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UMM AL-QURA UNIVERSITY

General Biology

Lectures (1 & 2): The Cell

College of Applied Sciences
Biology Department

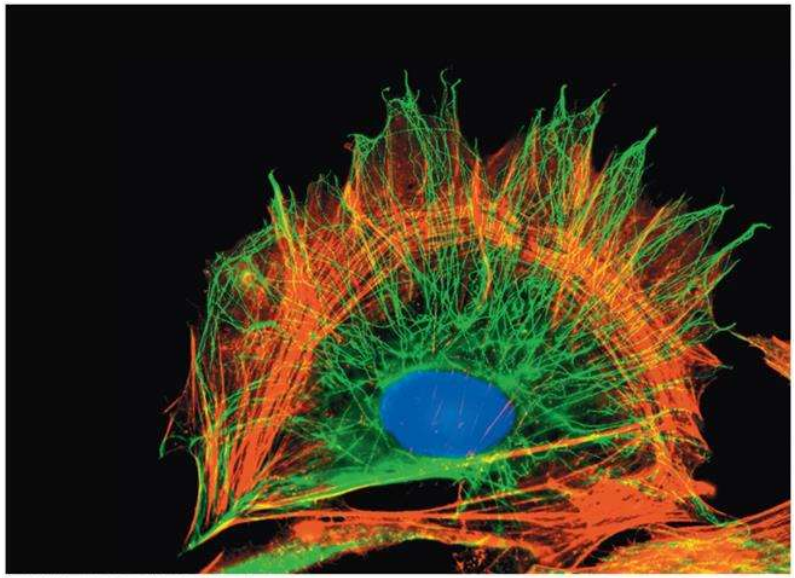
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1. A Tour of the cell

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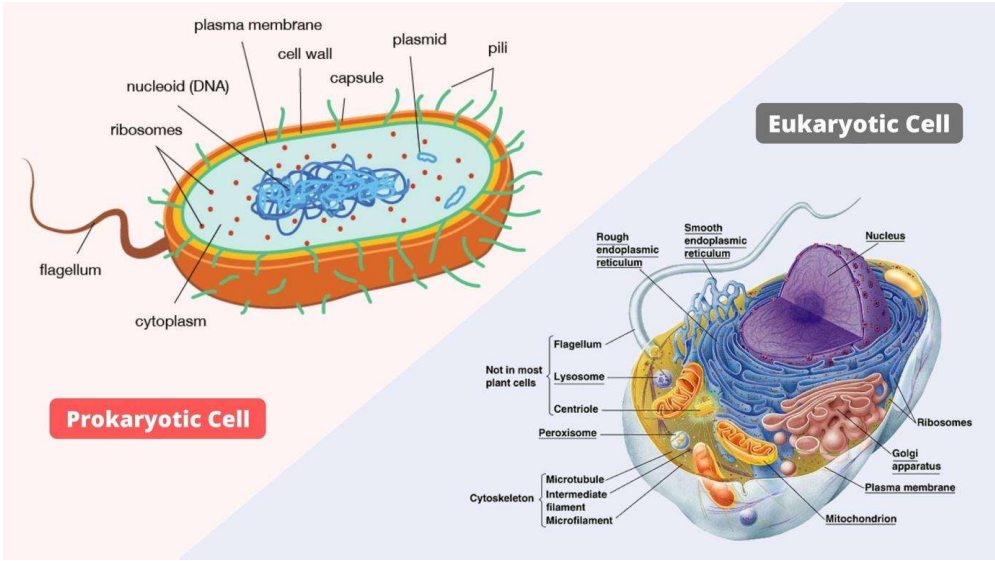
Overview: The Fundamental Units of Life

- All organisms are made of cells.
- The cell is the simplest collection of matter that can live.
- All cells are related by their descent from earlier cells.

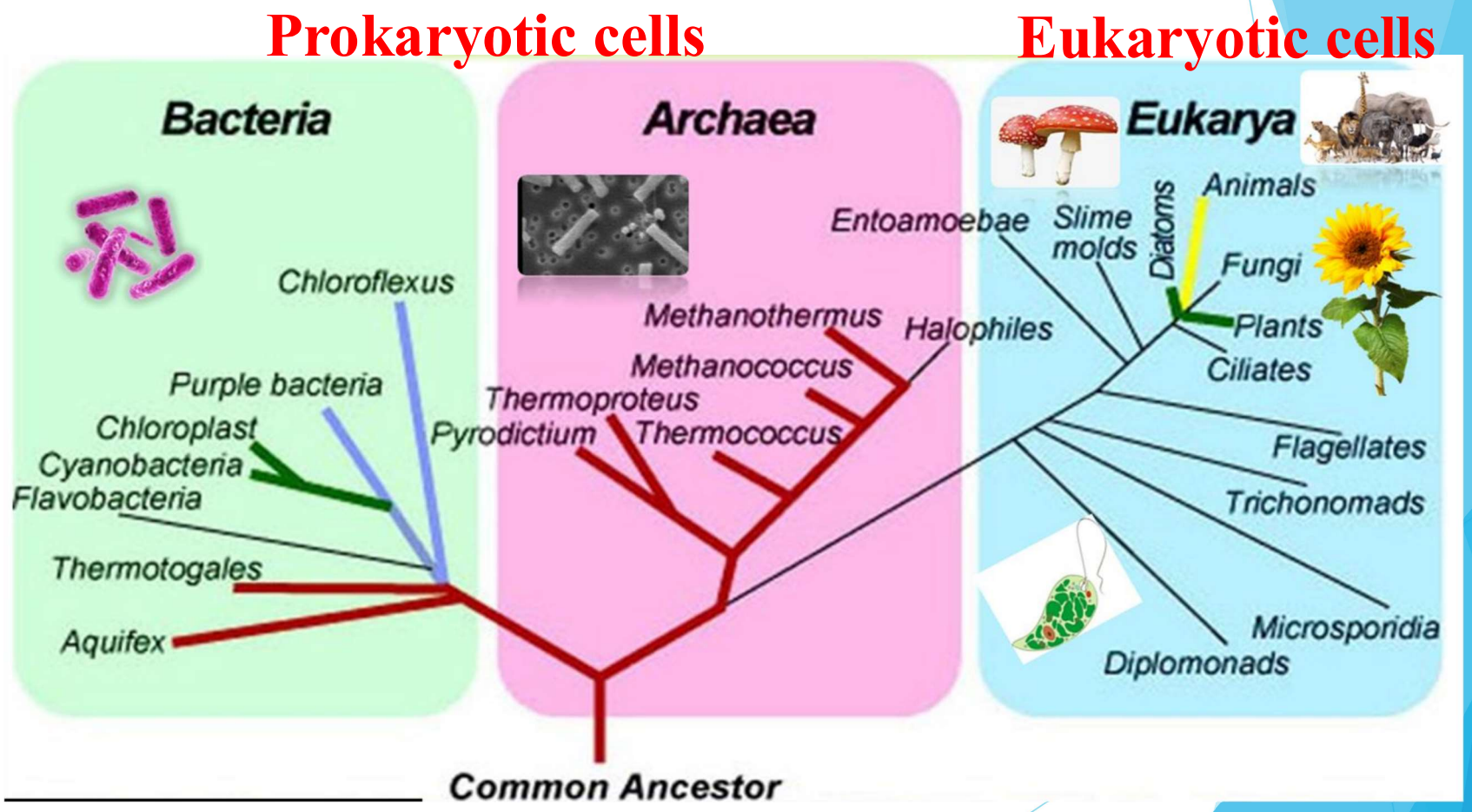

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Prokaryotic and Eukaryotic Cells

- The basic structural and functional unit of every organism is one of two types of cells: **prokaryotic** or **eukaryotic.**
- Only organisms of the domains Bacteria and Archaea consist of **prokaryotic cells**.
- Protists, fungi, animals, and plants all consist of **eukaryotic cells**.

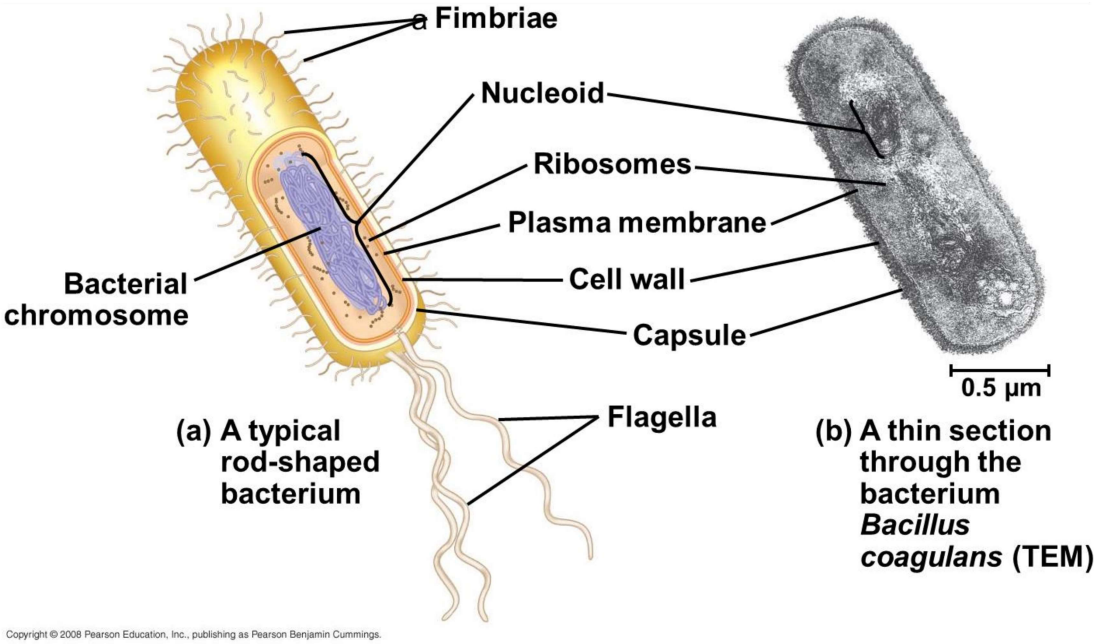


Three Domains of Life



Prokaryotic Cells

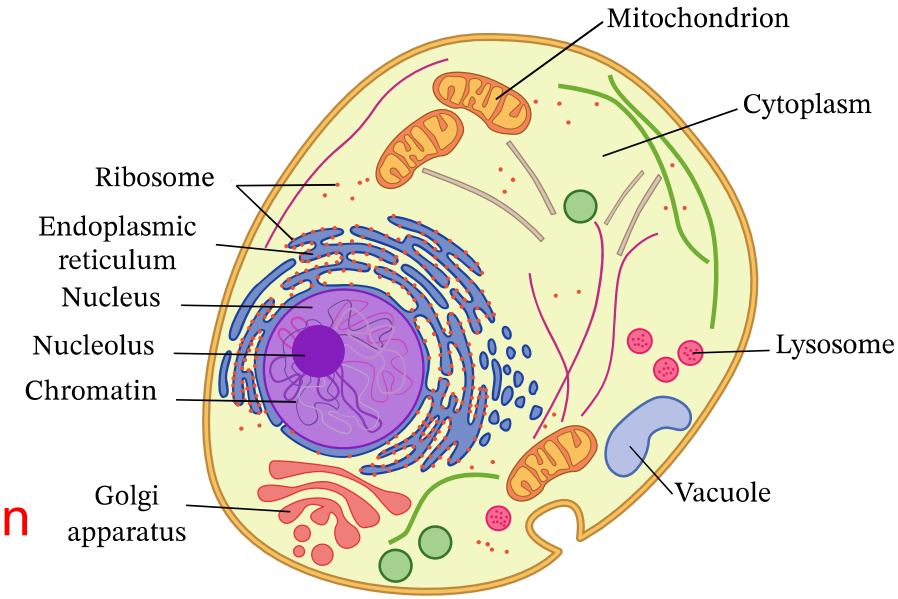
- **Prokaryotic cells** are characterized by having
  - No nucleus.
  - DNA in an unbound region called the **nucleoid**.
  - No membrane-bound organelles.
  - **Cytoplasm** bound by the plasma membrane.



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Eukaryotic Cells

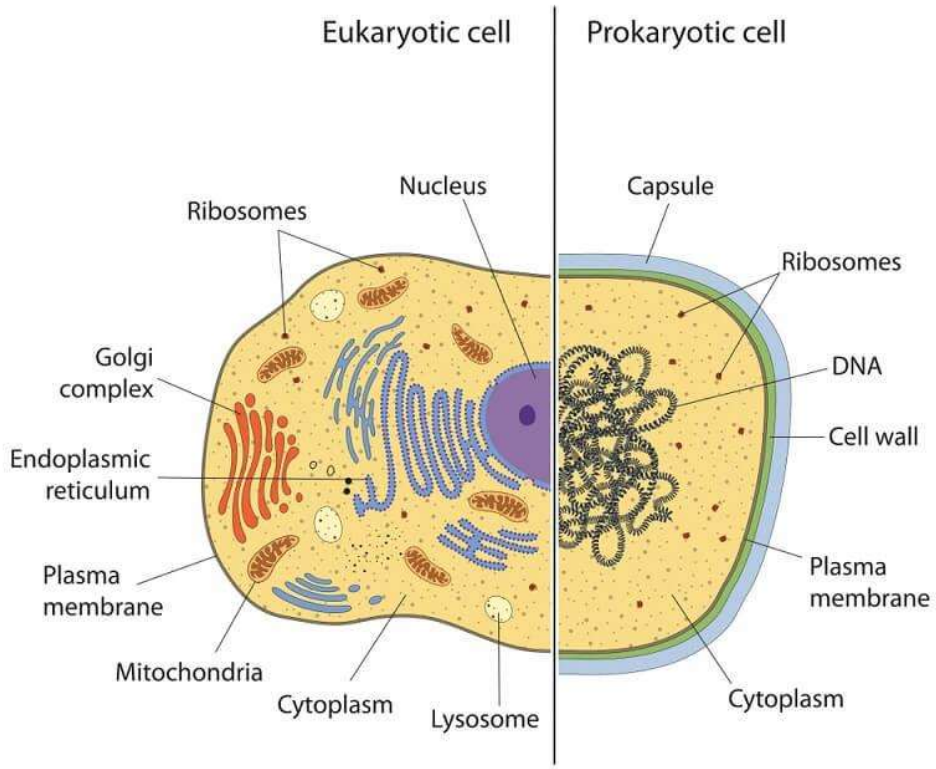
- **Eukaryotic cells** are characterized by having
  - DNA in a nucleus that is bounded by a membranous nuclear envelope.
  - Membrane-bound organelles.
  - Cytoplasm in the region between the plasma membrane and nucleus.
- Eukaryotic cells are generally much larger than prokaryotic cells.



Comparing Prokaryotic and Eukaryotic Cells

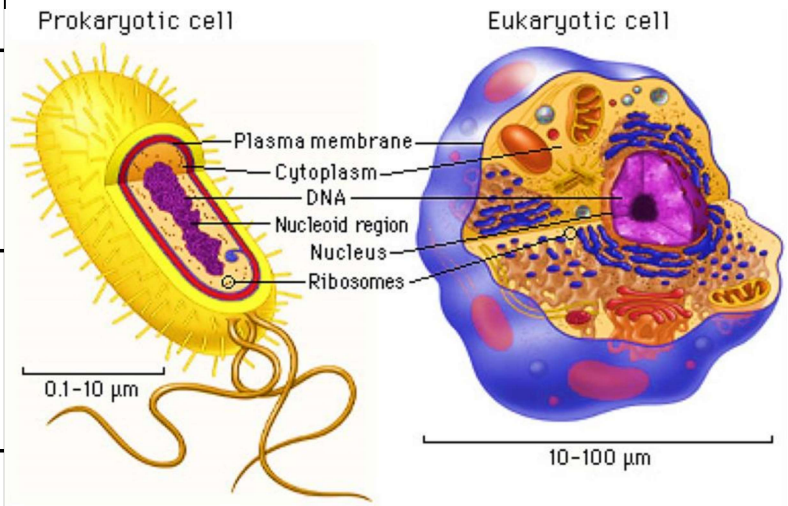
Common features between prokaryotic and eukaryotic cells of:

- Plasma membrane.
- Semifluid substance called cytoplasm (**cytosol**).
- Chromosomes (carry genes).
- Ribosomes (make proteins).



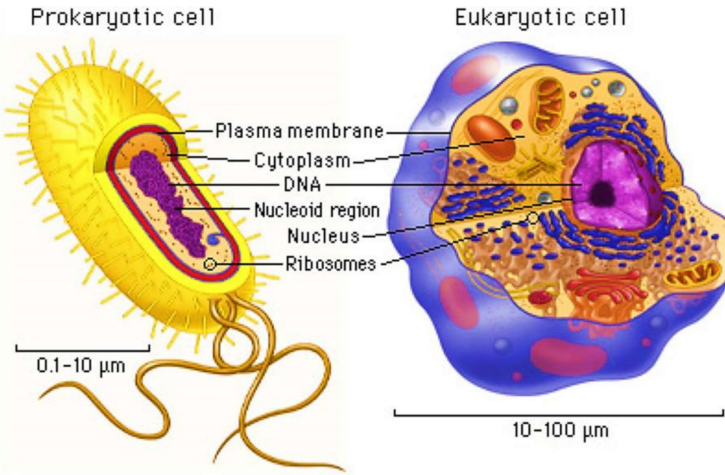
Eukaryotic VS Prokaryotic cells

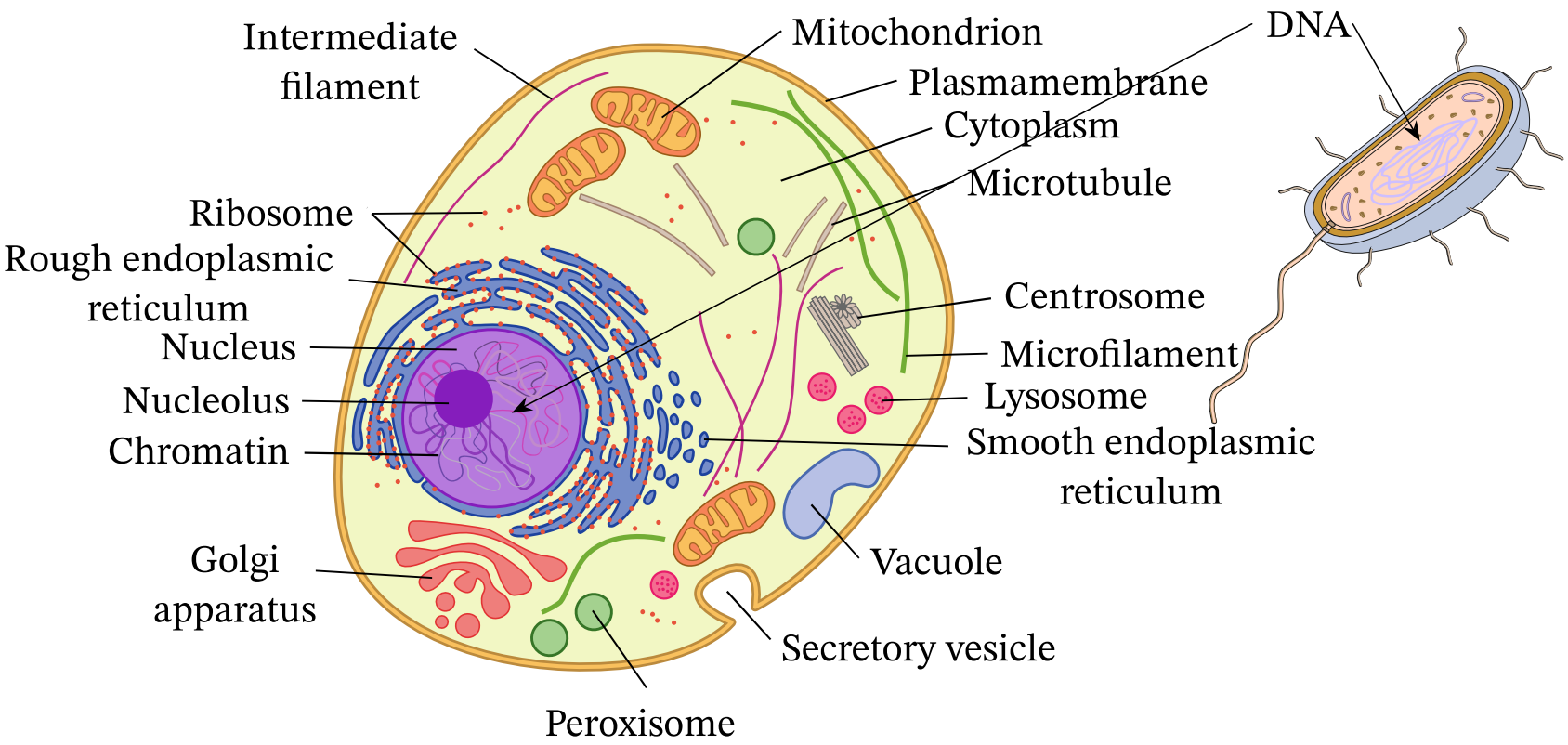
Prokaryotic Cells	Eukaryotic Cells
Nuclear region (nucleoid) is not enveloped by a nuclear membrane.	Nucleus is surrounded by a double membrane layer.
Single chromosome present.	More than one chromosome are present.
Nucleolus is absent.	Nucleolus is present.
Membrane bound organelles are absent.	Membrane bound organelles are present.



Eukaryotic VS Prokaryotic cells

Prokaryotic Cells	Eukaryotic Cells
Multiplication of cell is by fission or budding.	Cell division by mitosis or meiosis.
Cell Walls present, which are chemically complex.	Cell walls seen in only plant cells, which are chemically simpler.
Cell type is usually unicellular.	Usually multicellular cells.
Cell size is 1-10µm	Cell size 10 - 100µm.
Example: Bacteria, archaea	Example: animal cells and plant cells.

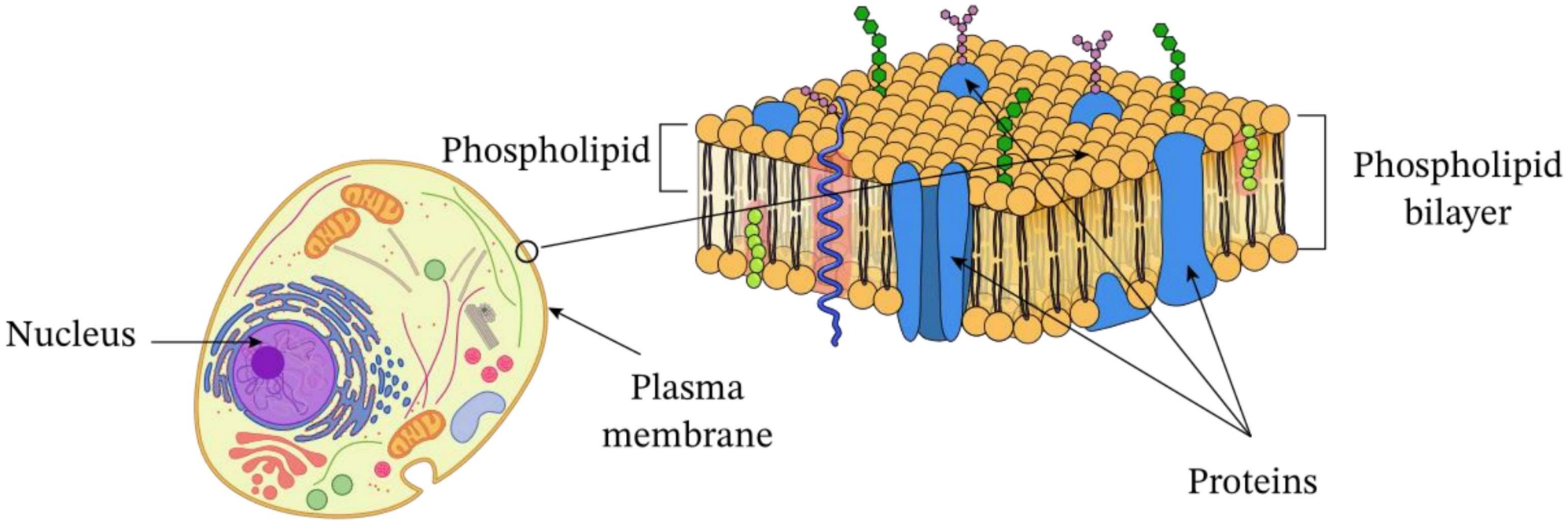



Intermediate filament
Mitochondrion
DNA
Plasmamembrane
Cytoplasm
Microtubule
Ribosome
Rough endoplasmic reticulum
Centrosome
Nucleus
Microfilament
Nucleolus
Lysosome
Chromatin
Smooth endoplasmic reticulum
Golgi apparatus
Vacuole
Secretory vesicle
Peroxisome
Eukaryotic Cell
Prokaryotic Cell

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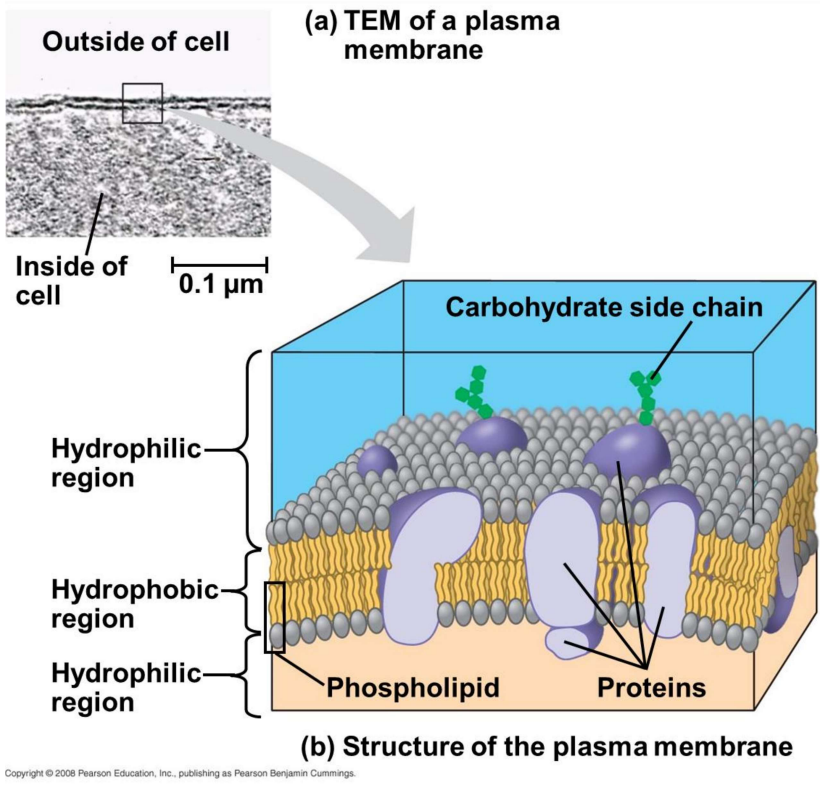
2. Membrane Structure and Function

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Phospholipid
Phospholipid bilayer
Nucleus
Plasma membrane
Proteins

Plasma Membrane

- A eukaryotic cell has internal membranes that partition the cell into organelles.
- Plant and animal cells have most of the same organelles.
- The plasma membrane is the boundary that separates the living cell from its surroundings.
- Also called **Cell membrane** is a **selective barrier** that allows sufficient passage of oxygen, nutrients, and waste to service the volume of every cell.
- Plasma membrane is made of a double layer of phospholipids.

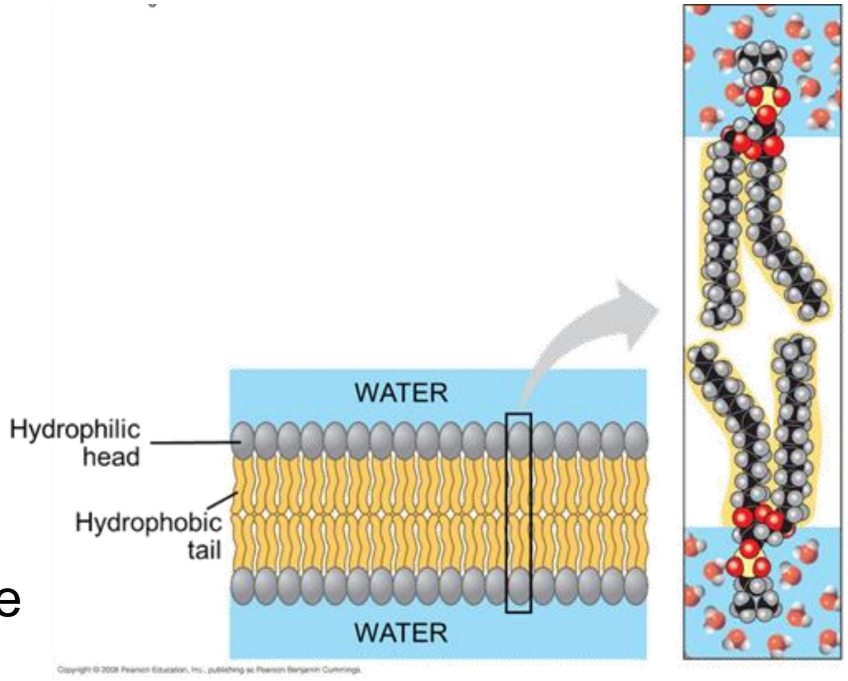


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Membrane Structure and Function

➢ Cell Membrane structure:

- Phospholipids are the most abundant lipid in the plasma membrane.
- Membranes have been chemically analyzed and found to be made of proteins and lipids.
- Phospholipids are **amphipathic molecules**, containing hydrophobic and hydrophilic regions.
- The **fluid mosaic model** states that a membrane is a fluid structure with a "mosaic" of various proteins embedded in it.



Membrane Structure and Function

Cell Membrane Functions:

- The main function of plasma membrane is that it acts as a physical barrier between the external environment and the inner cell organelles.
- Is a selectively permeable membrane.
- Osmosis.
- The plasma membrane also functions by facilitating the communication and signaling between the cells.

The Nucleus: Information Central

- The **nucleus** contains most of the cell's genes.
- The **nuclear envelope** encloses the nucleus, separating it from the cytoplasm.
- The **nuclear membrane** is a double membrane; each membrane consists of a lipid bilayer, and it contains **pores.**
- **Pores** regulate the entry and exit of molecules from the nucleus.
- In the nucleus, DNA and proteins form genetic material called **chromatin.**
- The **nucleolus** is located within the nucleus and is the site of ribosomal RNA (rRNA) synthesis.

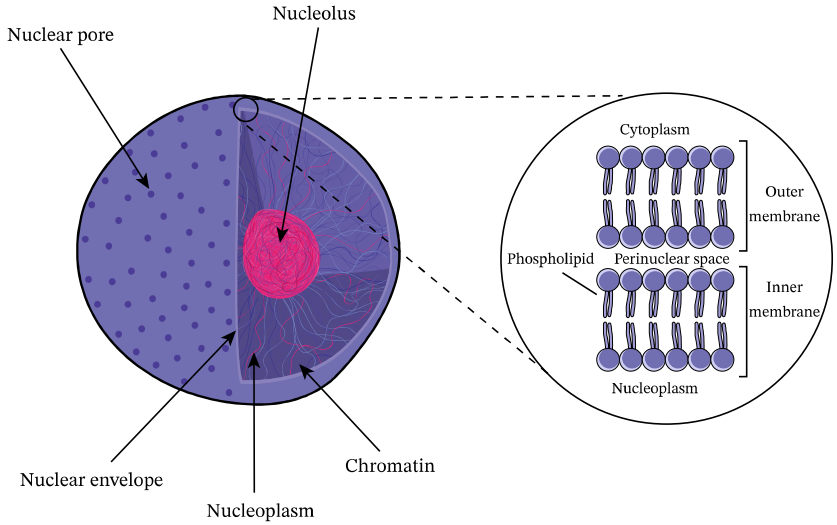
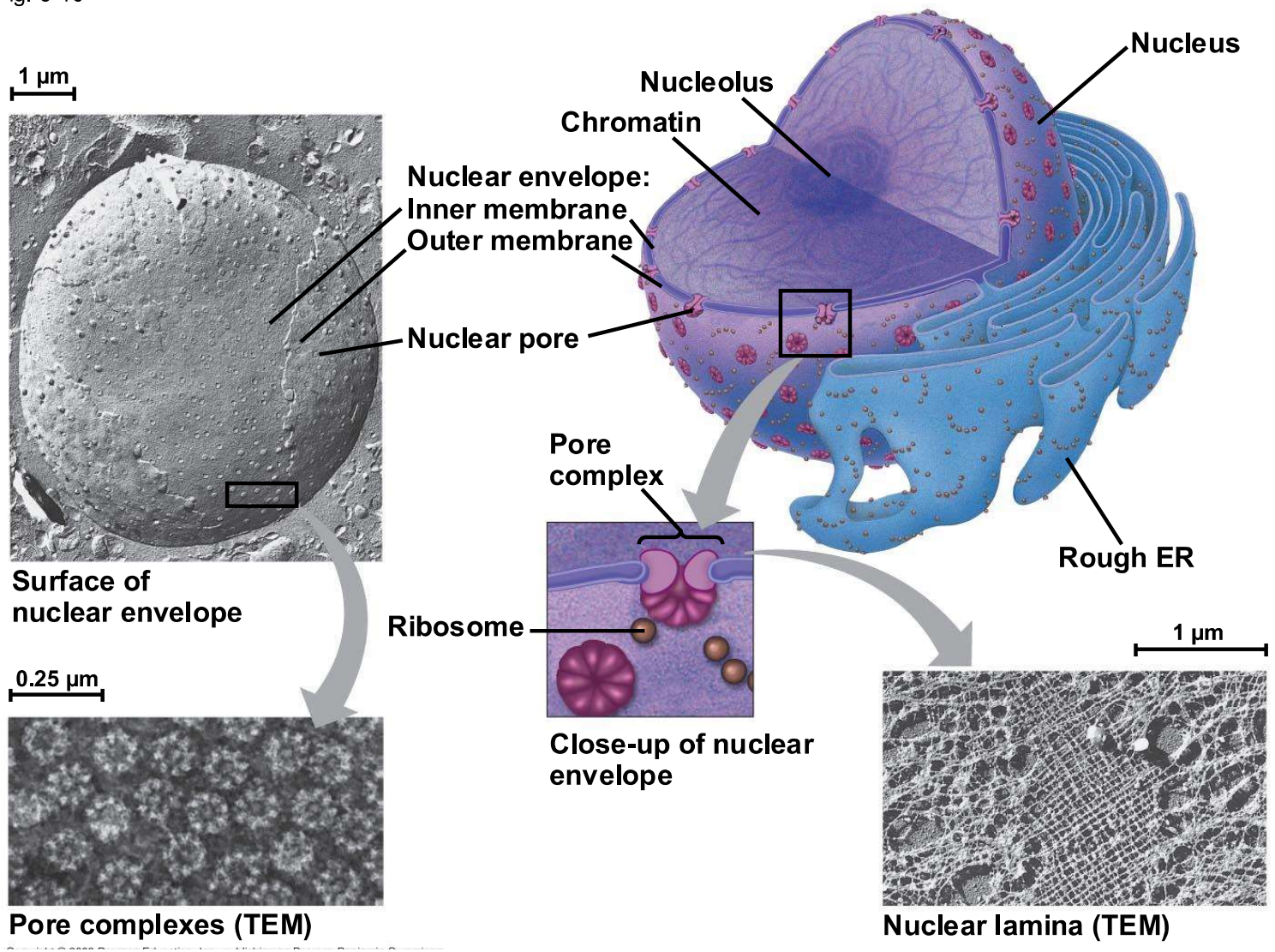
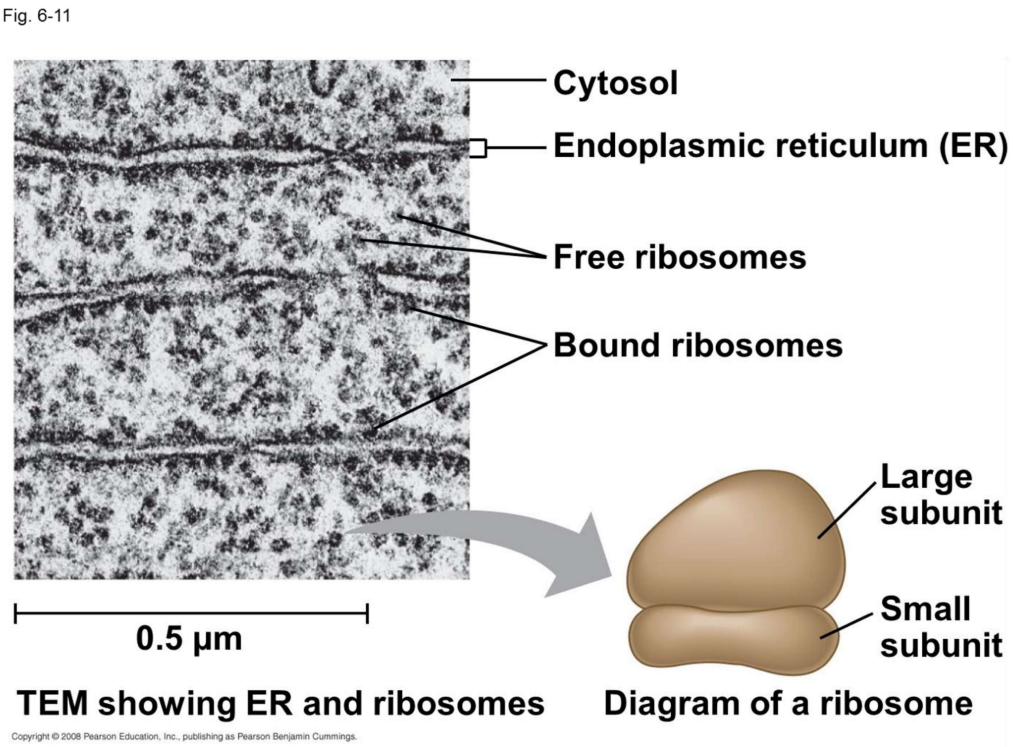


Fig. 6-10


1 µm
Nucleus
Nucleolus
Chromatin
Nuclear envelope:
Inner membrane
Outer membrane
Nuclear pore
Pore complex
Rough ER
Surface of nuclear envelope
Ribosome
1 µm
0.25 µm
Close-up of nuclear envelope
Pore complexes (TEM)
Nuclear lamina (TEM)

Ribosomes: Protein Factories

- **Ribosomes** are particles made of ribosomal RNA and protein.
- Ribosomes carry out protein synthesis in two locations:
  - In the **cytosol** (free ribosomes)
  - On the outside of the **endoplasmic reticulum** or the **nuclear envelope** (bound ribosomes)

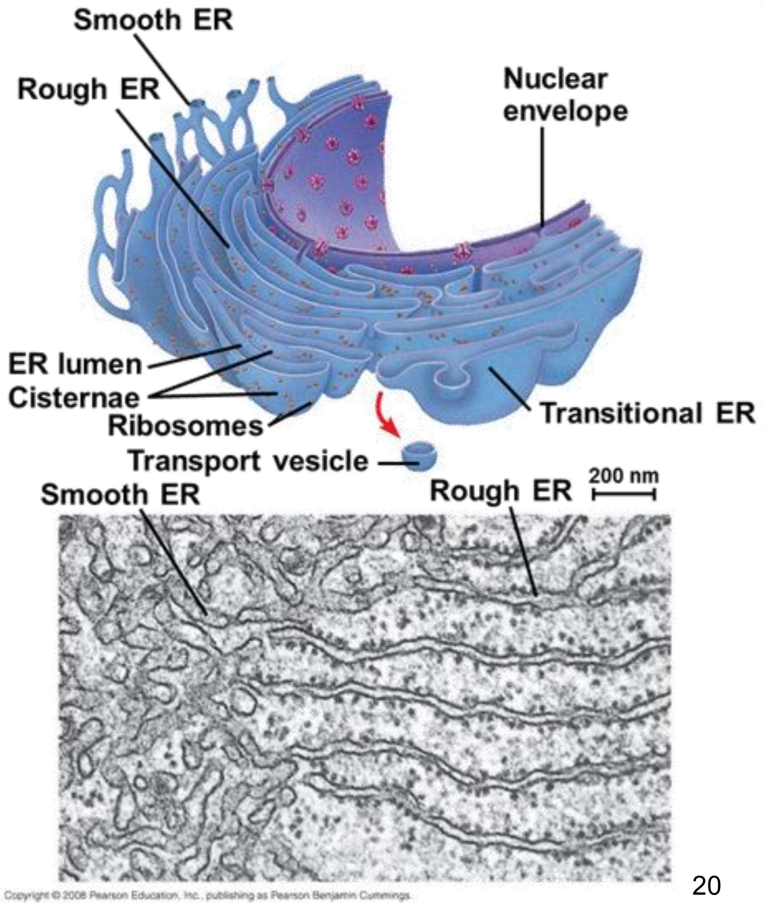


The Endoplasmic Reticulum: Biosynthetic Factory

- The **endoplasmic reticulum (ER)** accounts for more than half of the total membrane in many eukaryotic cells.
- The ER membrane is continuous with the nuclear envelope.

- There are two distinct regions of ER:

  - **Smooth ER**, which lacks ribosomes.
  - **Rough ER**, with ribosomes studding its surface.



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