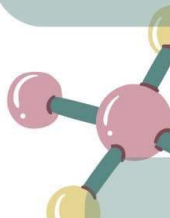
تَنوير

BIOLOGY

Lec no : 5

File Title : Chapter 7

Done By : AlMiqdad Nwihi



وَقُل رَّبِّ زِدْنِي عِلْمًا

Overview: The Fundamental Units of Life

- All organisms are made of cells
- The cell is the simplest collection of matter that can be alive
- Cell structure is correlated to cellular function
- All cells are related by their descent from earlier cells

The scientist who discovered the cell
Is Robert Hooke

Figure 6.1

Concept 6.1: Biologists use microscopes and the tools of biochemistry to study cells

- Though usually too small to be seen by the unaided eye, cells can be complex

معقد

العين المجردة

Microscopy

- Scientists use microscopes to visualize cells too small to see with the naked eye
- In a **light microscope (LM)**, visible light is passed through a specimen and then through glass lenses
- Lenses refract (bend) the light, so that the image is magnified

- Three important parameters of microscopy
  - *Magnification*, the ratio of an object's image size to its real size
  - *Resolution*, the measure of the clarity of the image, or the minimum distance of two distinguishable points
  - *Contrast*, visible differences in parts of the sample

جهاز المجهر
Microscope: A device that is used for تكبير **magnification** | عملية النظر بالمجهر **Microscopy:** is the process of using the microscope to see something (معلومة اضافية غير منهجية)

Kinds of microscopes

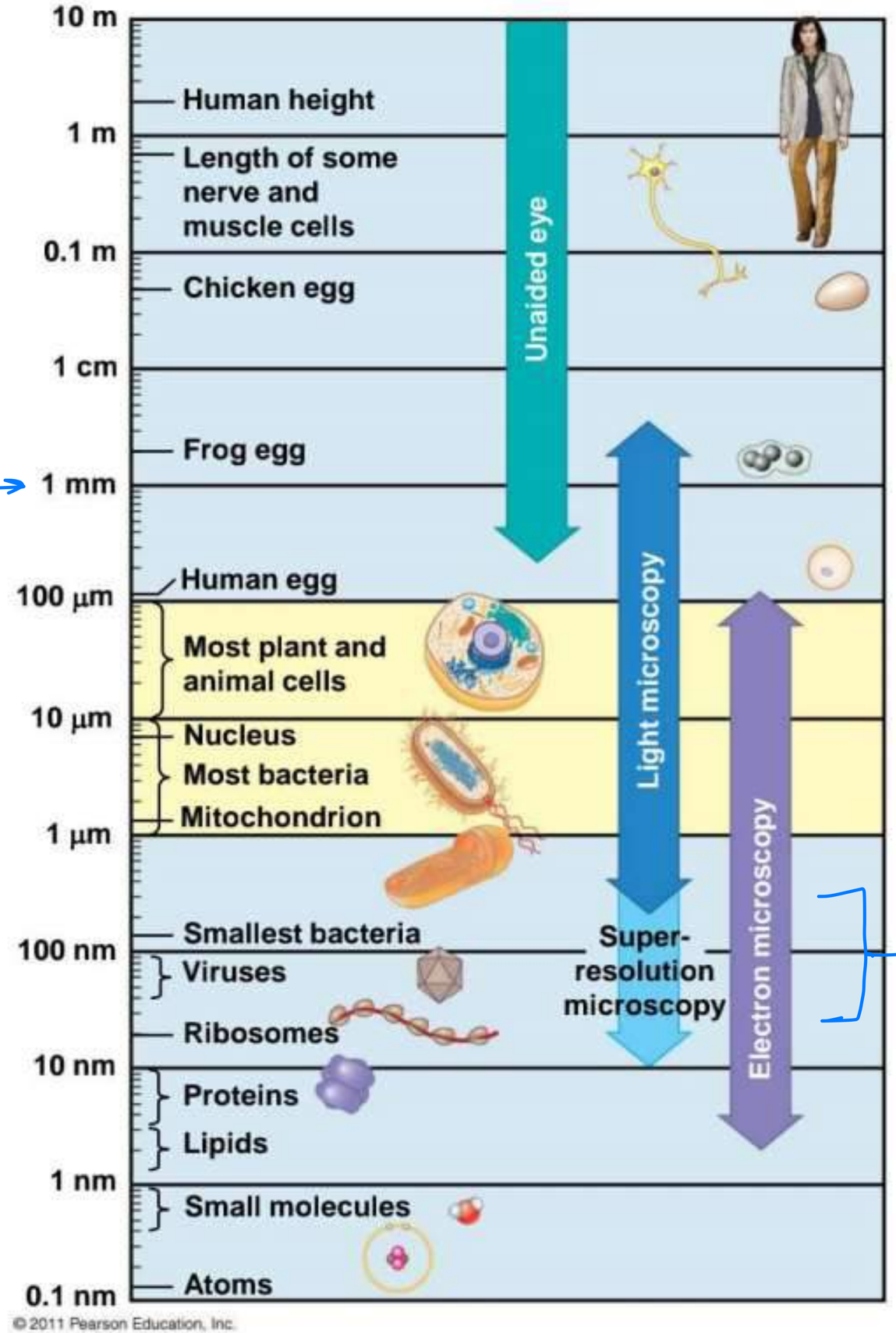
	Light microscopes	Electron microscopes
مصدر الضوء source of light	normal light	Electron beams
العدسات lenses	glass lenses	electromagnetic lenses
الحد الأقصى للتكبير maximum Zoom	1000 X	1 million X

Examples
- Scanning electron microscope (SEM) 3D-image
- Transmission electron microscope (TEM) 2D-image

The three parameters of microscopy:
1) magnification التكبير
2) Resolution الجودة/الوضوح
3) Contrast التباين

Figure 6.2

need a light microscope →



electron microscope →

SEM

Figure 6.2a

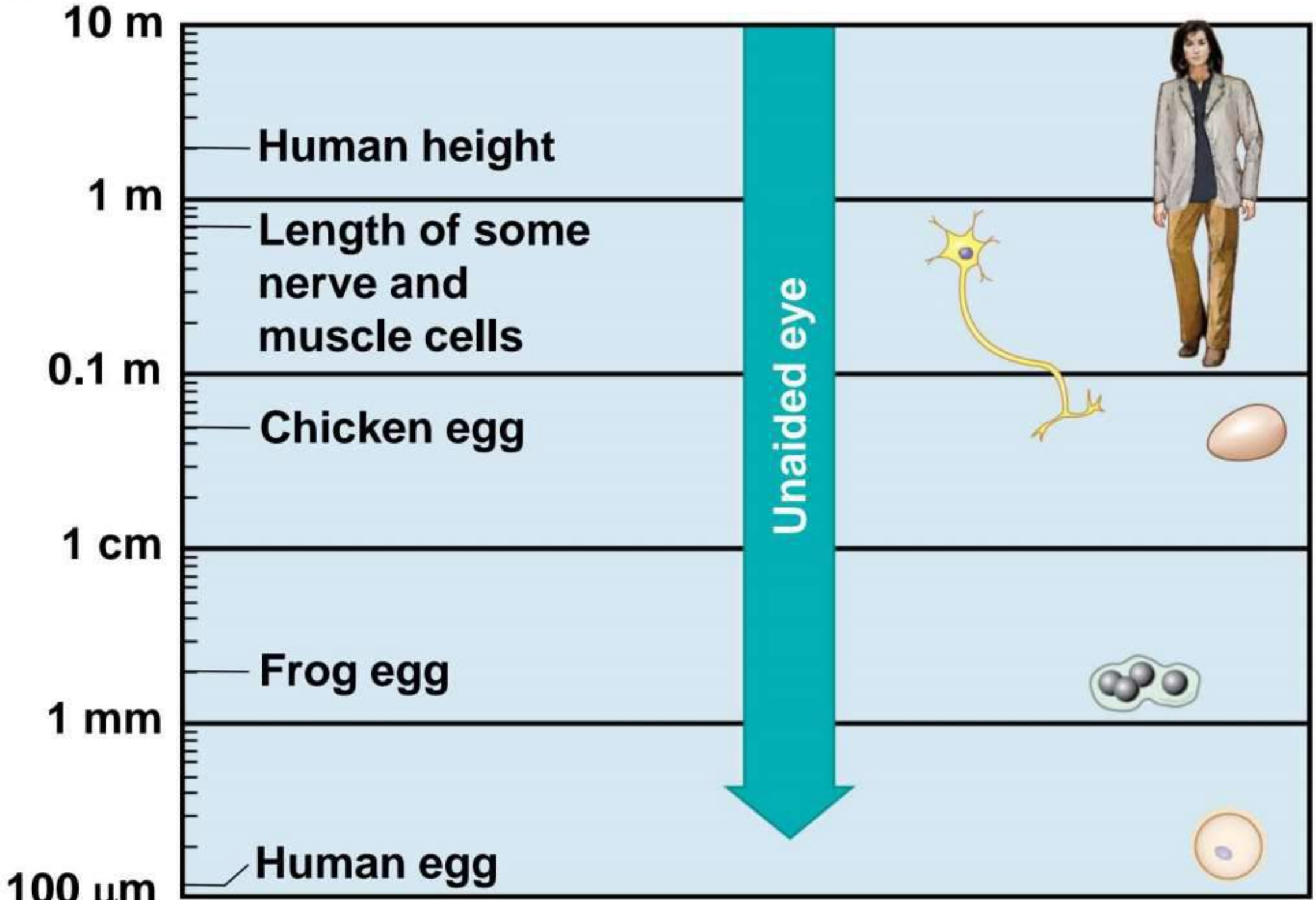
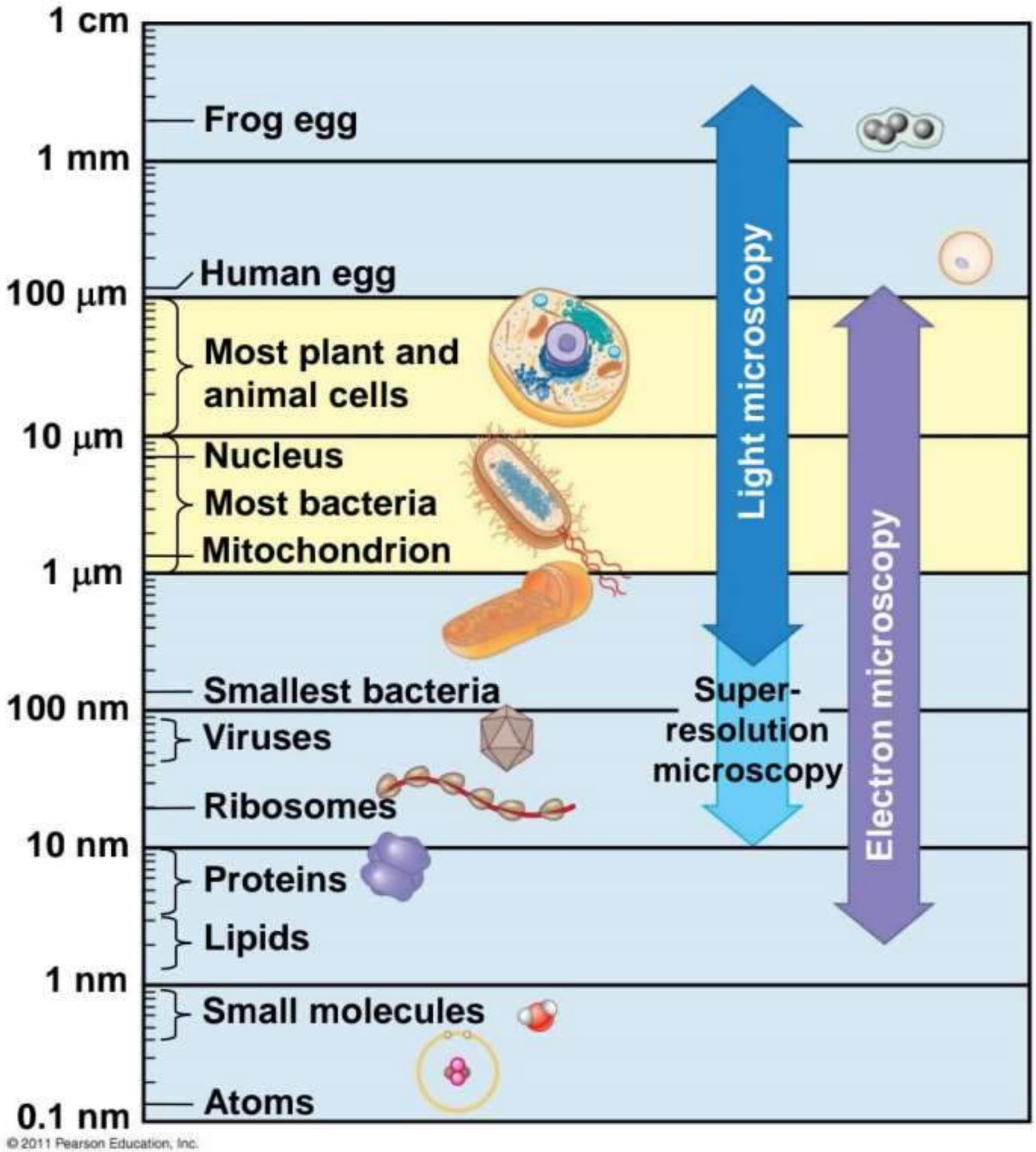


Figure 6.2b



- LMs can magnify effectively to about 1,000 times the size of the actual specimen
- Various techniques enhance contrast and enable cell components to be stained or labeled
- Most subcellular structures, including **organelles** (membrane-enclosed compartments), are too small to be resolved by an LM

- Two basic types of **electron microscopes (EMs)** are used to study subcellular structures
- **Scanning electron microscopes (SEMs)** focus a beam of electrons onto the surface of a specimen, providing images that look 3-D
- **Transmission electron microscopes (TEMs)** focus a beam of electrons through a specimen
- TEMs are used mainly to study the internal structure of cells 2D image

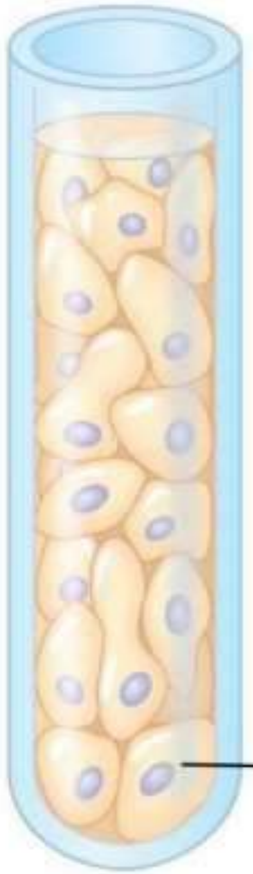
- Recent advances in light microscopy
  - Confocal microscopy and deconvolution microscopy provide sharper images of three-dimensional tissues and cells
  - New techniques for labeling cells improve resolution

Cell Fractionation

- **Cell fractionation** takes cells apart and separates the major organelles from one another
- Centrifuges fractionate cells into their component parts
- Cell fractionation enables scientists to determine the functions of organelles
- Biochemistry and cytology help correlate cell function with structure

Figure 6.4a

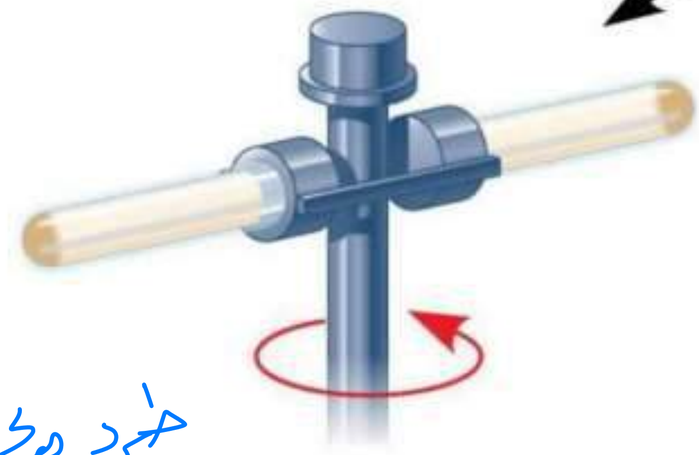
TECHNIQUE



Tissue cells

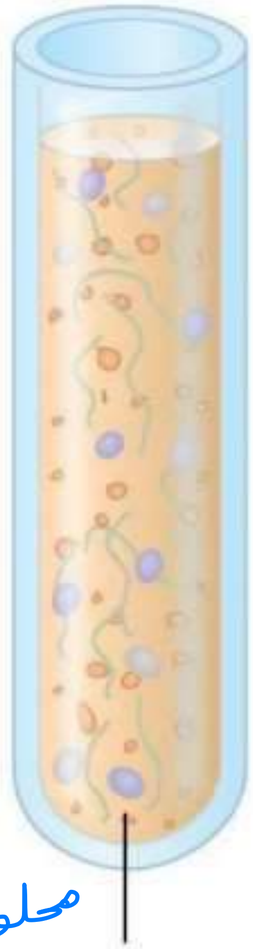
التجانس

Homogenization



خرد مركزي

Centrifugation



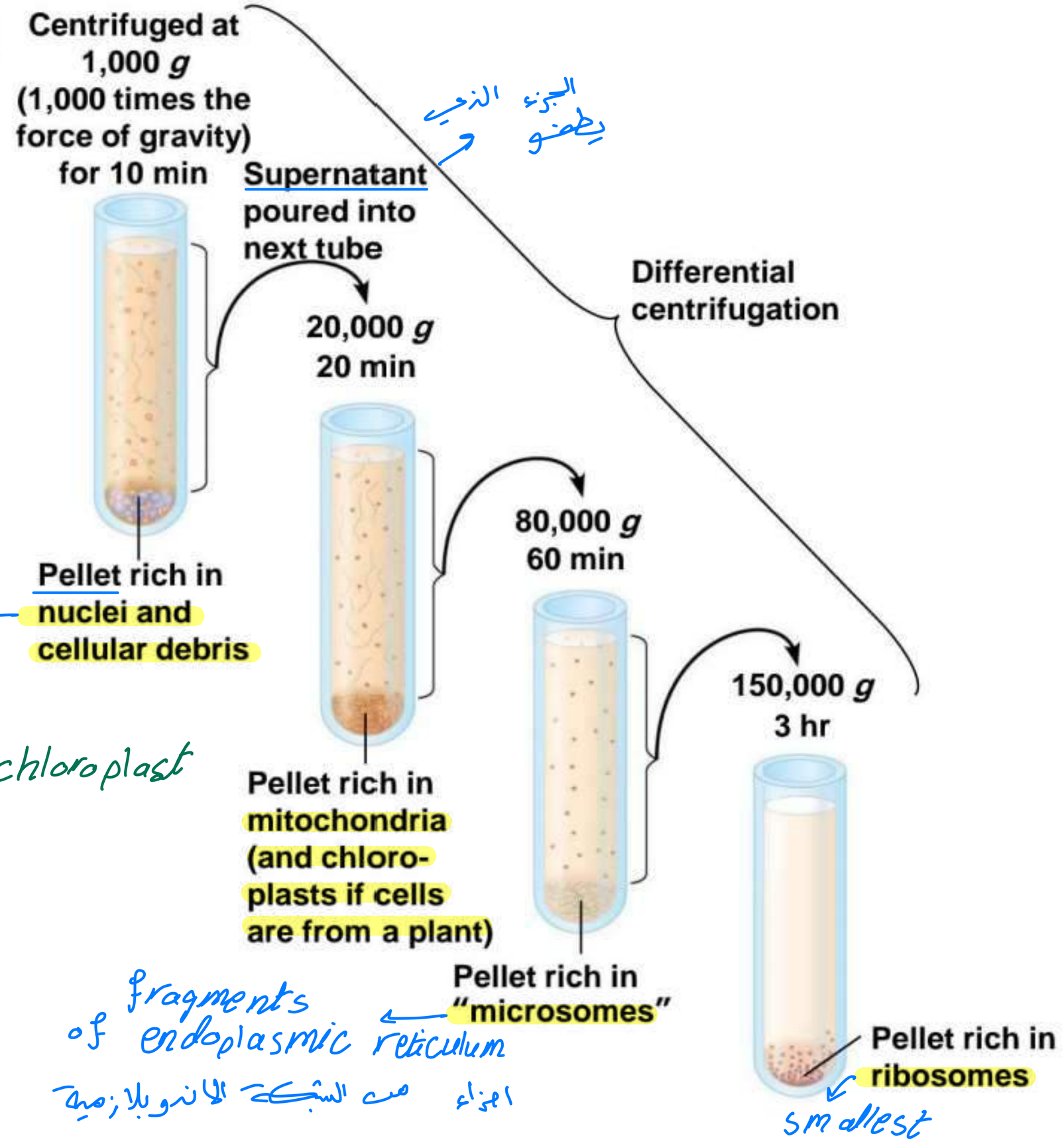
محلول متجانس

Homogenate

to fractionate smaller components you need higher speeds and longer durations

Figure 6.4b

TECHNIQUE (cont.)



الجزء الذي يطفو

الراسب

Largest

on size:

nuclei

↓

mitochondria and chloroplast

↓

microsomes

↓

ribosomes

fragments of endoplasmic reticulum

اجزاء من الشبكة الاندوبلازمية

smallest

Concept 6.2: Eukaryotic cells have internal membranes that compartmentalize their functions

- 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

Cells

	Prokaryotic	Eukaryotic
Nucleus	don't have	have
DNA	only 1 circular chromosome in nucleoid region	many linear chromosomes in nucleus
membrane bound organelle	NO	YES
cytoplasm	surrounded by plasma membrane	in between the plasma membrane and nucleus
size	smaller	much large

Karyo: نواة

Pro: بدائي

Eu: حقيقي

Domains

- Bacteria — Prokaryotic
- Archaea — Prokaryotic
- Eukaryotic
  - protists
  - fungi
  - animals
  - Plants

Comparing Prokaryotic and Eukaryotic Cells

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

- **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

only

- only one circular chromosome

Figure 6.5

for adherance

Fimbriae

Nucleoid

Ribosomes

Plasma membrane

Bacterial chromosome

Cell wall

Capsule

يستخدم للتخفي

Specially in pathogen

Flagella

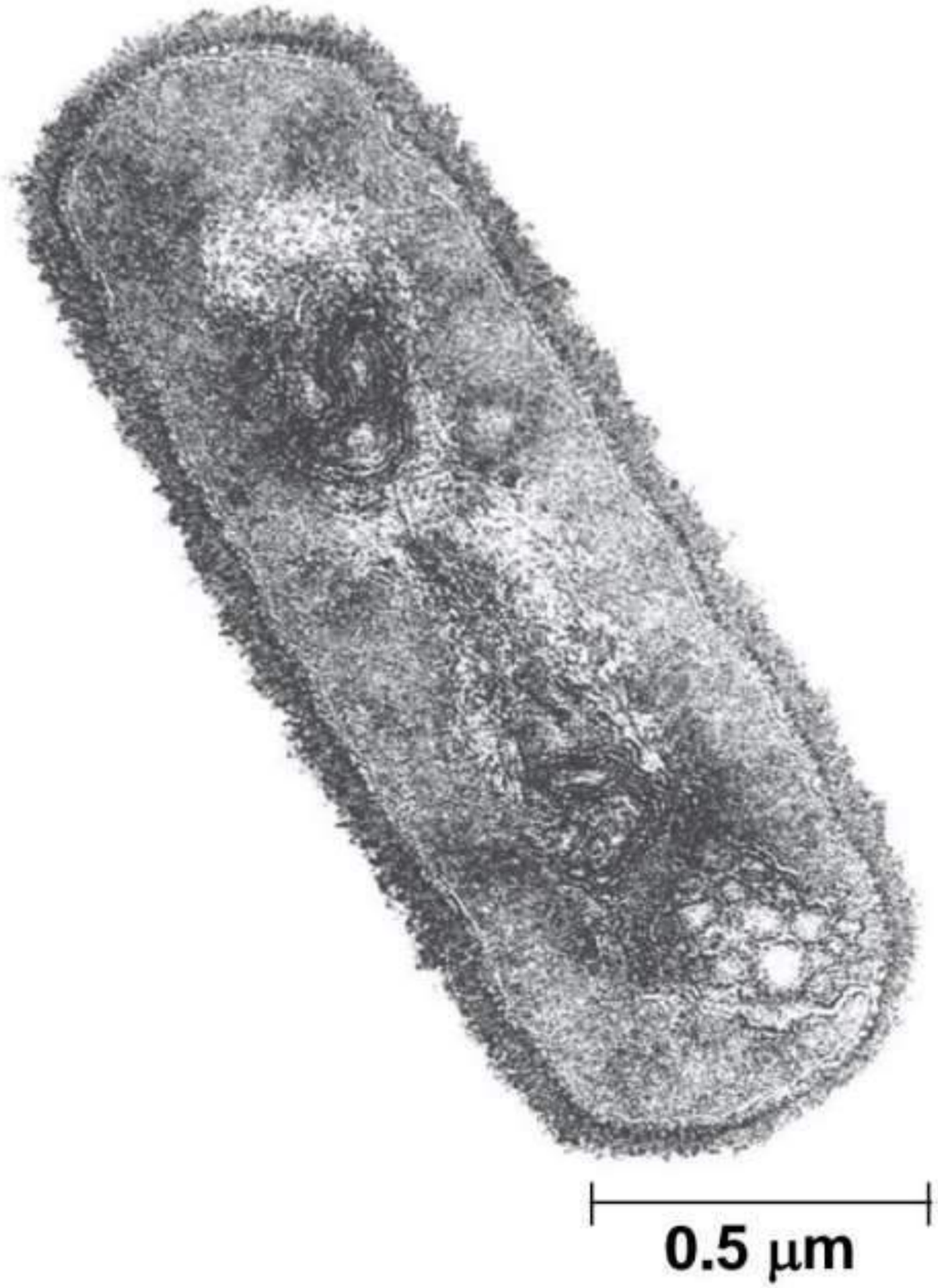
for motion

(a) A typical rod-shaped bacterium

0.5 μm

(b) A thin section through the bacterium *Bacillus coagulans* (TEM)

Figure 6.5a



(b) A thin section through the bacterium *Bacillus coagulans* (TEM)

- **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

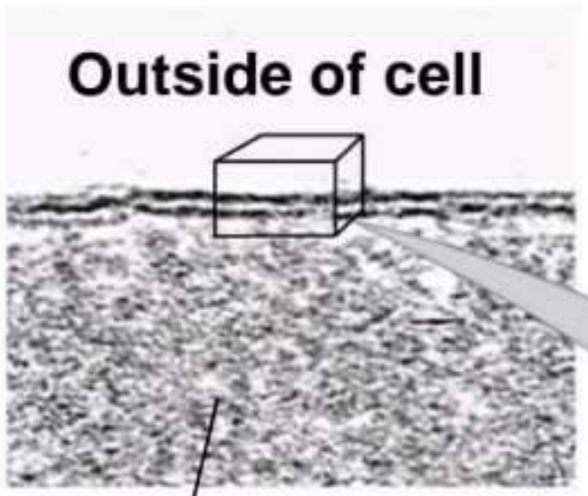
حاجز اختياري (خاصية النفاذية الاختيارية)

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

كافي — ممر — مواد غذائية

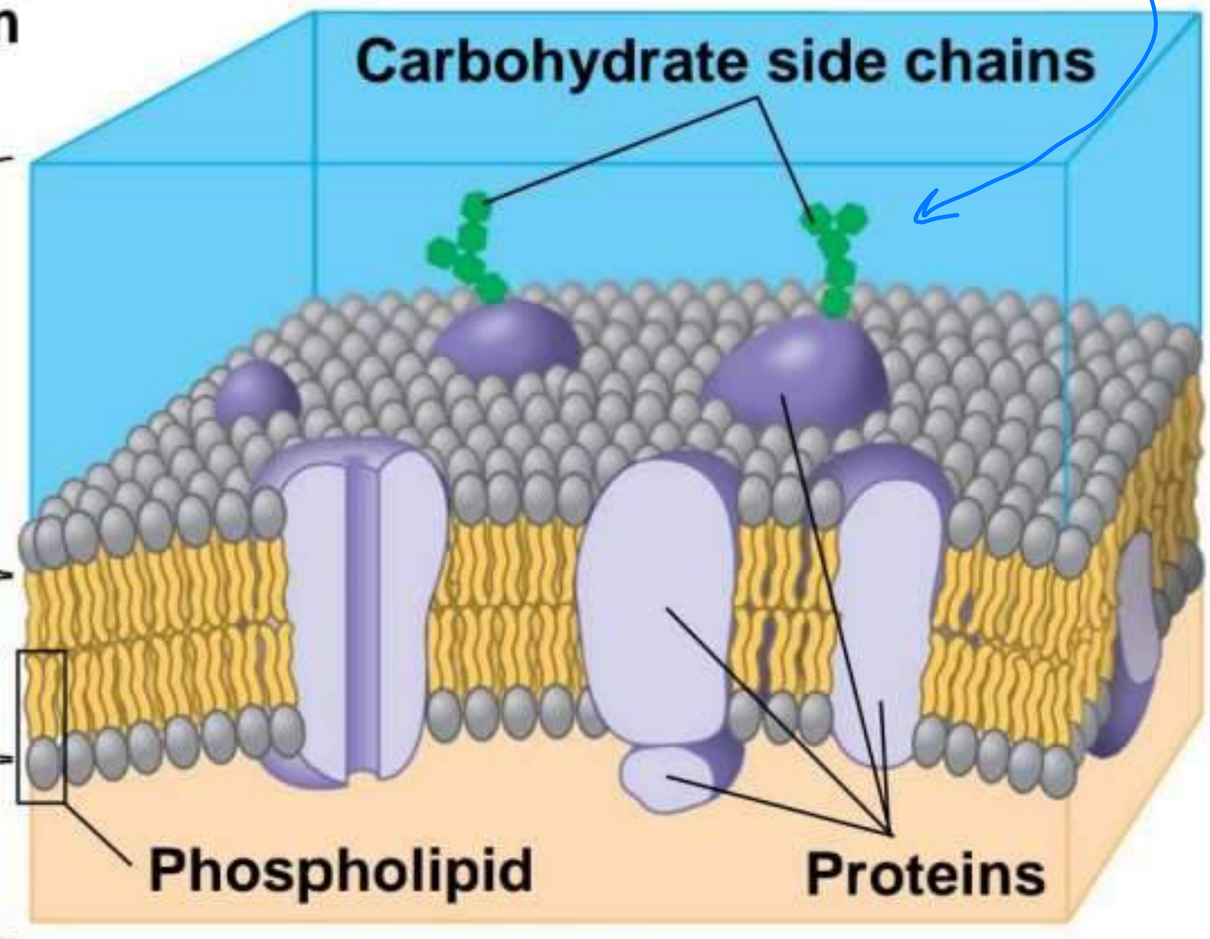
- The general structure of a biological membrane is a double layer of phospholipids

Figure 6.6



(a) TEM of a plasma membrane

it isn't smooth on the outside



(b) Structure of the plasma membrane

Surface area / Volume ↑ ⟷ efficiency ↑

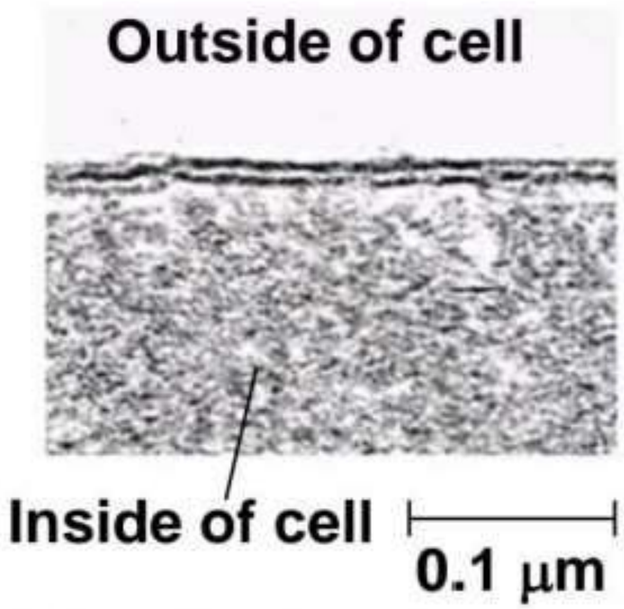
to increase service area

Examples:

1) plants roots
2) intestines

الاثنان فيها بتؤدي الى زيادة سطح العمل

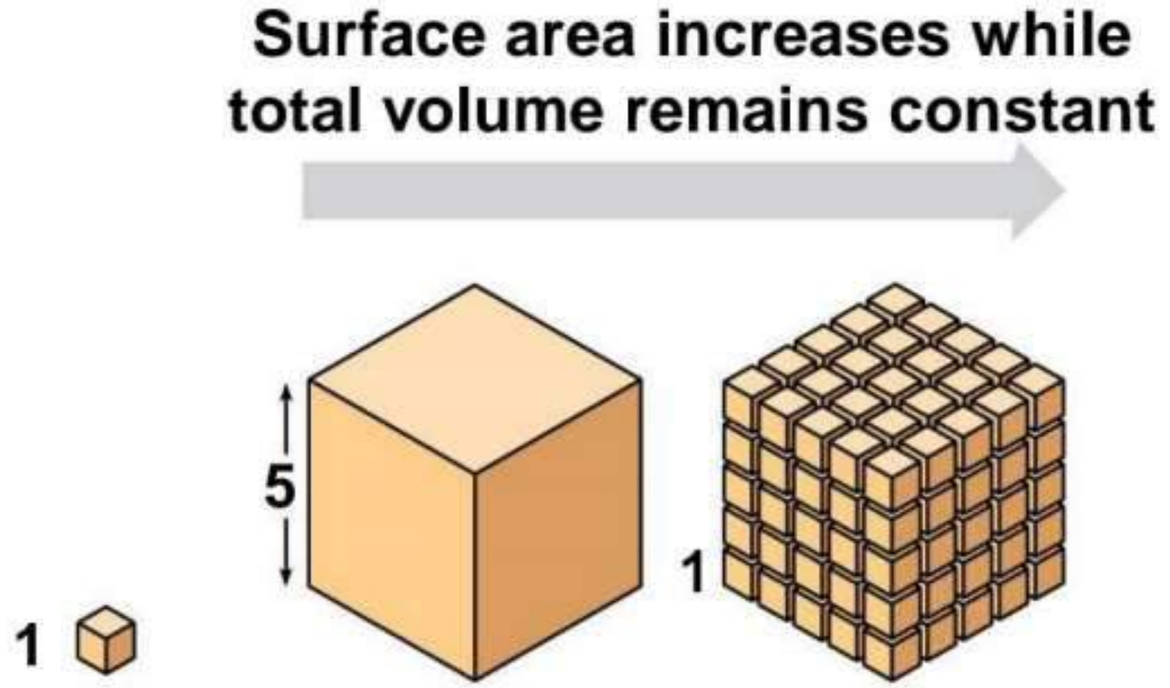
Figure 6.6a



(a) TEM of a plasma membrane

- Metabolic requirements set upper limits on the size of cells
- The surface area to volume ratio of a cell is critical
- As the surface area increases by a factor of n^2, the volume increases by a factor of n^3
- Small cells have a greater surface area relative to volume

Figure 6.7



Total surface area [sum of the surface areas (height × width) of all box sides × number of boxes]	**6**	**150**	**750**
Total volume [height × width × length × number of boxes]	**1**	**125**	**125**
Surface-to-volume (S-to-V) ratio [surface area ÷ volume]	**6**	**1.2**	**6**

قياس كفاءة عمل الخلية

A Panoramic View of the Eukaryotic Cell

- A eukaryotic cell has internal membranes that partition the cell into organelles
- Plant and animal cells have most of the same organelles

PLAY BioFlix: Tour of an Animal Cell

PLAY BioFlix: Tour of a Plant Cell

Figure 6.8a

المكتوب بالأحمر هو الاختلاف بين الخلايا الحيوانية والخلايا النباتية

شبكة اندوبلازمية

ENDOPLASMIC RETICULUM (ER)

Rough ER

Smooth ER

Because of the ribosomes

Flagellum

Nuclear envelope

Nucleolus

Chromatin

NUCLEUS

1) Central location

الجسم المركزي

Centrosome

3) have 2 centrioles

سنتريكزات

Plasma membrane

made of protein

CYTOSKELETON:

Microfilaments

Intermediate filaments

Microtubules

خلايا بس مش بكل الخلايا

Microvilli

Peroxisome

Mitochondrion

Free

Ribosomes

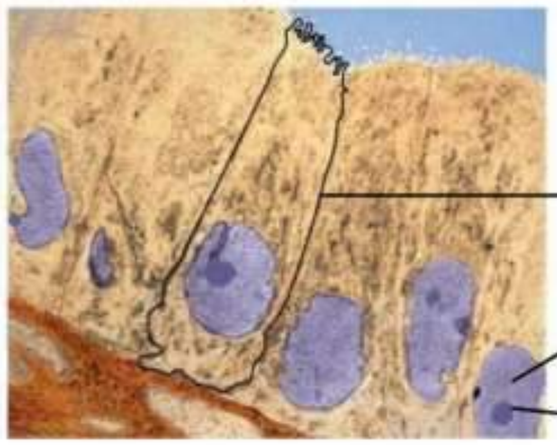
Golgi apparatus

2) Lysosome

Figure 6.8b

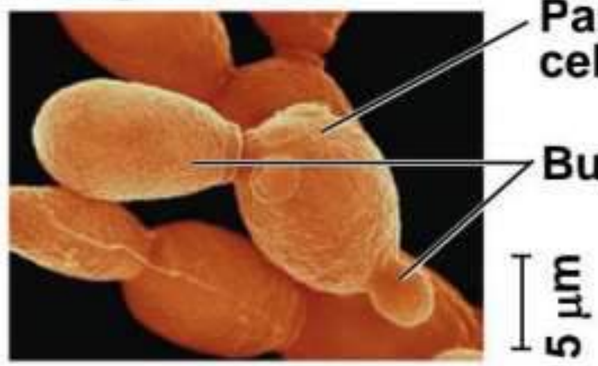
* الجسم المركزي يقوم بوظيفة هامة في مرحلة الانقسام (معلومة خارجية)

Animal Cells

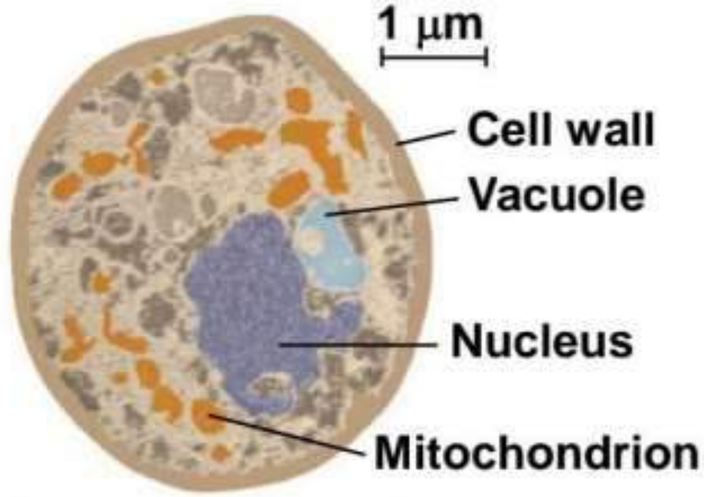


Human cells from lining of uterus (colorized TEM)

Fungal Cells



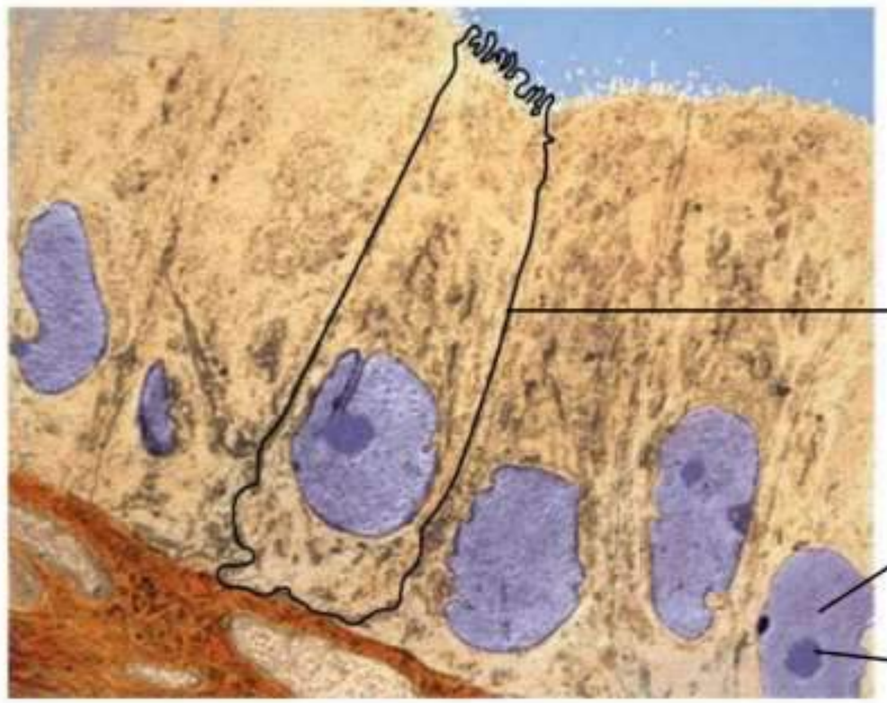
Yeast cells budding (colorized SEM)



A single yeast cell (colorized TEM)

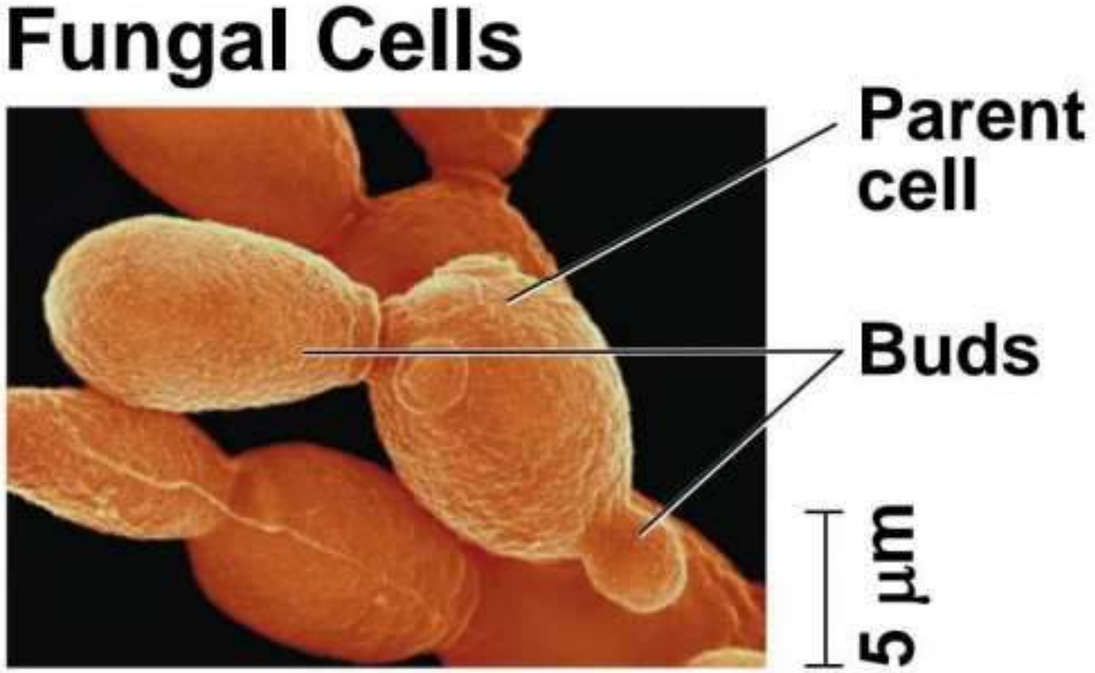
Figure 6.8ba

Animal Cells



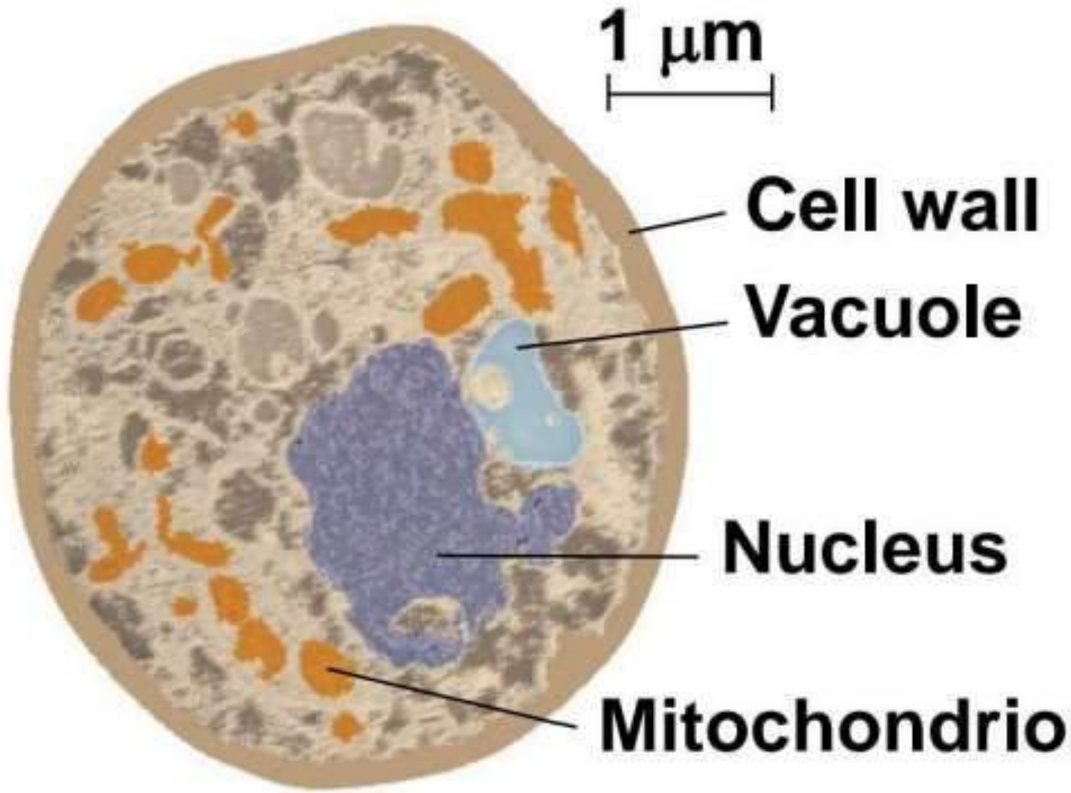
Human cells from lining of uterus (colorized TEM)

Figure 6.8bb



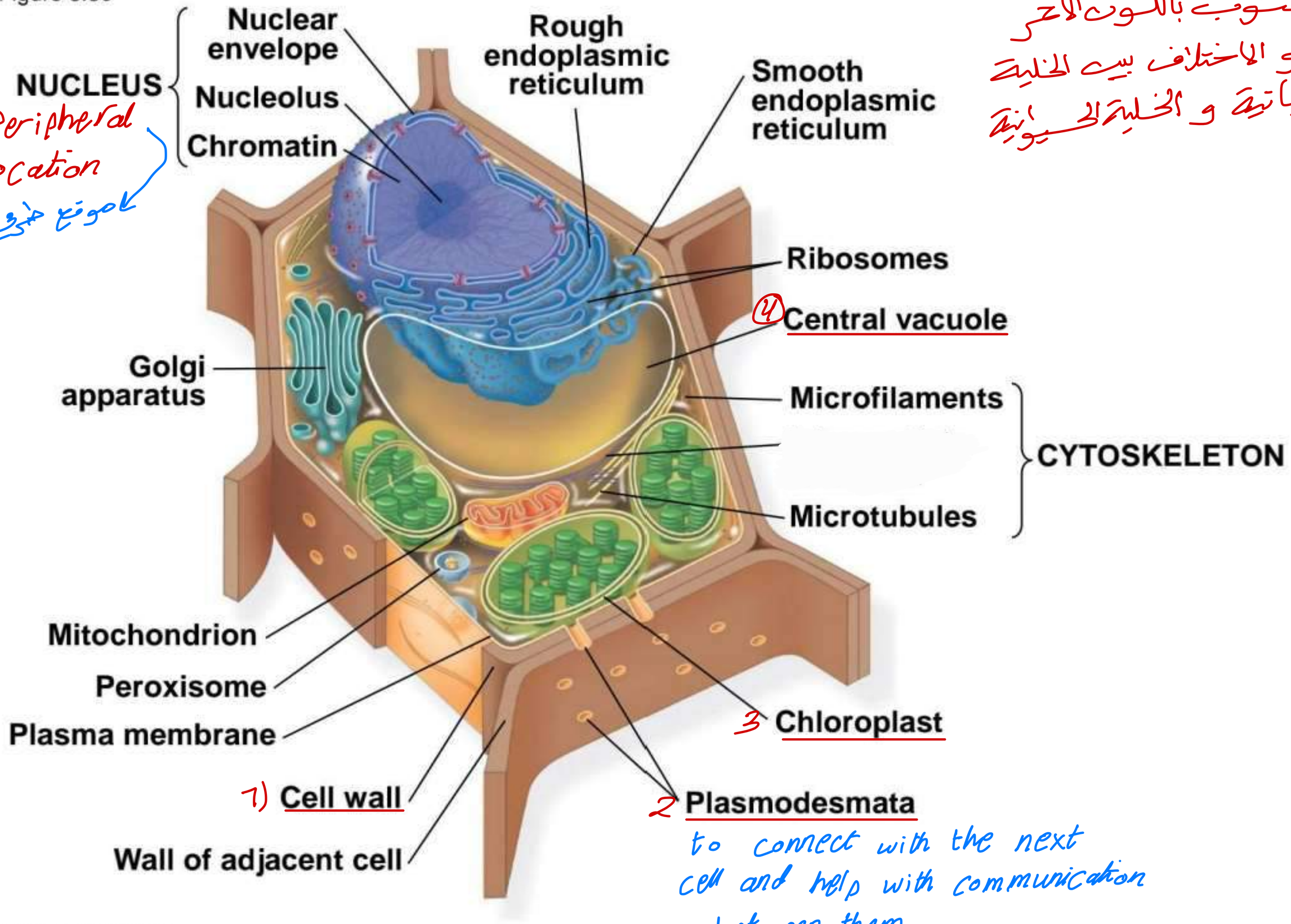
Yeast cells budding (colorized SEM)

Figure 6.8bc



A single yeast cell
(colorized TEM)

Figure 6.8c



المكتوب باللون الأحمر هو الاختلاف بين الخلية النباتية و الخلية الحيوانية

⑤ Peripheral location موقع جانبي

4 Central vacuole

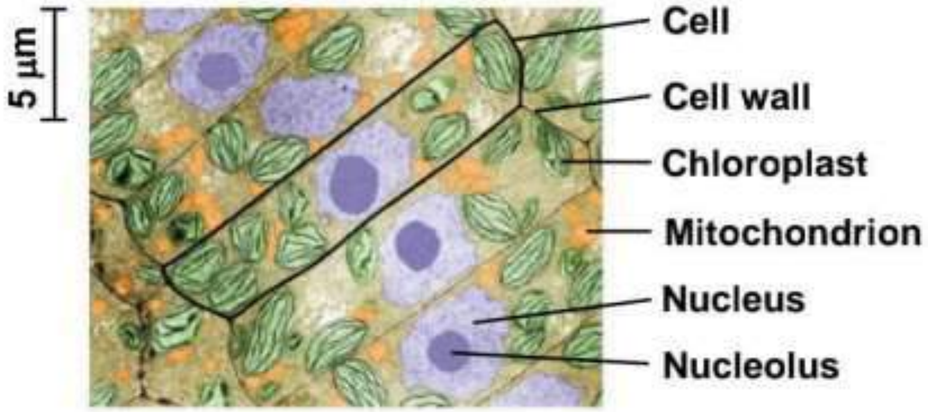
1) Cell wall

2 Plasmodesmata
to connect with the next cell and help with communication between them

3 Chloroplast

Figure 6.8d

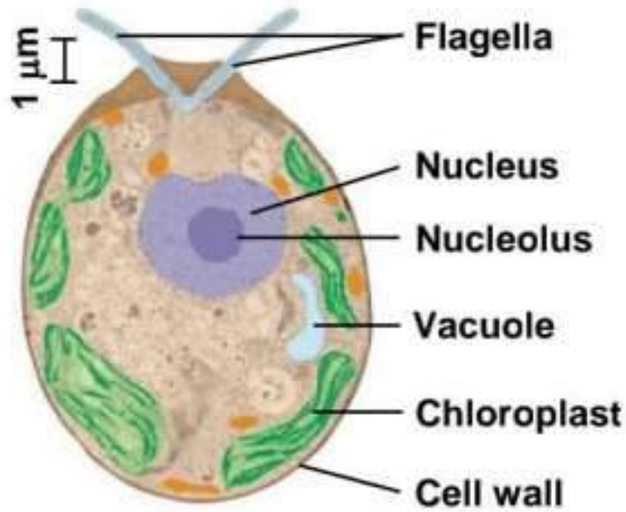
Plant Cells



Cells from duckweed (colorized TEM)

Protistan Cells

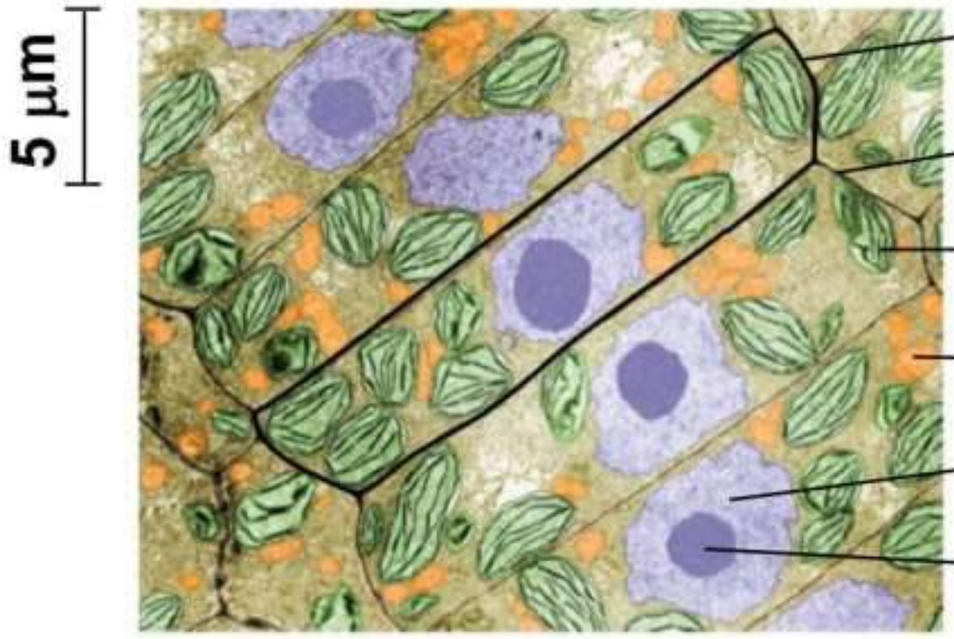
Chlamydomonas **(colorized SEM)**



Chlamydomonas **(colorized TEM)**

Figure 6.8da

Plant Cells



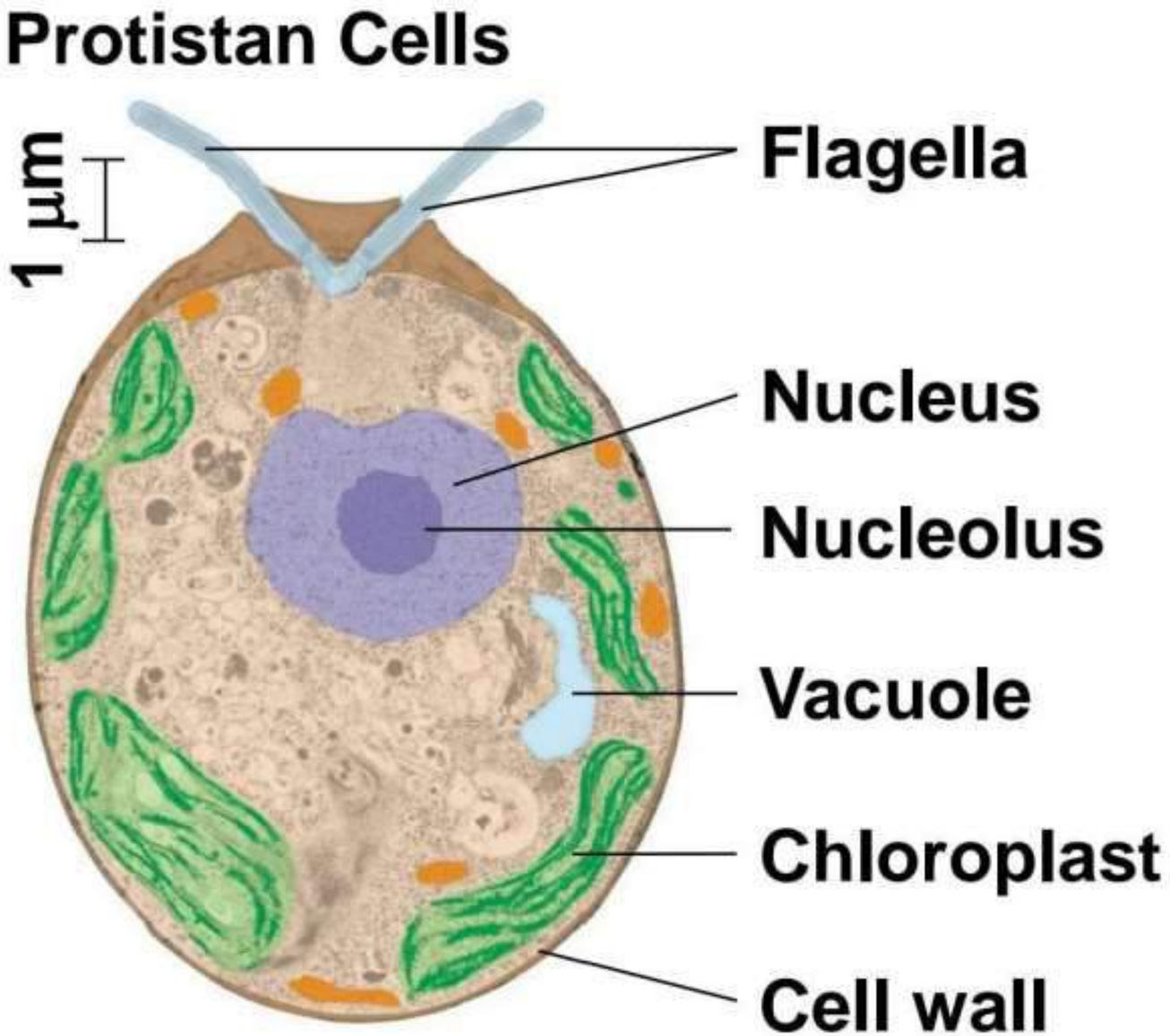
Cells from duckweed
(colorized TEM)

Figure 6.8db

Protistan Cells

Chlamydomonas
(colorized SEM)

Figure 6.8dc



Concept 6.3: The eukaryotic cell's genetic instructions are housed in the nucleus and carried out by the ribosomes

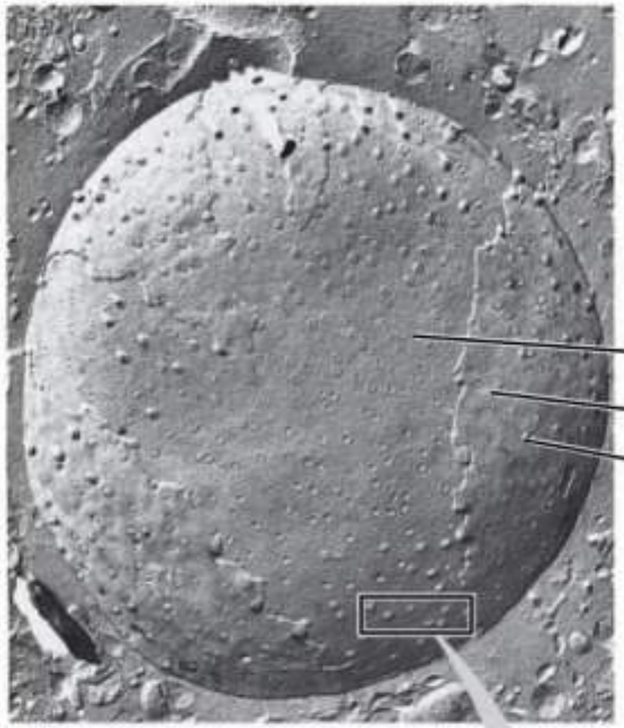
- The nucleus contains most of the DNA in a eukaryotic cell
- Ribosomes use the information from the DNA to make proteins

The Nucleus: Information Central

- The **nucleus** contains most of the cell's genes and is usually the most conspicuous organelle
- 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

Figure 6.9

1 µm



▲ Surface of nuclear envelope

نواة
Nucleus

نوية
Nucleolus

Chromatin

Nuclear envelope:

Inner membrane

Outer membrane

Nuclear pore

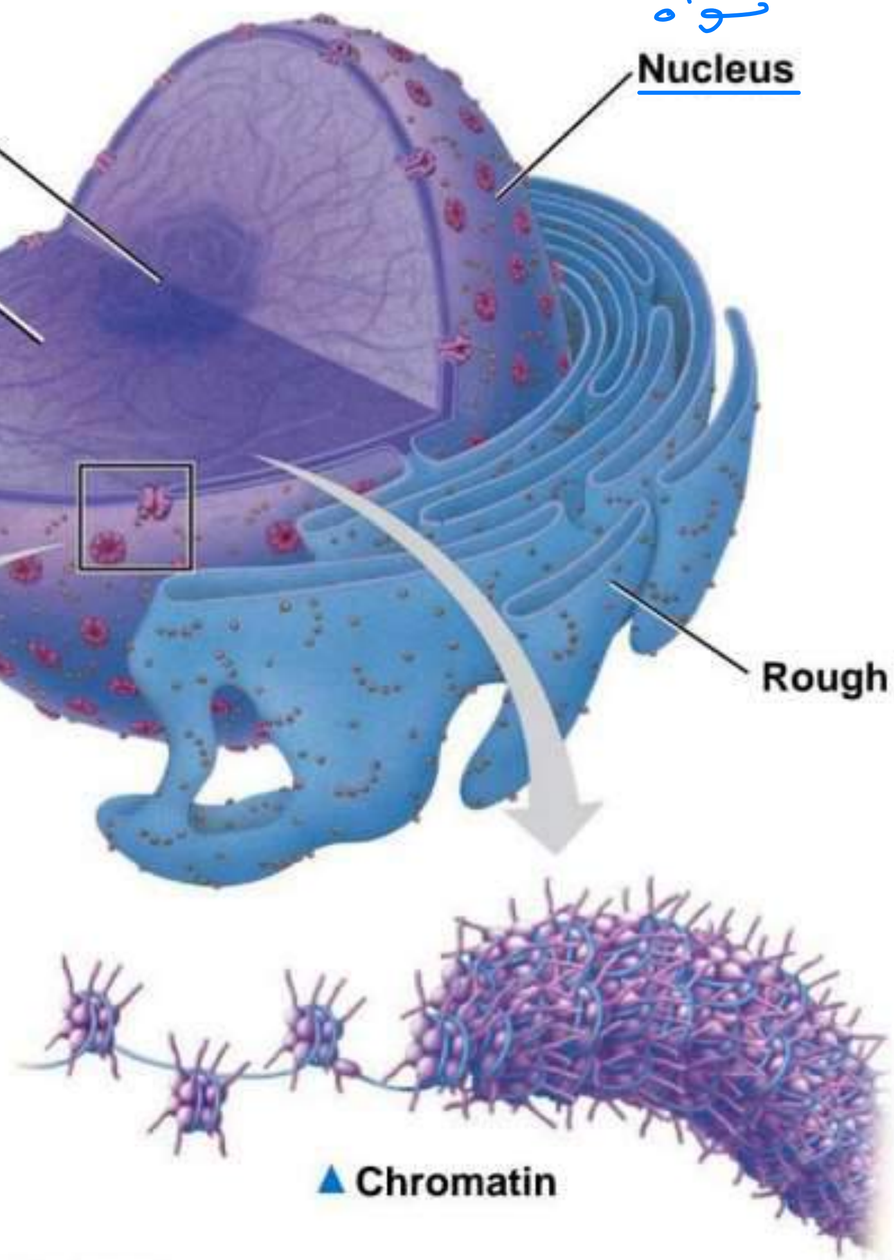
ثقوب نووية

Rough ER

Pore complex

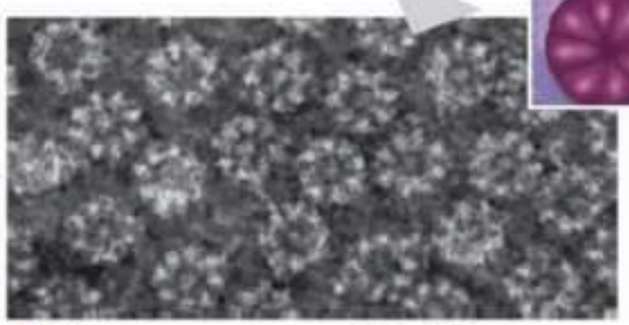
Ribosome

◀ Close-up of nuclear envelope



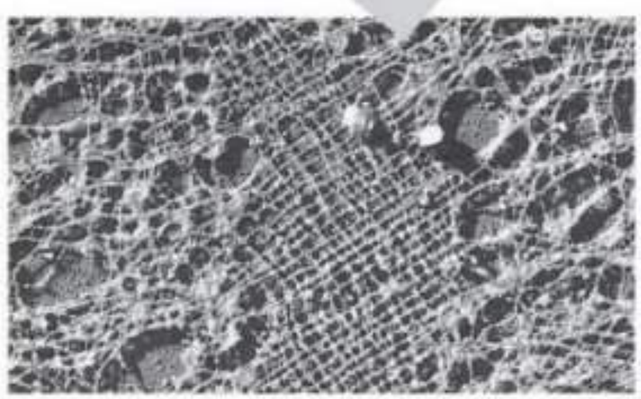
▲ Chromatin

0.25 µm



▲ Pore complexes (TEM)

1 µm



made of intermediate filaments

◀ Nuclear lamina (TEM)

in the inner membrane

Figure 6.9a

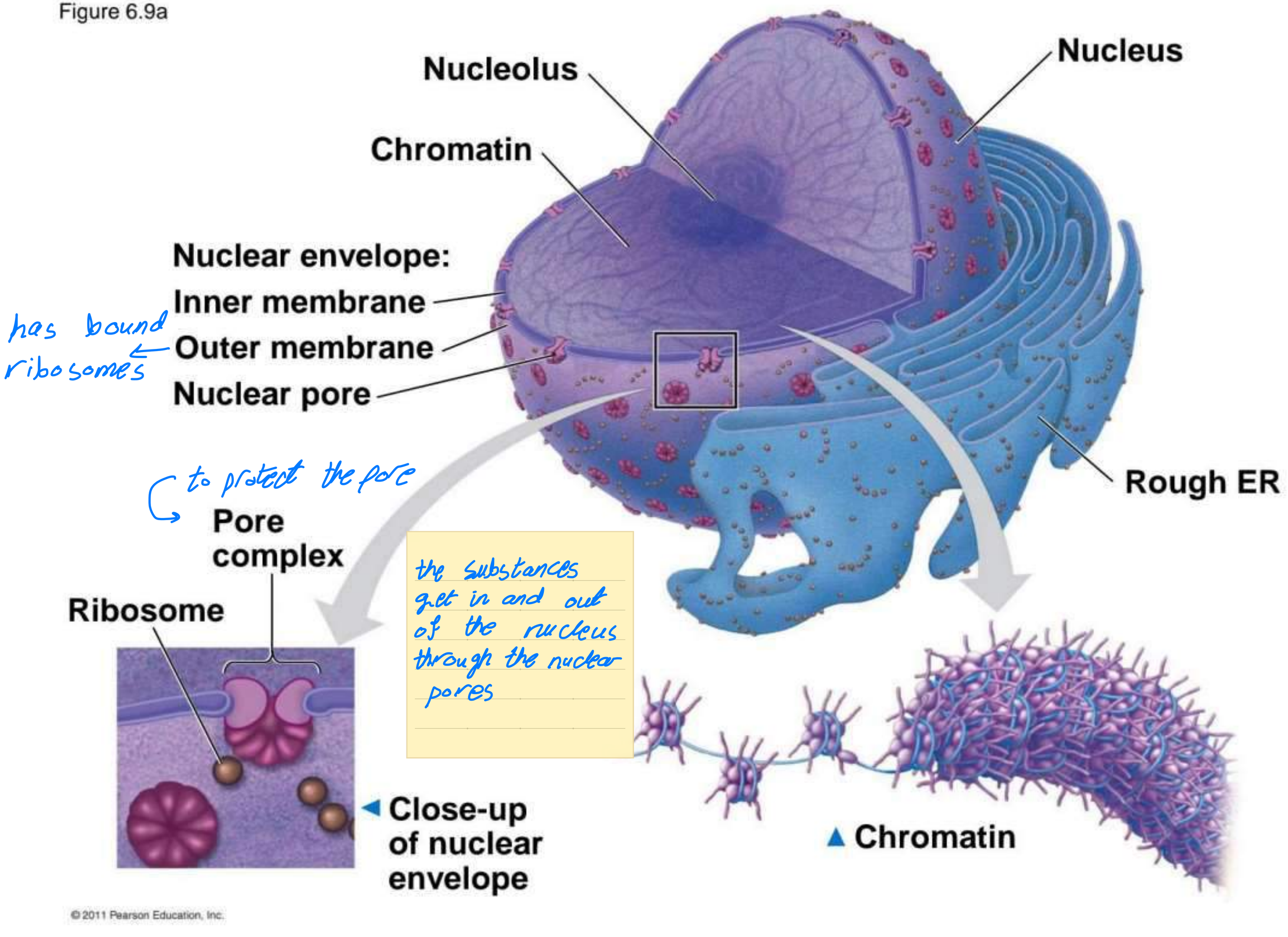
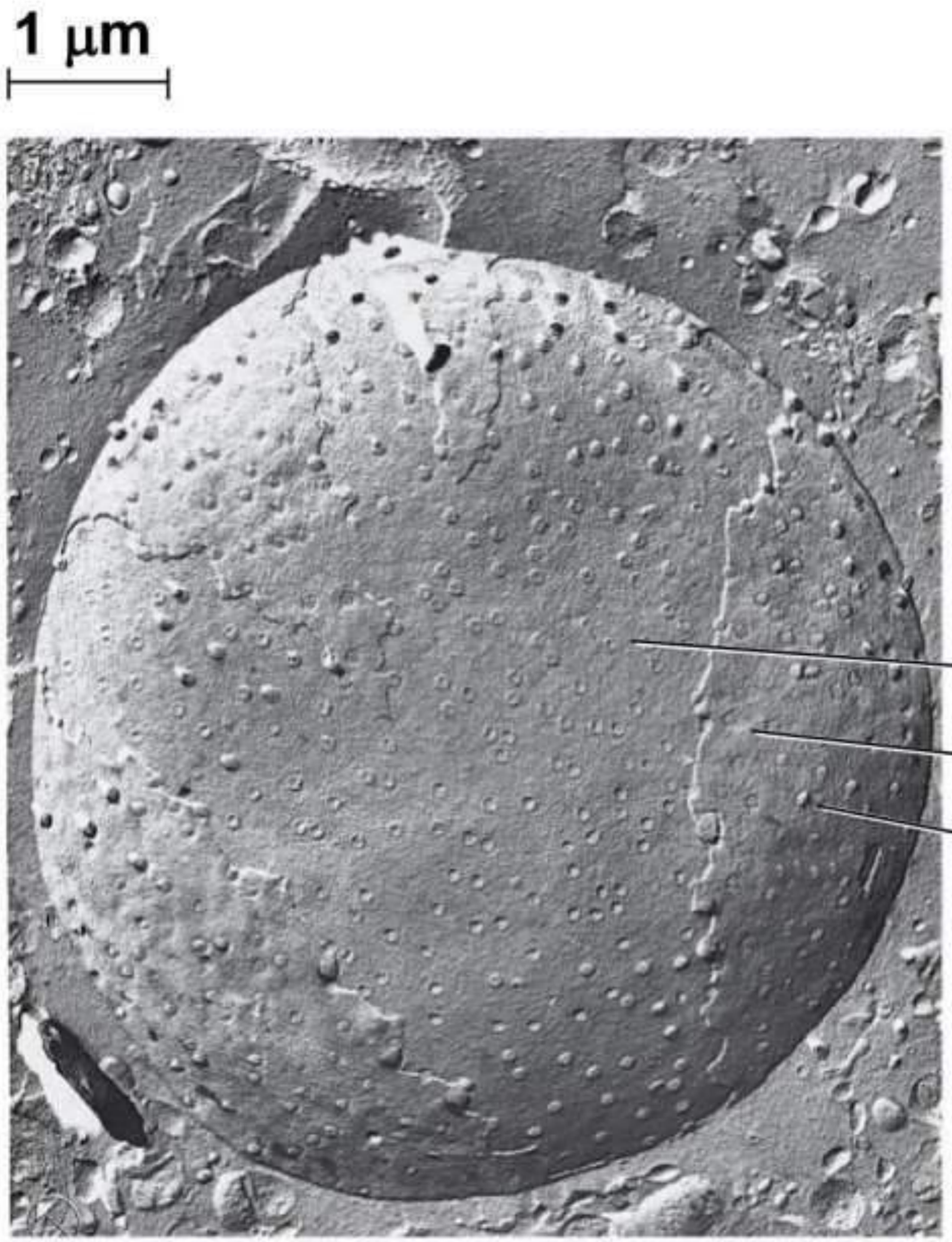
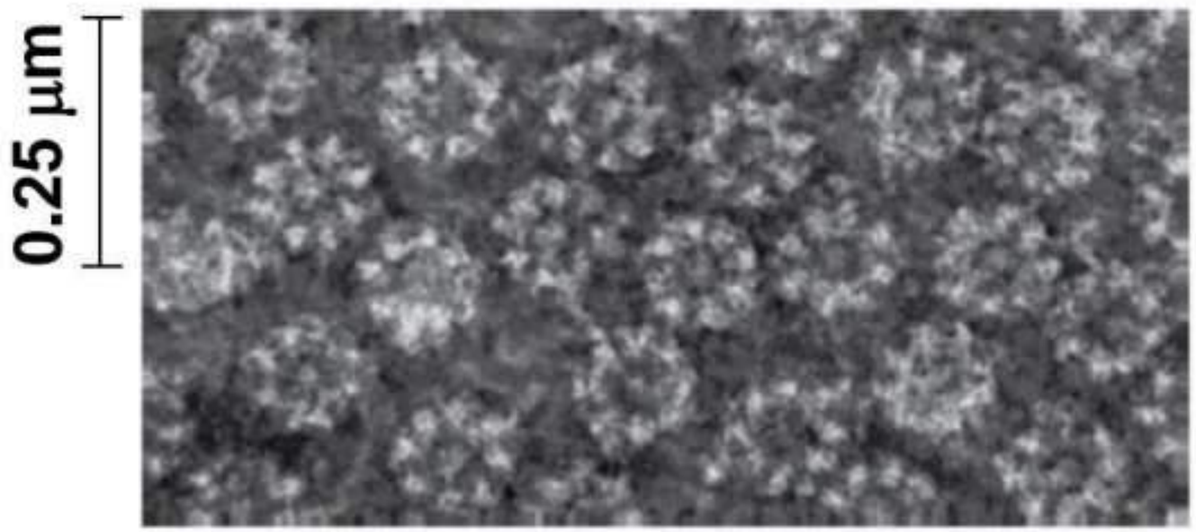


Figure 6.9b



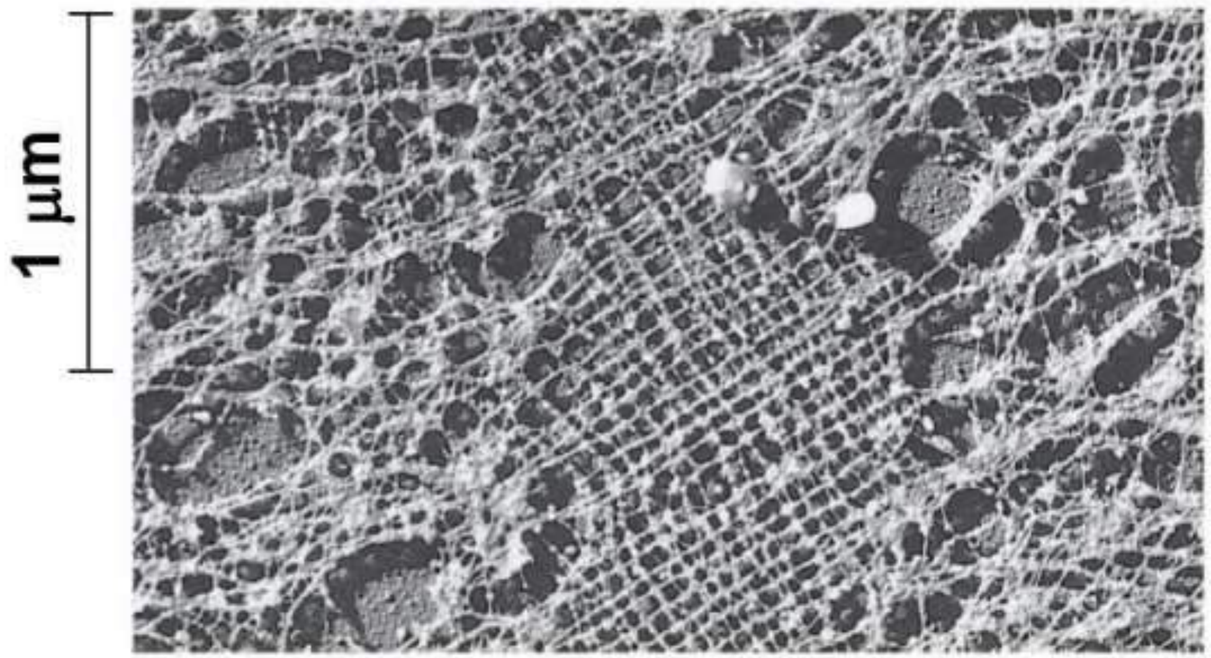
▲ Surface of nuclear envelope

Figure 6.9c



▲ Pore complexes (TEM)

Figure 6.9d



▲ Nuclear lamina (TEM)

- Pores regulate the entry and exit of molecules from the nucleus
- The shape of the nucleus is maintained by the **nuclear lamina**, which is composed of protein