATALASE

WATER
+

+ OXYGEN

$2 \text{H}_2\text{O}_2$

$2 \text{H}_2\text{O}$

+ O_2



CELLULAR PROTECTION

Against harmful reactive molecules

Single Membrane

Matrix (Enzymes)



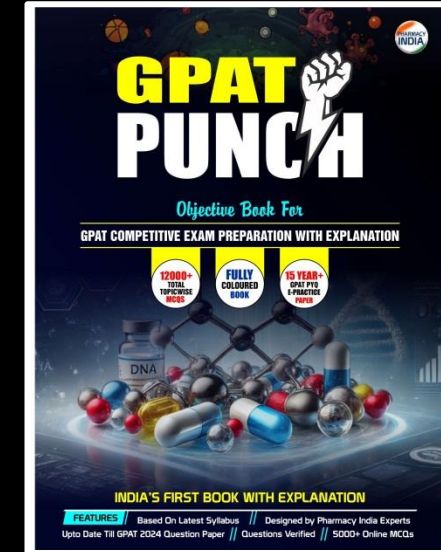
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38.

Which organelle stores calcium ions in muscle cells?

- (a) Sarcoplasmic reticulum
- (b) Lysosome
- (c) Golgi apparatus
- (d) Nucleolus



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38.

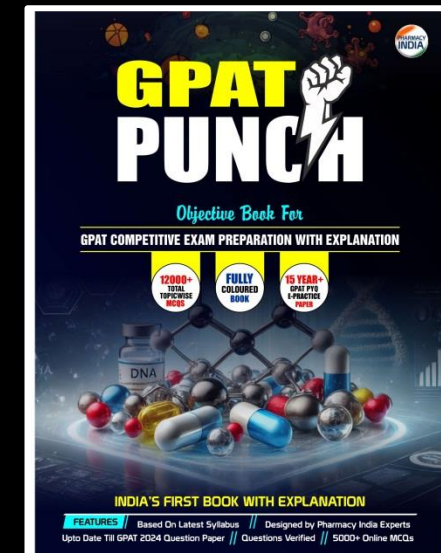
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(b) Lysosome

(c) Golgi apparatus

(d) Nucleolus



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SARCOPLASMIC RETICULUM

THE CALCIUM STOREHOUSE OF MUSCLE CELLS

MUSCLE FIBER
(MUSCLE CELL)

ENLARGED VIEW

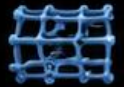
SARCOPLASMIC
RETICULUM (SR)

CALCIUM IONS
(Ca^{2+})

MYOFIBRILS

T-TUBULE

TERMINAL
CISTERNAE



Sarcoplasmic
Reticulum (SR)



Calcium Ions (Ca^{2+})



Myofibrils



Mitochondrion

KEY FUNCTIONS



1. SPECIALIZED SMOOTH
ER OF MUSCLE CELLS



2. STORES CALCIUM IONS
(Ca^{2+})



3. CALCIUM RELEASE
TRIGGERS MUSCLE
CONTRACTION



4. CALCIUM REUPTAKE
CAUSES MUSCLE
RELAXATION



5. ESSENTIAL FOR
MUSCLE FUNCTION

SR SURROUNDS MYOFIBRILS AND STORES CALCIUM IONS



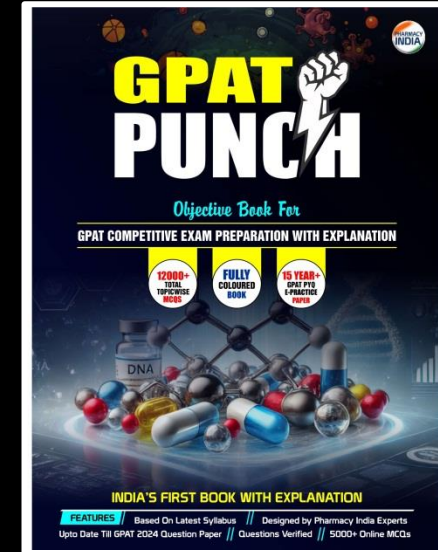
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39.

Which organelle contains cristae?

- (a) Mitochondria
- (b) Lysosome
- (c) Golgi apparatus
- (d) Ribosome



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39.

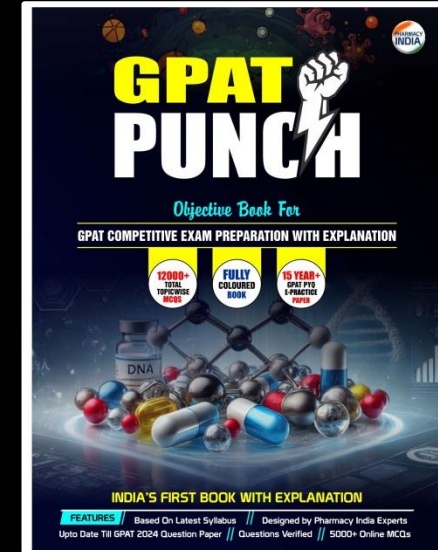
Which organelle contains cristae?

(a) Mitochondria

(b) Lysosome

(c) Golgi apparatus

(d) Ribosome



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KEY POINTS

1



Cristae are **folds** of the inner mitochondrial membrane.

2



They **increase** the **surface area** for biochemical reactions.

3



The **electron transport chain** is located on the inner membrane.

4



More cristae allow **greater ATP production**.

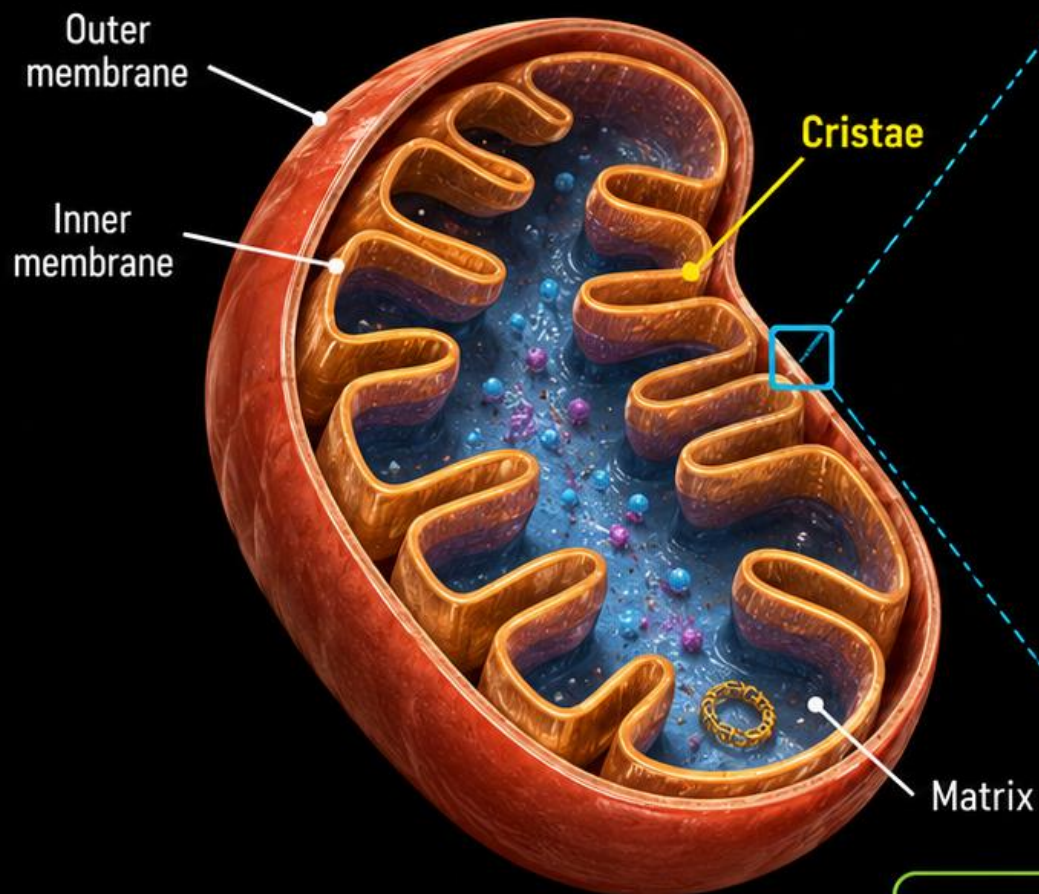
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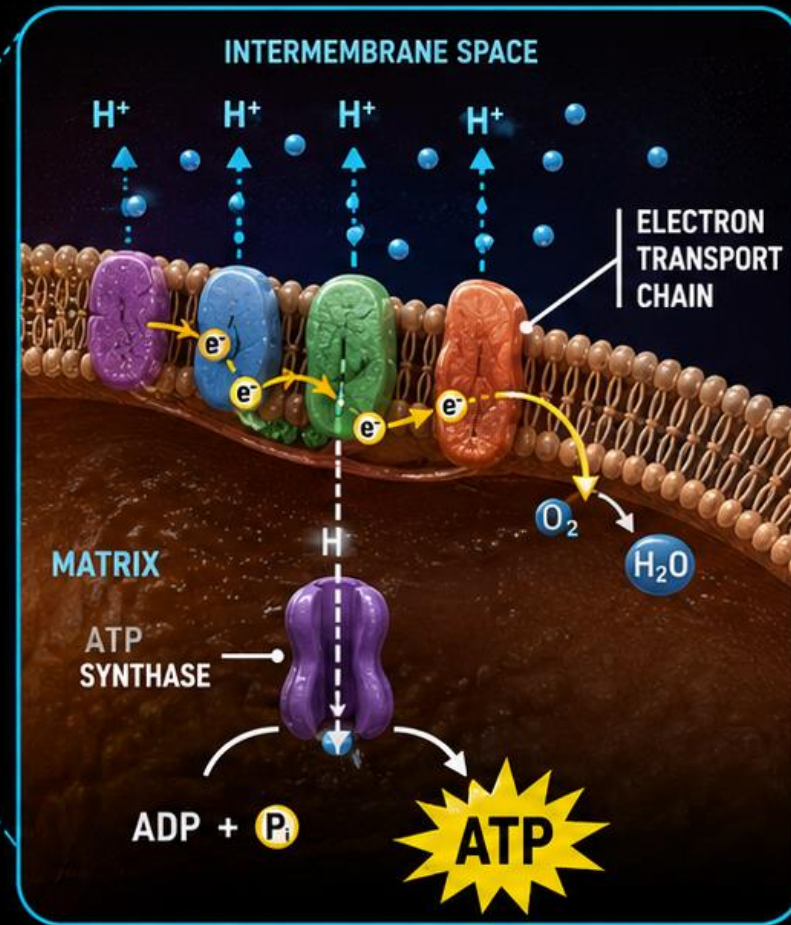
Cristae are **characteristic** of mitochondria.

CRISTAE

FOLDS THAT POWER CELLULAR ENERGY



INSIDE A CRISTAE (INNER MEMBRANE)



FUNCTION:

Site of aerobic respiration and **ATP** synthesis.



MORE CRISTAE = **MORE SURFACE AREA** = **MORE ATP** = **ENERGY**



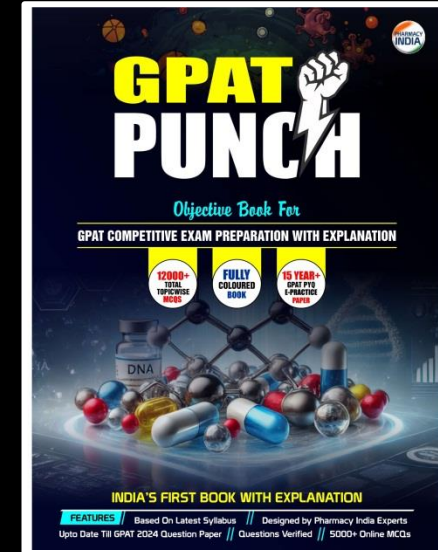
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40.

Which organelle has cis and trans faces?

- (a) Golgi apparatus
- (b) Lysosome
- (c) Ribosome
- (d) Centriole



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40.

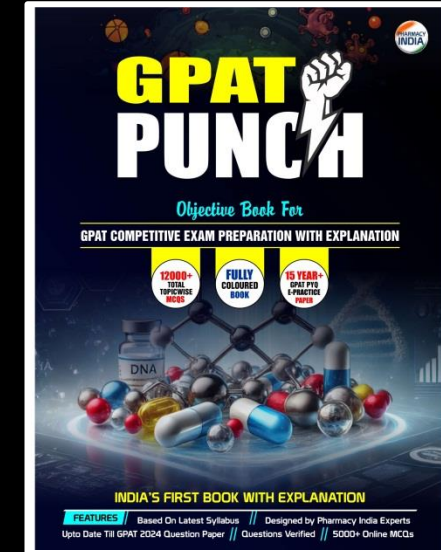
Which organelle has cis and trans faces?

(a) Golgi apparatus

(b) Lysosome

(c) Ribosome

(d) Centriole



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KEY POINTS



1 GOLGI APPARATUS HAS POLARITY



2 CIS FACE RECEIVES VESICLES FROM ER



3 GOLGI MODIFIES PROTEINS AND LIPIDS

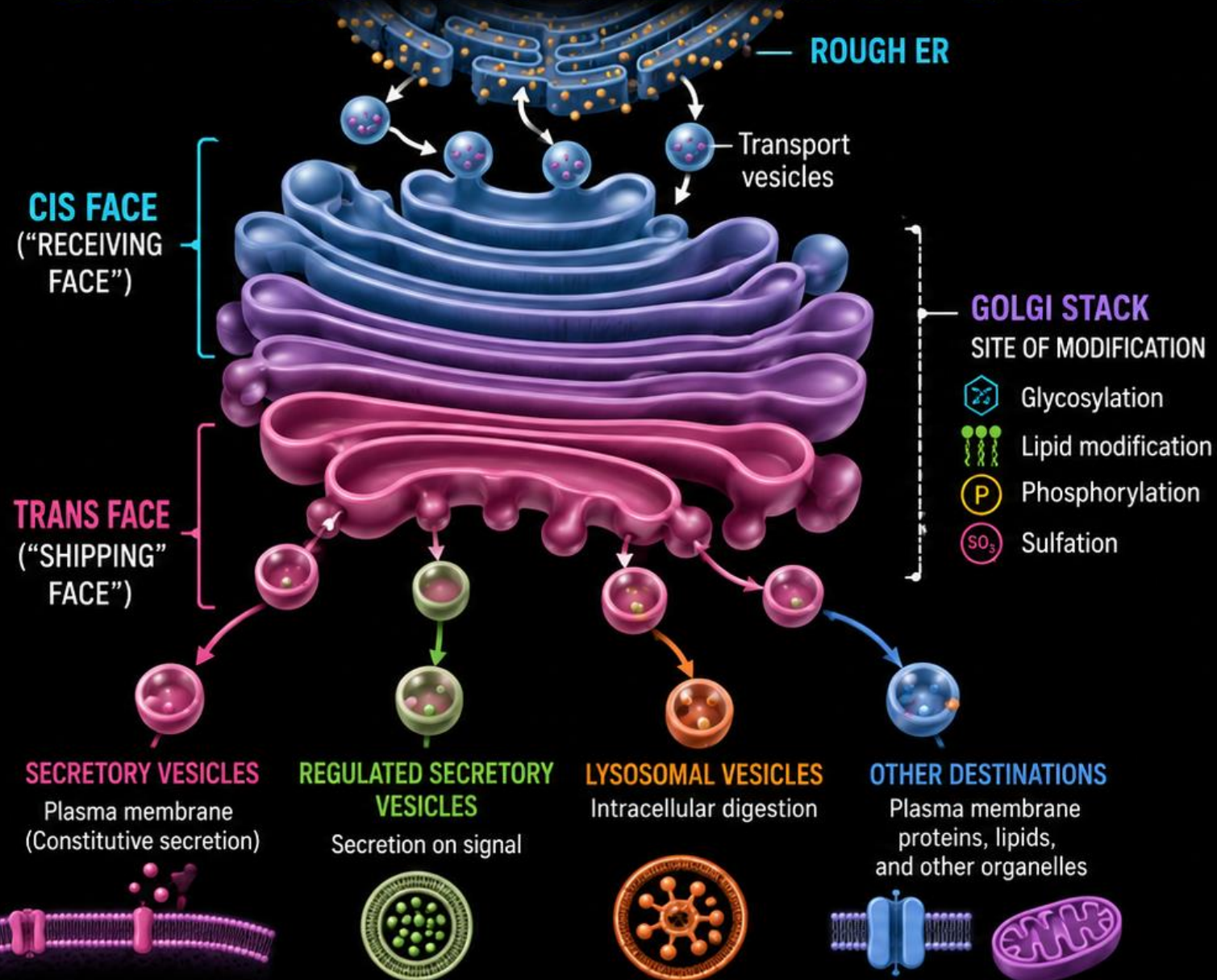


4 TRANS FACE SORTS AND DISPATCHES MATERIALS



5 FORMS SECRETORY AND LYSOSOMAL VESICLES

GOLGI APPARATUS



POLARITY IN ACTION

CIS FACE

Receives from ER



GOLGI STACK

Modifies proteins
and lipids



TRANS FACE

Sorts and dispatches
to destinations



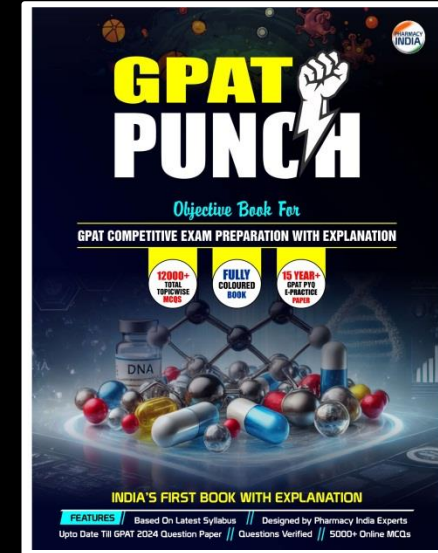
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41.

The cytoplasm consists of:

- (a) Nucleus only
- (b) Cytosol and organelles outside the nucleus
- (c) Cell membrane only
- (d) Chromosomes only



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41.

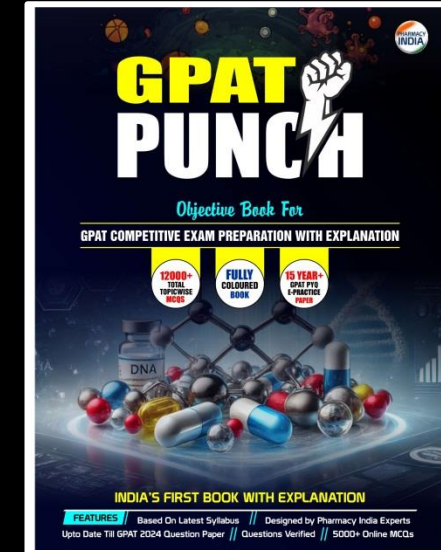
The cytoplasm consists of:

(a) Nucleus only

(b) Cytosol and organelles outside the nucleus

(c) Cell membrane only

(d) Chromosomes only



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CYTOPLASM

Cytoplasm = **cytosol** + **organelles** outside nucleus



The cytoplasm is the living, **active** area of the cell.

KEY POINTS



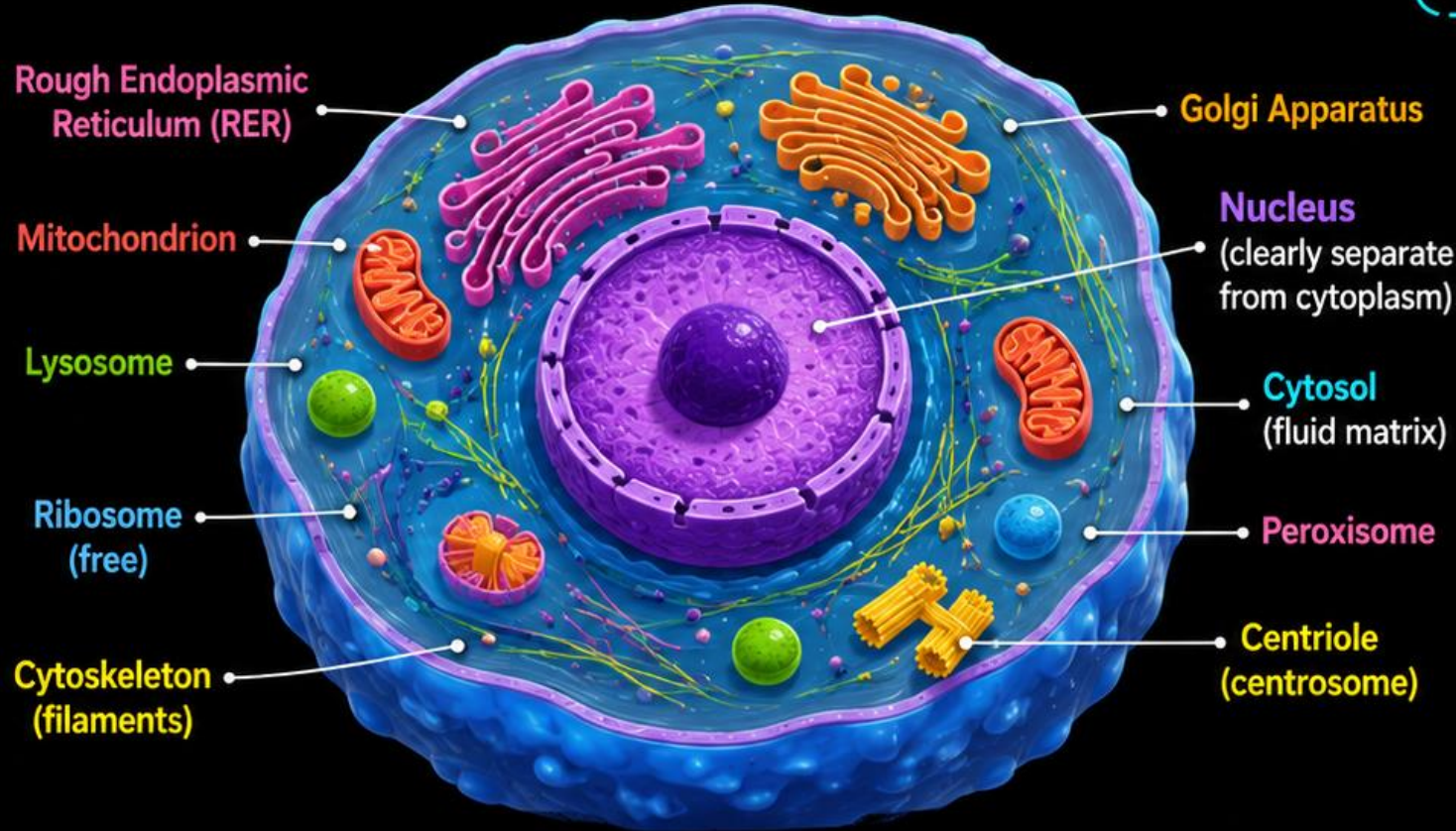
Cytoplasm =
cytosol + organelles
outside nucleus



**Site of many
metabolic
reactions**



Organelles
remain suspended
in cytosol



CYTOPLASM

Region between
plasma membrane
and nucleus



HIGHLIGHT SUMMARY:

Cytoplasm includes **cytosol** and **cell organelles**.

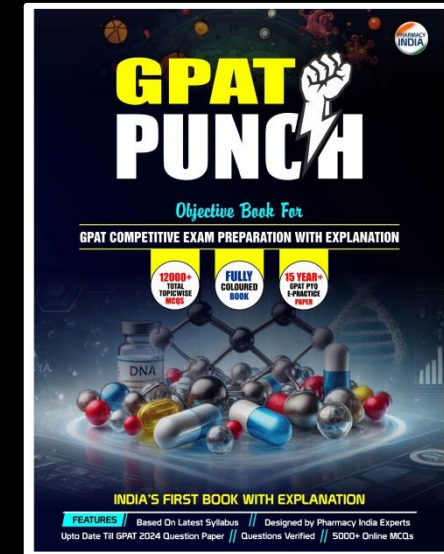


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42.

Which cell structure is responsible for selective permeability?

- (a) Plasma membrane
- (b) Nucleolus
- (c) Ribosome
- (d) Chromosome



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42.

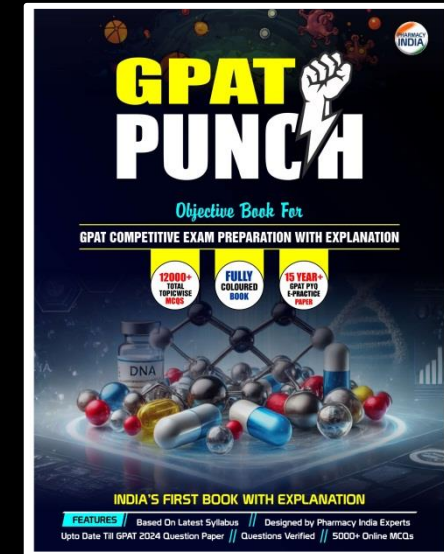
Which cell structure is responsible for selective permeability?

(a) Plasma membrane

(b) Nucleolus

(c) Ribosome

(d) Chromosome



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PLASMA MEMBRANE AND SELECTIVE PERMEABILITY

The plasma membrane regulates what enters and exits the cell.

SMALL NONPOLAR MOLECULES

O₂, CO₂



PHOSPHOLIPID BILAYER

Hydrophilic
heads

Hydrophobic
tails

Hydrophilic
heads

SMALL UNCHARGED MOLECULES

H₂O, UREA



IONS

Na⁺, K⁺, Ca²⁺, Cl⁻



LARGE POLAR MOLECULES

Glucose, Amino acids



LARGE OR CHARGED MOLECULES

Proteins, DNA



DIRECT DIFFUSION

Passes directly through
lipid bilayer

CHANNEL PROTEIN

Forms a pore for specific
ions to pass

CARRIER PROTEIN

Binds and changes shape to
transport specific molecules

BLOCKED

Cannot pass through
the lipid bilayer



Passes easily



Passes (some)



Passes via channel



Passes via carrier



Blocked

KEY POINTS



Plasma membrane is
selectively permeable.



Controls movement of
ions and molecules.



Lipid bilayer blocks
many polar molecules.



Transport proteins help
specific substances cross.

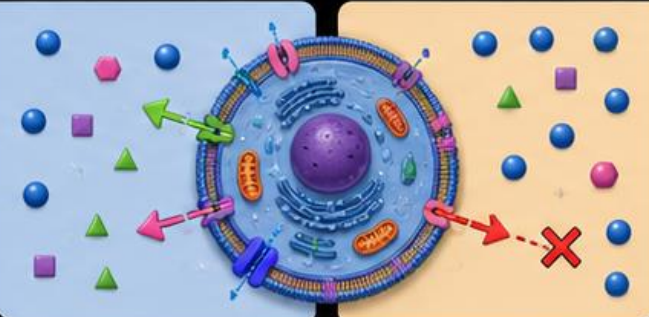


Maintains internal
cellular environment.

INSIDE vs OUTSIDE THE CELL

OUTSIDE OF CELL

INSIDE OF CELL



The plasma membrane allows needed substances in
and keeps unwanted substances out.



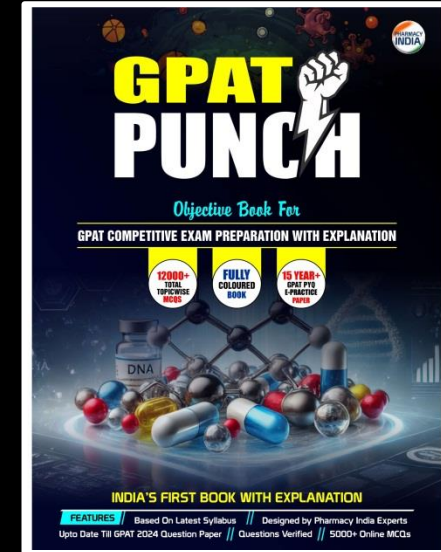
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43.

Which organelle is absent in mature human red blood cells?

- (a) Cell membrane
- (b) Cytoplasm
- (c) Nucleus
- (d) Hemoglobin



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43.

Which organelle is absent in mature human red blood cells?

- (a) Cell membrane
- (b) Cytoplasm
- (c) Nucleus**
- (d) Hemoglobin



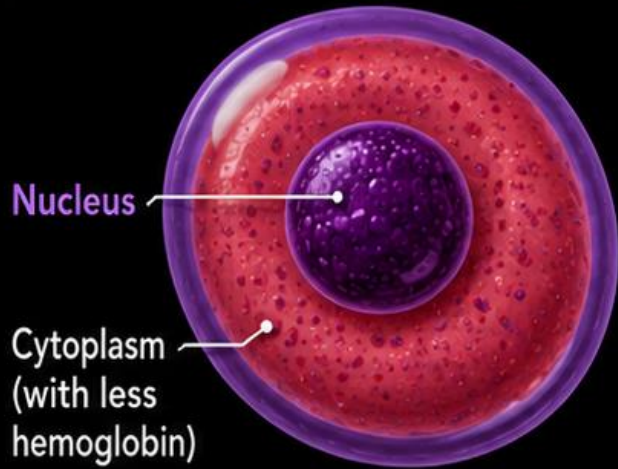
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MATURE HUMAN RBC IS ANUCLEATE

During maturation, the nucleus is lost to maximize **hemoglobin** content and **oxygen transport**.

IMMATURE RBC

(NORMOBLAST)



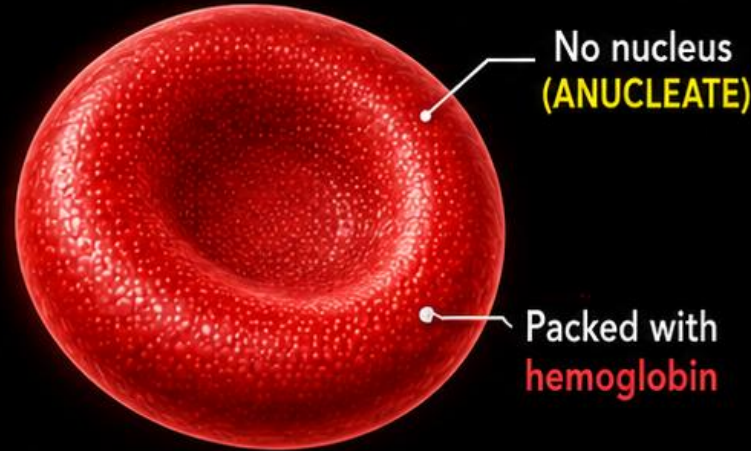
MATURATION



Nucleus is expelled during maturation in the bone marrow

MATURE HUMAN RBC

(ERYTHROCYTE)



Lower hemoglobin space
Less efficient at carrying oxygen



Maximum hemoglobin space
Highly efficient at carrying oxygen



Mature human RBCs **lack a nucleus**



Nucleus is **lost** during maturation



Creates more space for **hemoglobin**



Improves **oxygen-carrying capacity**



Mature RBCs also **lack mitochondria**



MATURE HUMAN RBCs ARE ANUCLEATE.



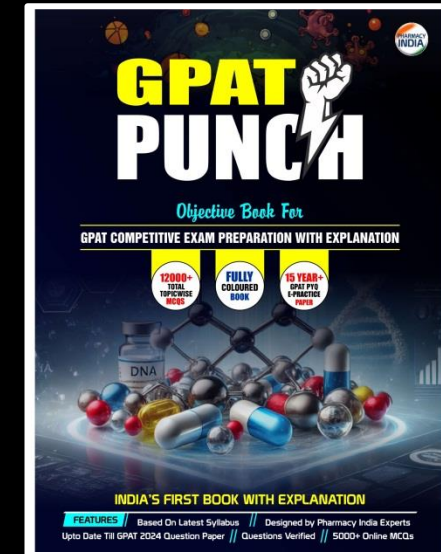
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44.

Which process removes old and damaged cell organelles?

- (a) Autophagy
- (b) Pinocytosis
- (c) Exocytosis
- (d) Osmosis



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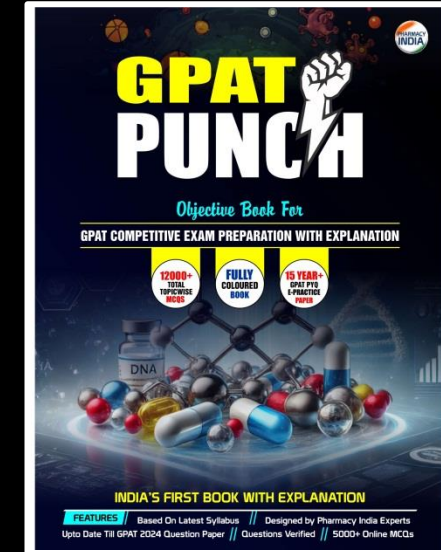
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Which process removes old and damaged cell organelles?

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- (d) Osmosis



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AUTOPHAGY

The cell's recycling and cleanup mechanism

1. DAMAGED COMPONENTS



Old and damaged organelles accumulate in the cell.

2. AUTOPHAGOSOME FORMATION



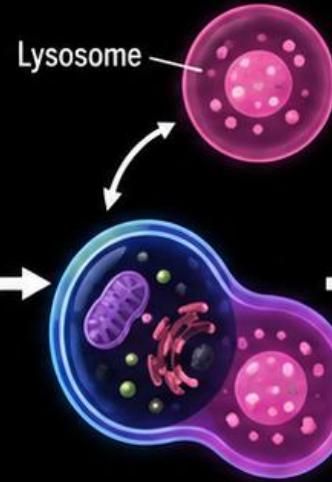
Isolation membrane (phagophore) engulfs the damaged components and forms a double-membrane vesicle called **autophagosome**.

3. AUTOPHAGOSOME



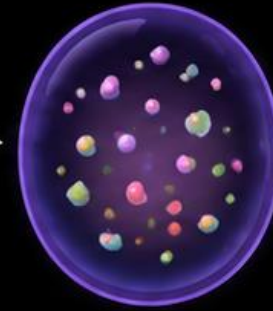
The autophagosome seals off the damaged components.

4. FUSION WITH LYSOSOME



Autophagosome fuses with lysosome to form **autolysosome**.

5. DIGESTION & RECYCLING



Lysosomal enzymes digest the contents. Breakdown products are **recycled and reused** by the cell.

KEY POINTS



Autophagy = **self-eating**



Removes **old and damaged** organelles



Lysosomes **digest** the damaged components



Maintains cellular **health**



Important during **starvation** and **stress**



TAKEAWAY: Autophagy removes damaged organelles.



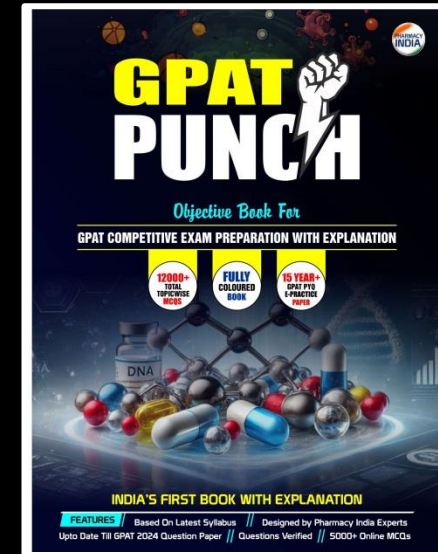
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45.

Which process leads to programmed cell death?

- (a) Apoptosis
- (b) Necrosis
- (c) Osmosis
- (d) Diffusion



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45.

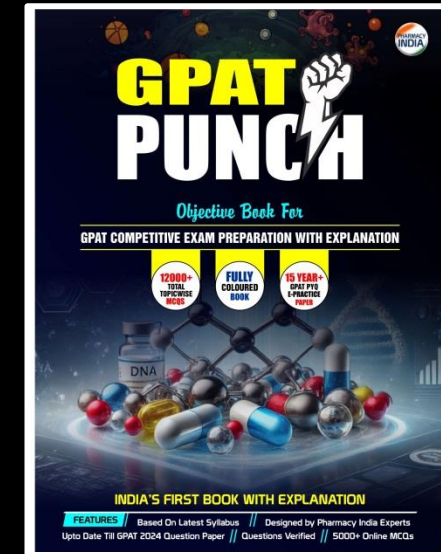
Which process leads to programmed cell death?

(a) Apoptosis

(b) Necrosis

(c) Osmosis

(d) Diffusion



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APOPTOSIS

PROGRAMMED CELL DEATH



Apoptosis =
programmed cell death



Controlled and
energy-dependent



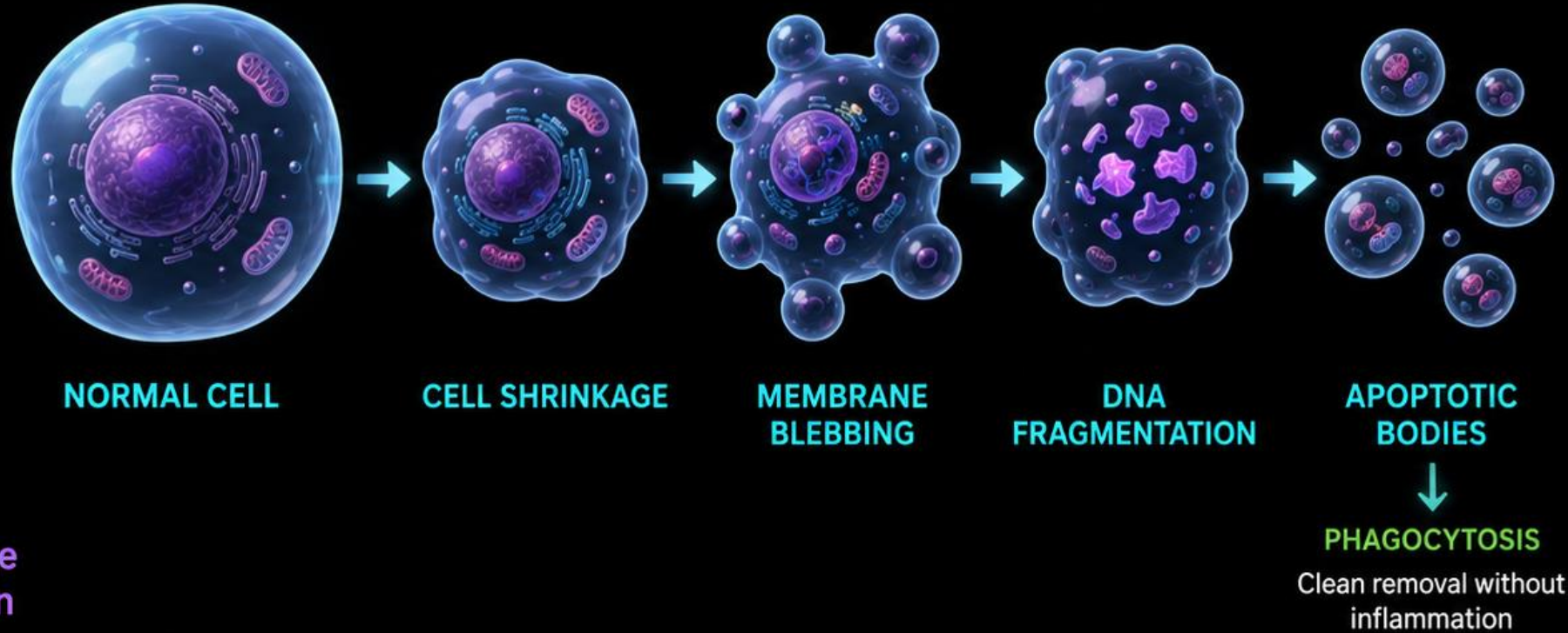
Removes unwanted
or damaged cells



Usually does not
cause inflammation



Features: cell shrinkage
and DNA fragmentation



Apoptosis is **programmed cell death**.

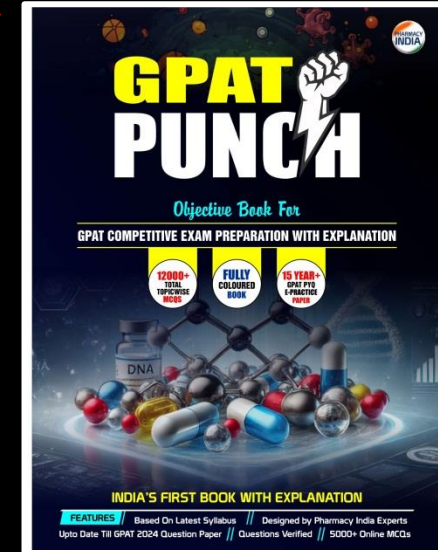


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46.

Which form of cell death is usually associated with inflammation?

- (a) Apoptosis
- (b) Necrosis
- (c) Mitosis
- (d) Pinocytosis



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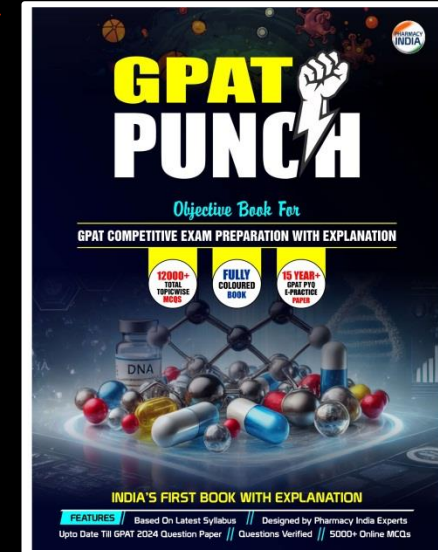


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46.

Which form of cell death is usually associated with inflammation?

- (a) Apoptosis
- (b) Necrosis**
- (c) Mitosis
- (d) Pinocytosis



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NECROSIS

Uncontrolled Cell Death

KEY POINTS



Necrosis =
uncontrolled cell death



Occurs due to injury,
toxins, or ischemia



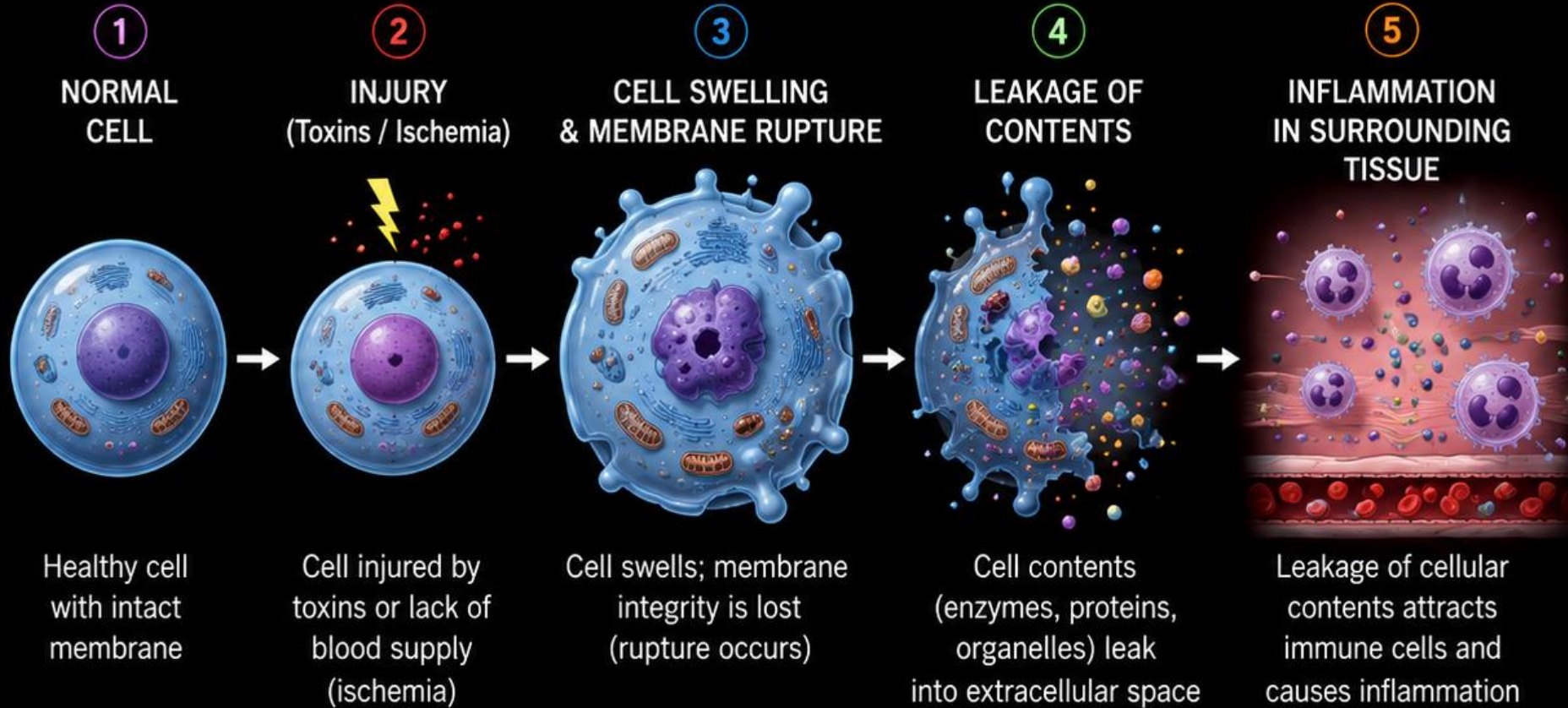
Cell swelling and
membrane rupture occur



Cell contents
leak out



Leakage triggers
inflammation



Necrosis is associated with inflammation.



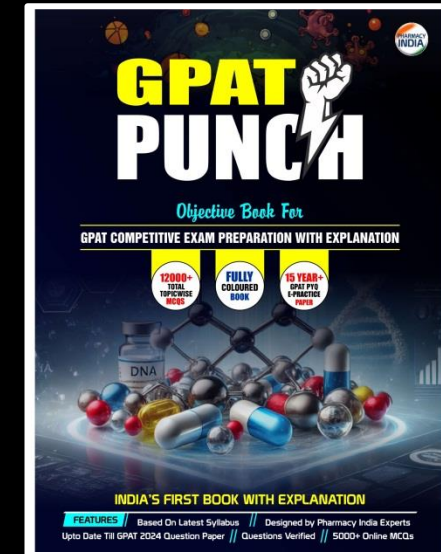
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47.

The movement of molecules from higher concentration to lower concentration is called:

- (a) Diffusion
- (b) Active transport
- (c) Phagocytosis
- (d) Exocytosis



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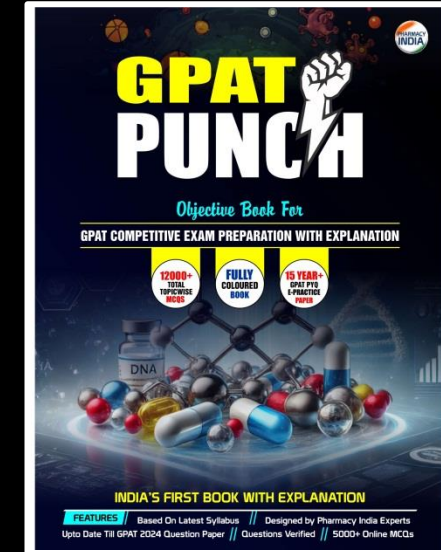
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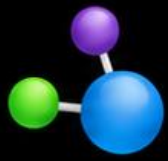
47.

The movement of molecules from higher concentration to lower concentration is called:

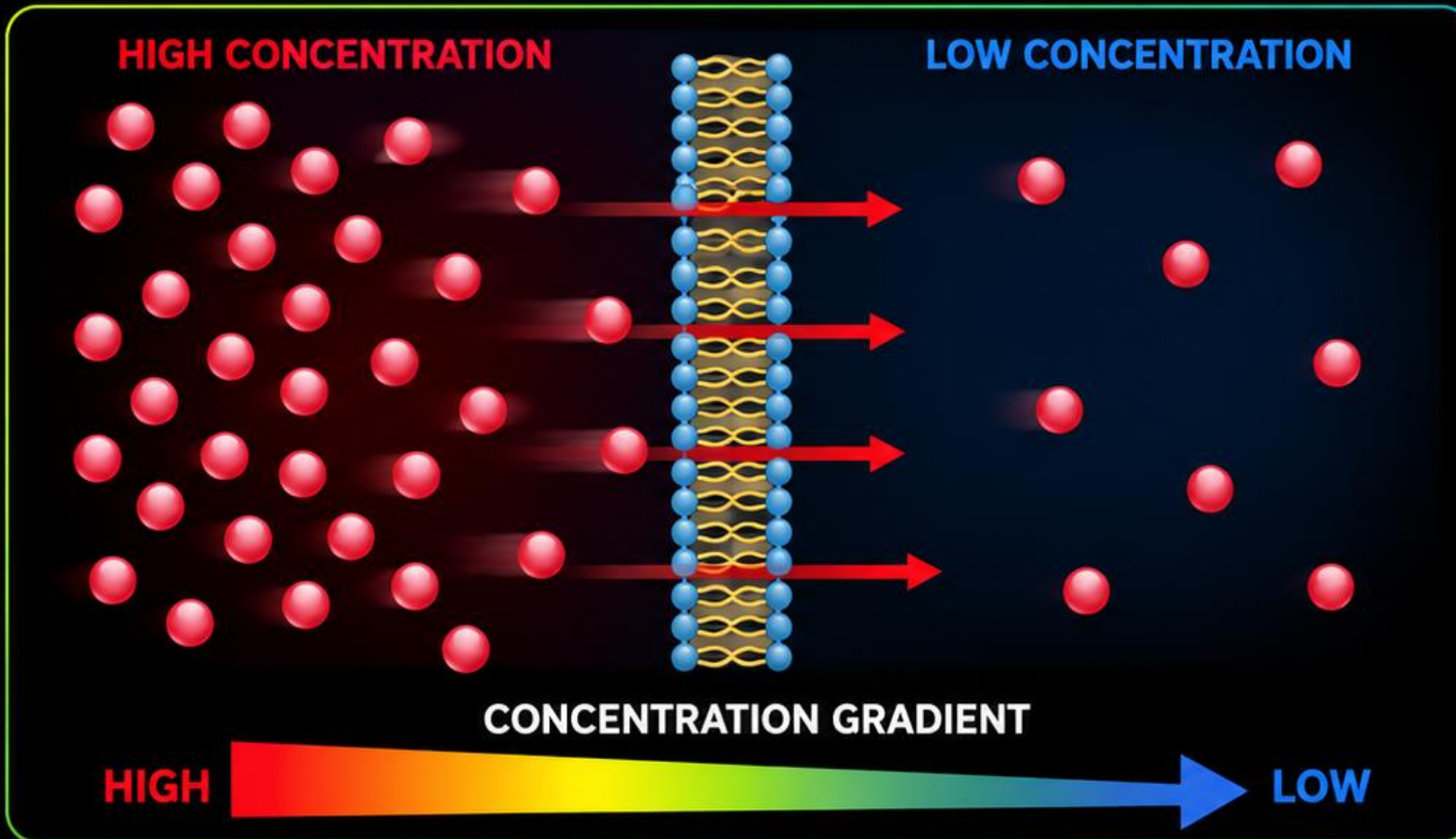
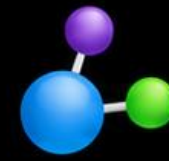
- (a) Diffusion
- (b) Active transport
- (c) Phagocytosis
- (d) Exocytosis



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DIFFUSION



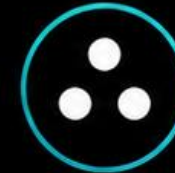
Passive movement
of molecules



Moves from high to
low concentration



No ATP required



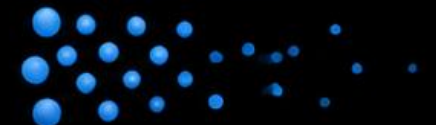
Small non-polar
molecules diffuse easily



Continues until
equilibrium is reached



Diffusion = movement down the **concentration gradient**.



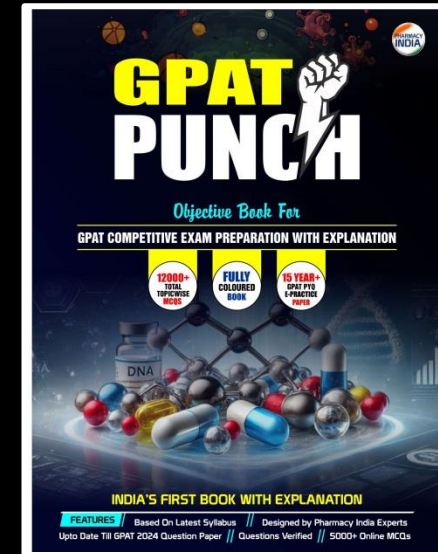


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48.

Which transport mechanism requires ATP directly?

- (a) Simple diffusion
- (b) Osmosis
- (c) Active transport
- (d) Facilitated diffusion



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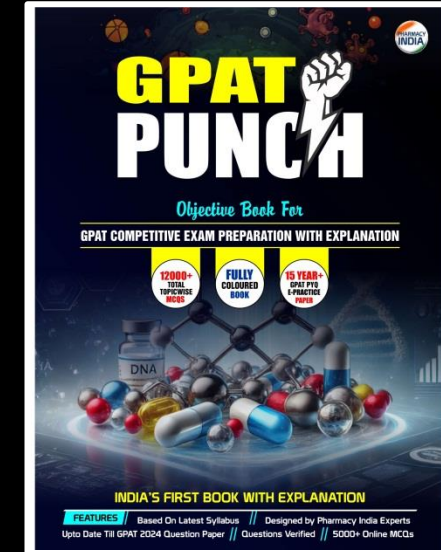
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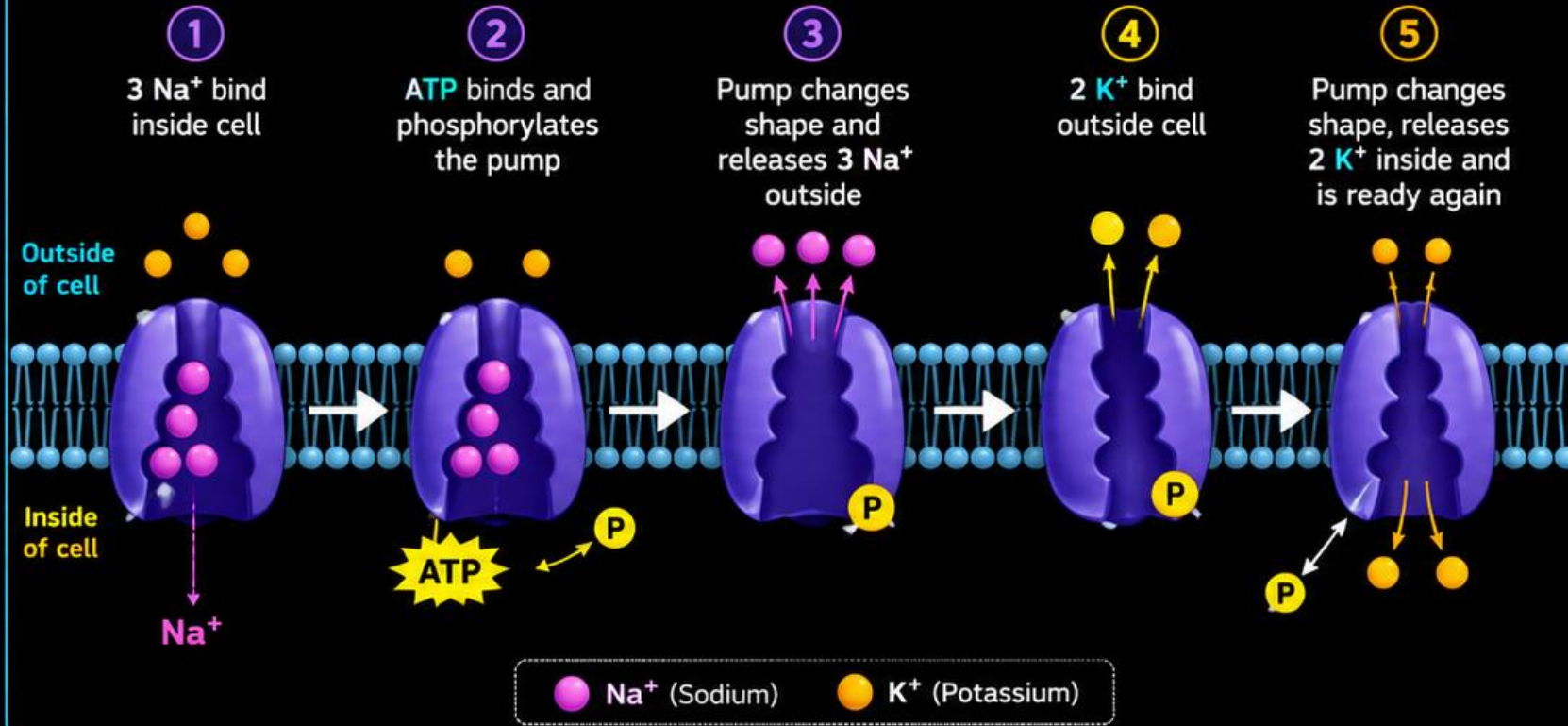


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ACTIVE TRANSPORT

Movement of substances across the cell membrane
AGAINST the concentration gradient using energy (ATP)

SODIUM-POTASSIUM PUMP (Na^+/K^+ -ATPase)



KEY POINTS



Moves substances **against** concentration gradient



Requires **ATP** directly



Uses **carrier** or **pump** proteins



Maintains **ionic gradients** across membrane



Example:
sodium-potassium pump



Active transport requires **ATP**.



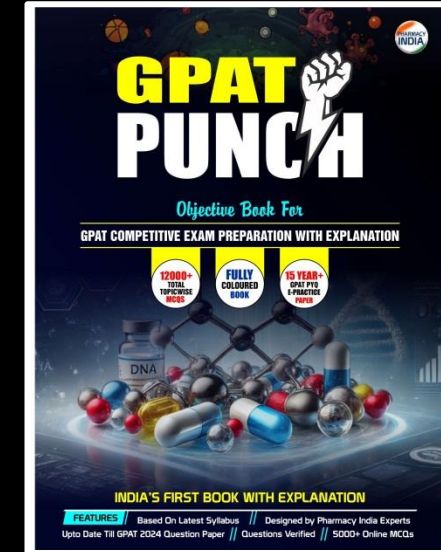
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49.

Which organelle synthesizes ATP by oxidative phosphorylation?

- (a) Mitochondria
- (b) Ribosome
- (c) Lysosome
- (d) Golgi apparatus



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49.

Which organelle synthesizes ATP by oxidative phosphorylation?

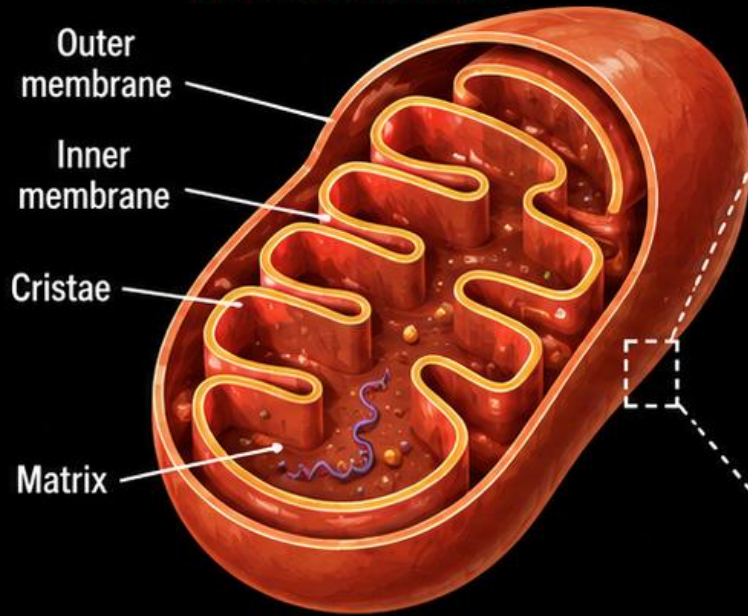
- (a) Mitochondria
- (b) Ribosome
- (c) Lysosome
- (d) Golgi apparatus



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MITOCHONDRIA AND OXIDATIVE PHOSPHORYLATION

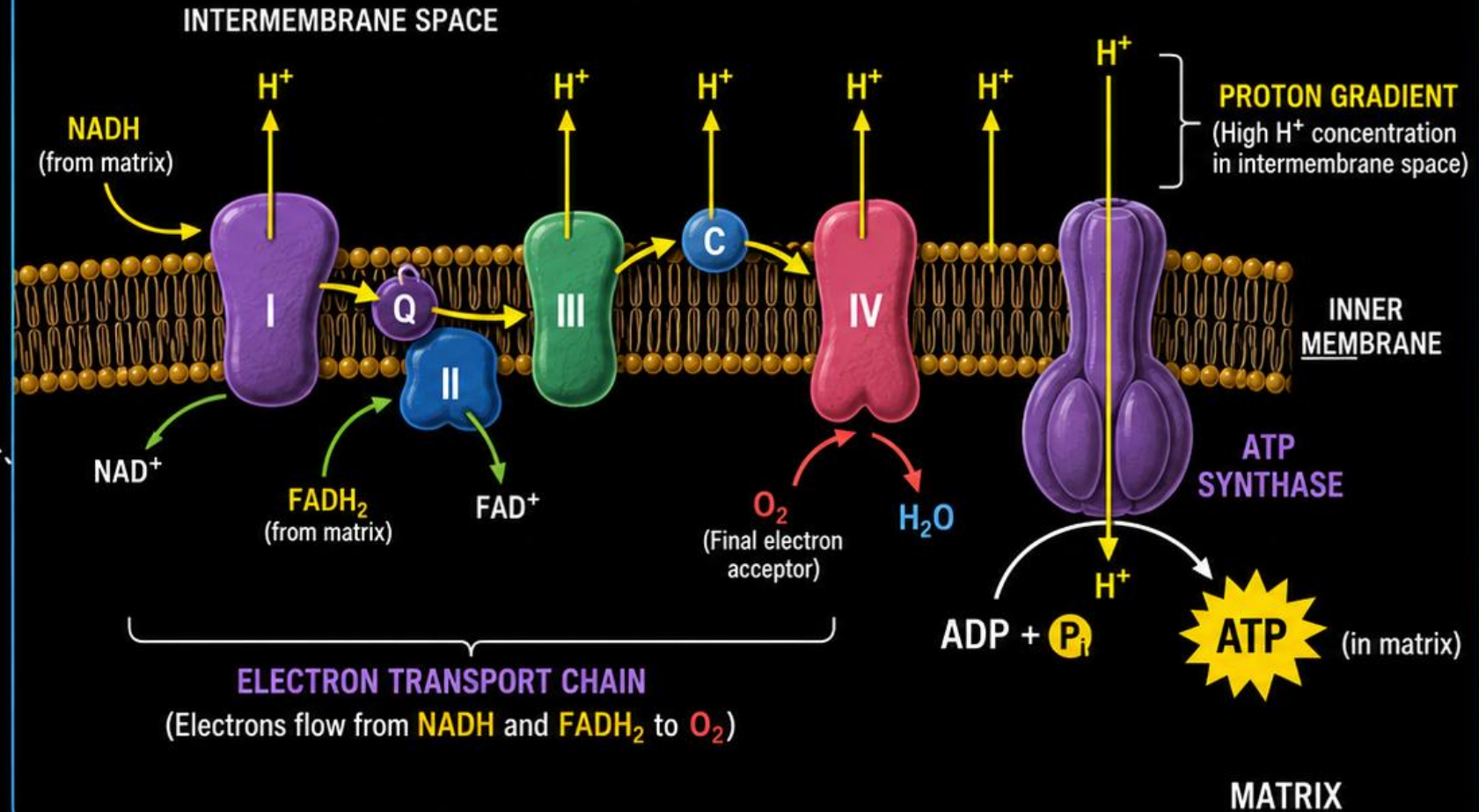
MITOCHONDRION



KEY POINTS

-  Oxidative phosphorylation occurs in mitochondria.
-  Occurs on the inner mitochondrial membrane.
-  Electron transport chain creates proton gradient.
-  ATP synthase forms ATP.
-  Oxygen is the final electron acceptor.

OXIDATIVE PHOSPHORYLATION OCCURS ON THE INNER MITOCHONDRIAL MEMBRANE



Mitochondria synthesize **ATP** by **oxidative phosphorylation**.





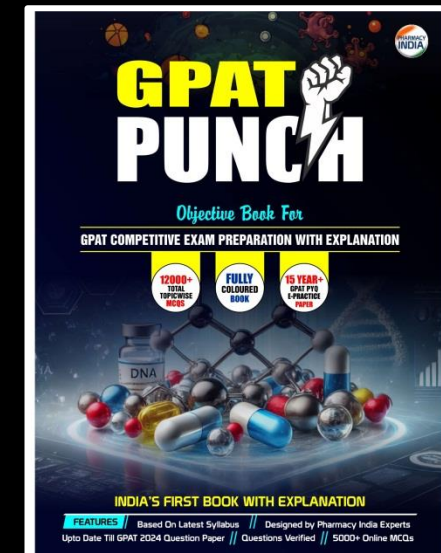
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50.

Which of the following correctly matches the organelle with its function?

- (a) Ribosome — Protein synthesis
- (b) Mitochondria — Intracellular digestion
- (c) Lysosome — Lipid synthesis
- (d) Golgi apparatus — DNA replication



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50.

Which of the following correctly matches the organelle with its function?

- (a) Ribosome — Protein synthesis**
- (b) Mitochondria — Intracellular digestion**
- (c) Lysosome — Lipid synthesis**
- (d) Golgi apparatus — DNA replication**



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RIBOSOME – PROTEIN SYNTHESIS

• The Cell's Protein Factory •



KEY POINTS



Ribosomes are the site of **protein synthesis**.



Translate **mRNA** into **polypeptide chains**.

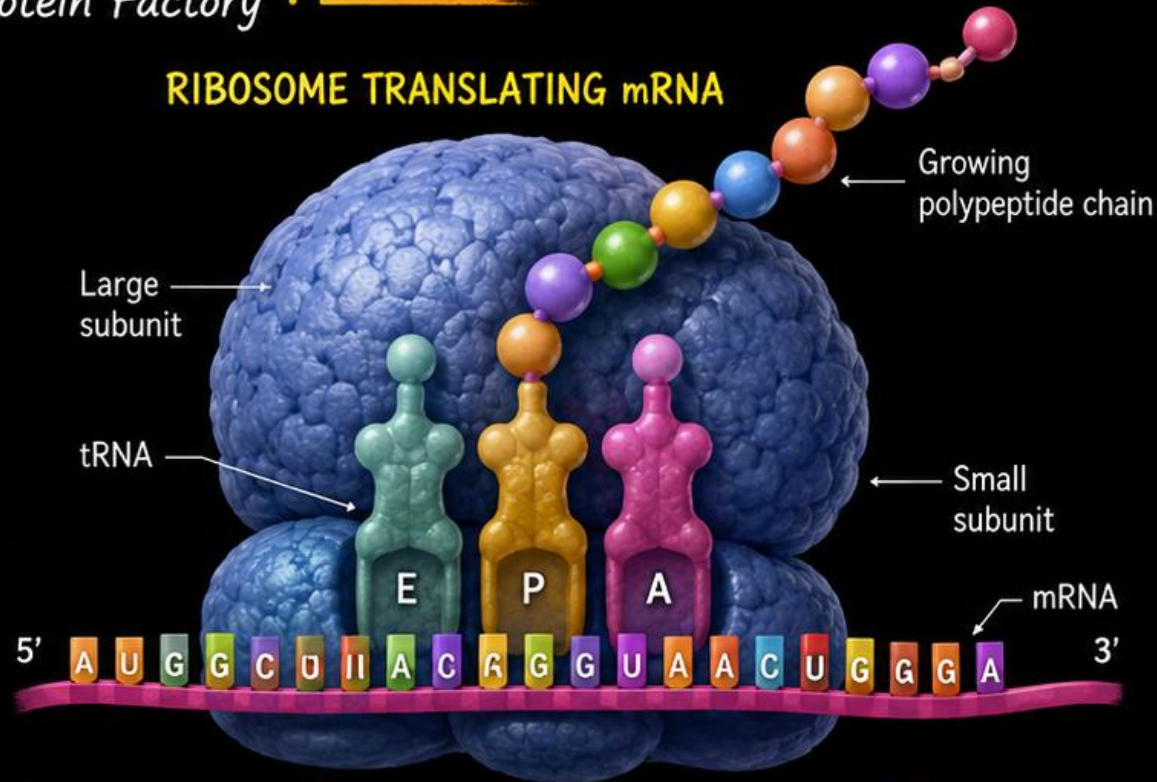


Free ribosomes make **cytoplasmic proteins**.



Bound ribosomes make **secretory and membrane proteins**.

RIBOSOME TRANSLATING mRNA



1

mRNA binds to the small subunit.

2

tRNA matches codons in A, P, E sites.

3

Peptide bond forms and the chain elongates.

4

Ribosome moves along mRNA (5' → 3').

ORGANELLES – FUNCTIONS



MITOCHONDRIA

→ ATP production



LYSOSOME

→ Intracellular digestion



SMOOTH ER

→ Lipid synthesis



RIBOSOME

→ Protein synthesis



CORRECT MATCH: **RIBOSOME** — **PROTEIN SYNTHESIS**.



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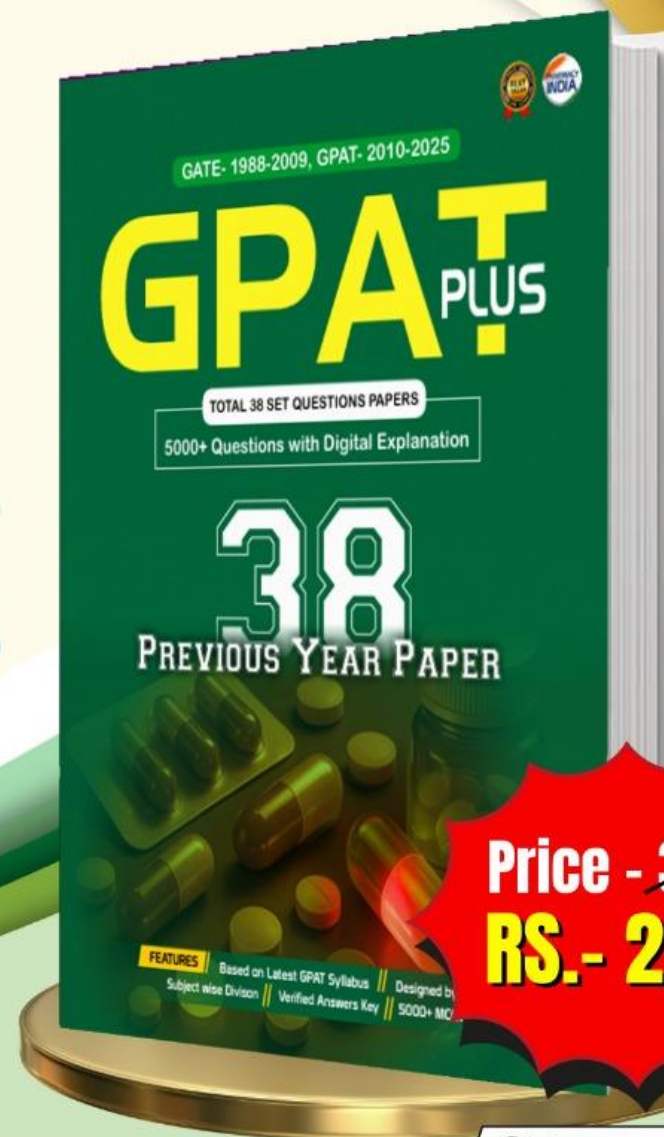
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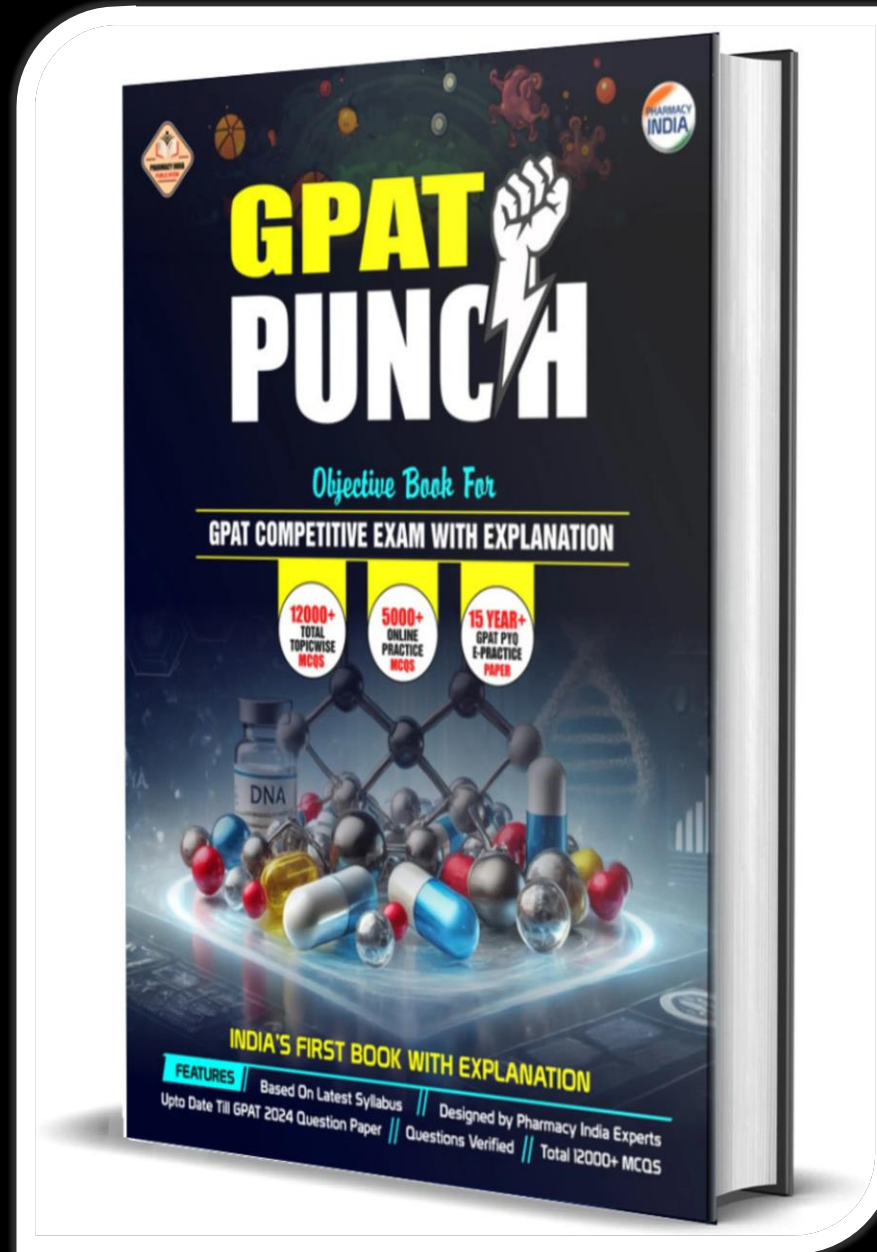


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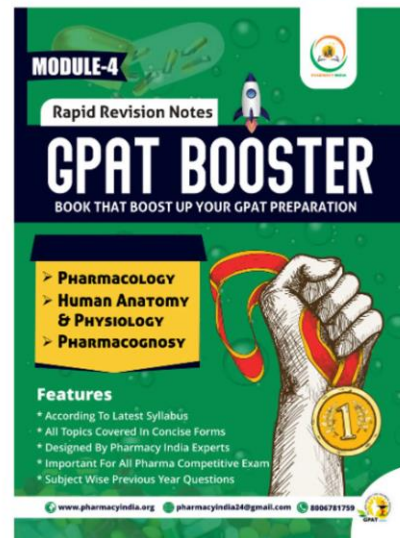
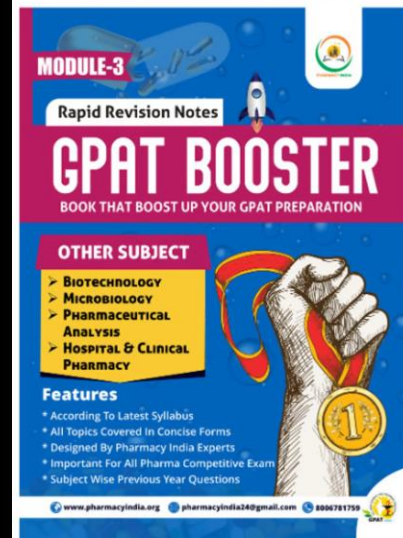
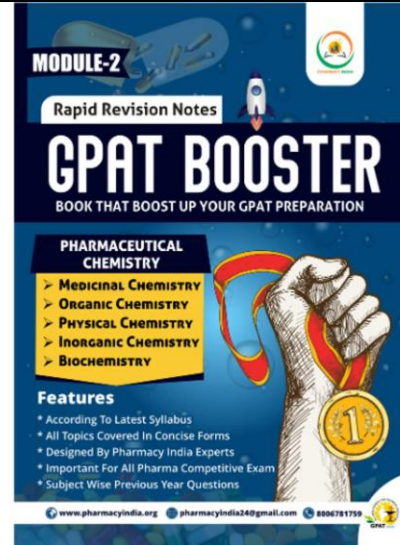
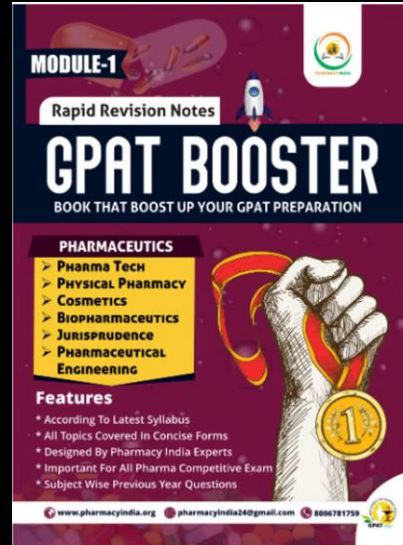
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