النادي الطبي

تَنوير

BIOLOGY

Lec no : 7

File Title : Chapter 7 part 3

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وَقُل رَّبِّ زِدْنِي عِلْمًا

Concept 6.5: Mitochondria and chloroplasts change energy from one form to another

- **Mitochondria** are the sites of cellular respiration, a metabolic process that uses oxygen to generate ATP
- **Chloroplasts**, found in plants and algae, are the sites of photosynthesis
- Peroxisomes are oxidative organelles

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The Evolutionary Origins of Mitochondria and Chloroplasts

- Mitochondria and chloroplasts have similarities with bacteria
  - Enveloped by a double membrane
  - Contain free ribosomes and circular DNA molecules
  - Grow and reproduce somewhat independently in cells

شرحه داخل الخلية

حلقي

That's make them able to synthesize their own proteins also they can replicate.

قادرين على تصنيع بروتينهم وعندهم القدرة على التضاعف

غير التشابه في الوظيفة والوزن للميتوكندريا والبلاستيدات الخضراء لقيوا انه تركيبهم متشابه برضه ومشابه للبكتيريا
هاد الاشي دفع علماء التطور Evolution scientists للتفكير بان اصل الميتوكندريا والبلاستيدات الخضراء بكتيريا

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نظرية التعايش الداخلي

داخل / متكافل

نظرية وضعت افتراضًا لكنها مقبولة إلى حد ما.

- The **Endosymbiont theory**
  - An early ancestor of eukaryotic cells engulfed a nonphotosynthetic prokaryotic cell, which formed an endosymbiont relationship with its host
  - The host cell and endosymbiont merged into a single organism, a eukaryotic cell with a mitochondrion
  - At least one of these cells may have taken up a photosynthetic prokaryote, becoming the ancestor of cells that contain chloroplasts

شرح النظرية

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يفترضوا العلماء انه كان عندهم بالاساس Eukaryotic cell فيها كل الorganelles باستثناء الميتوكندريا والبلاستيدات الخضراء ...

هاي ال Eukaryotic cell انتقلت الى بيئة معينة full of aerobic bacteria مليئة بالبكتيريا الهوائية

*Aerobic bacteria: a bacteria that can survive and grow in an oxygenated environment

(ما بتعيش الا بوجود الاكسجين)

فالخلية لما انتقلت لهاي البيئة ولقتها مليانة بالبكتيريا الهوائية راحت بلعتها فصارت هاي البكتيريا جوا الخلية مع مرور الزمن الخلية بتنقسم وبعدين هاي البكتيريا بتتحول لميتوكندريا

يعني اصل الميتوكندريا Aerobic bacteria

هلا لهون الخلية حيوانية

لكن نفترض انه الخلية راحت انتقلت على بيئة تانية وكانت full of photosynthetic bacteria فبرضه رح تبلع جزء من هاي البكتيريا ومع مرور الزمن رح تتحول هاي البكتيريا ل chloroplasts

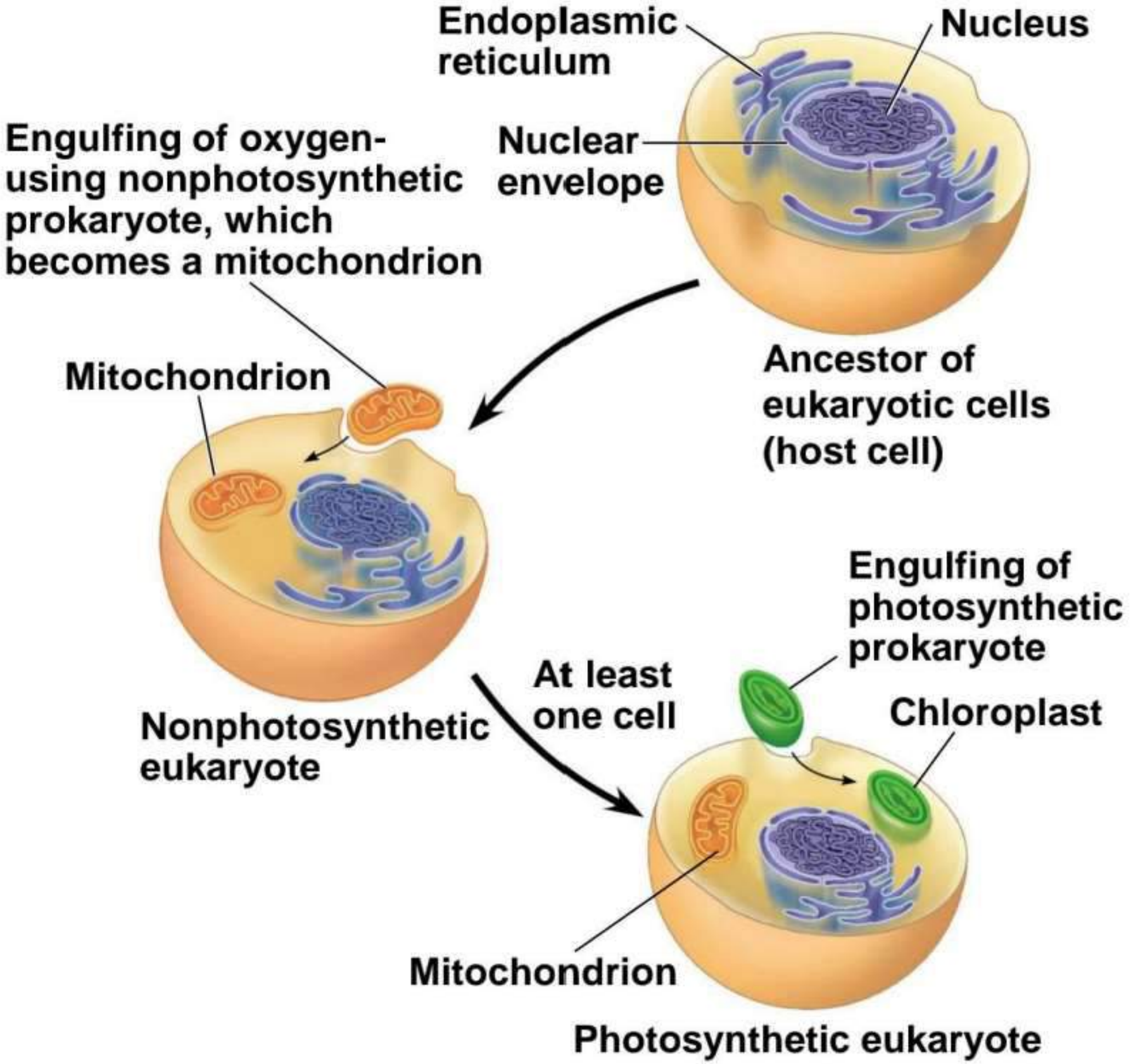
*photosynthetic bacteria:bacteria that can utilize sunlight to produce their food

وهيك بتعطينا خلية نباتية

يعني اصل البلاستيدات الخضراء Photosynthetic bacteria

Figure 6.16

ابتلاع الاكسجين باستخدام بدائيات النوى غير الضوئية والتي تصبح ميتوكنديا



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Mitochondria: Chemical Energy Conversion

- Mitochondria are in nearly all eukaryotic cells
- They have a smooth outer membrane and an inner membrane folded into **cristae**
- The inner membrane creates two compartments: intermembrane space and **mitochondrial matrix**
- Some metabolic steps of cellular respiration are catalyzed in the mitochondrial matrix
- Cristae present a large surface area for enzymes that synthesize ATP

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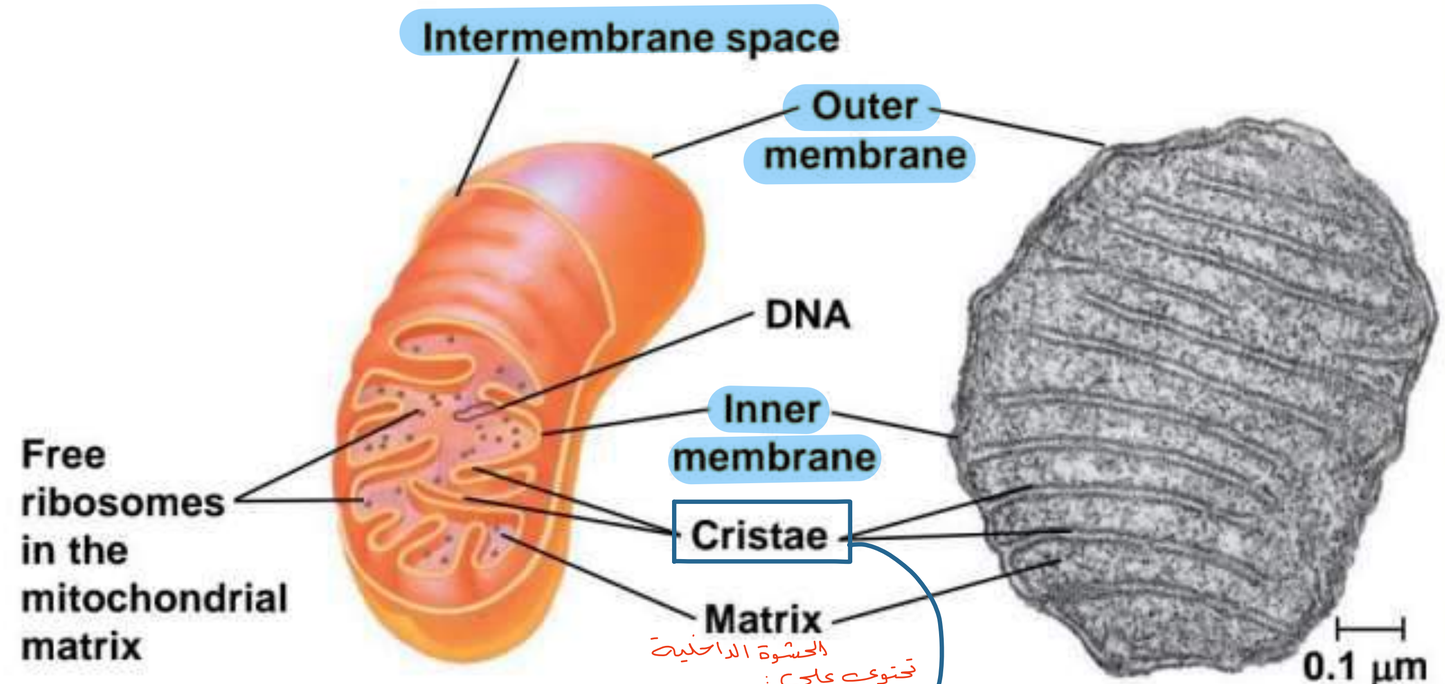
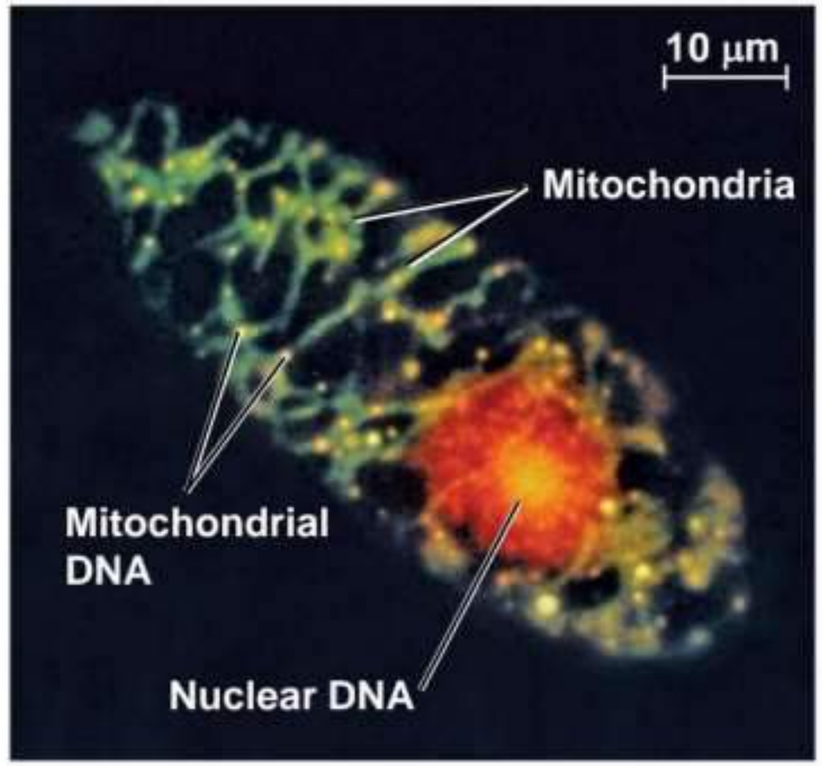
Figure 6.17



(a) Diagram and TEM of mitochondrion



(b) Network of mitochondria in a protist cell (LM)

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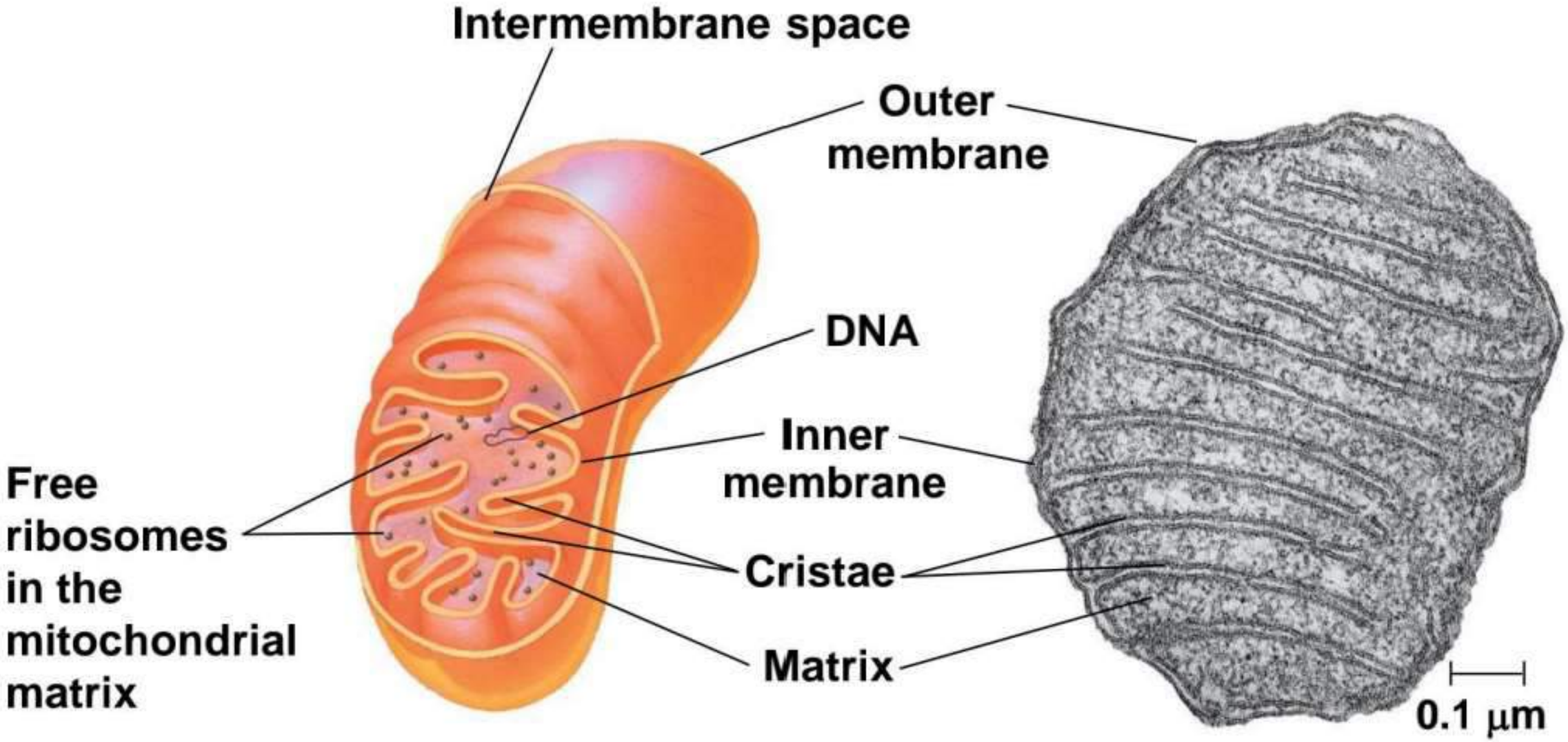
الحشوة الداخلية تحتوي على: 1 circular DNA, Ribosomes

يسمى الانثناءات highly folded

Foldings → to increase the surface area to volume ratio $\frac{S.A}{V_o}$

Figure 6.17a



(a) Diagram and TEM of mitochondrion

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Figure 6.17aa

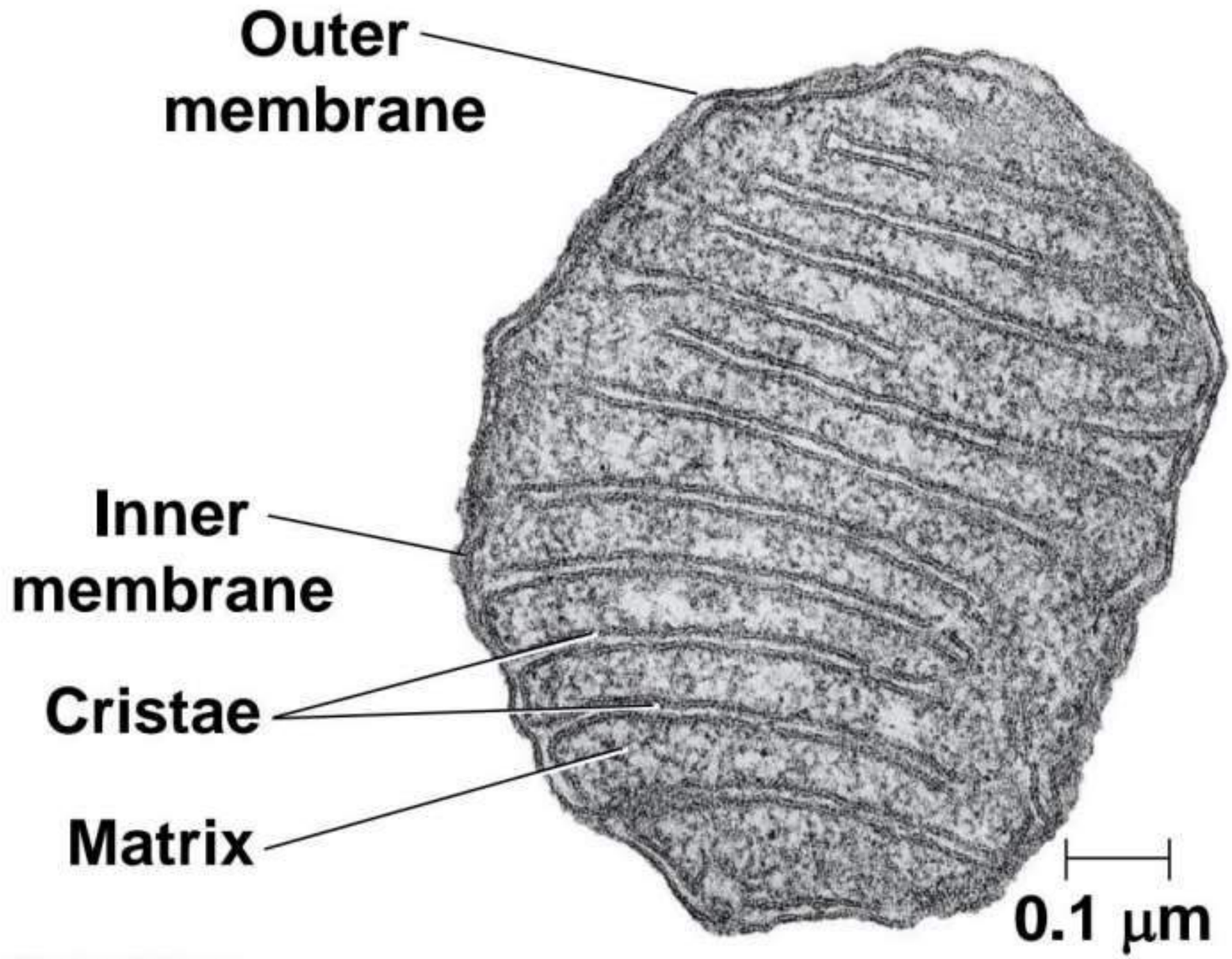

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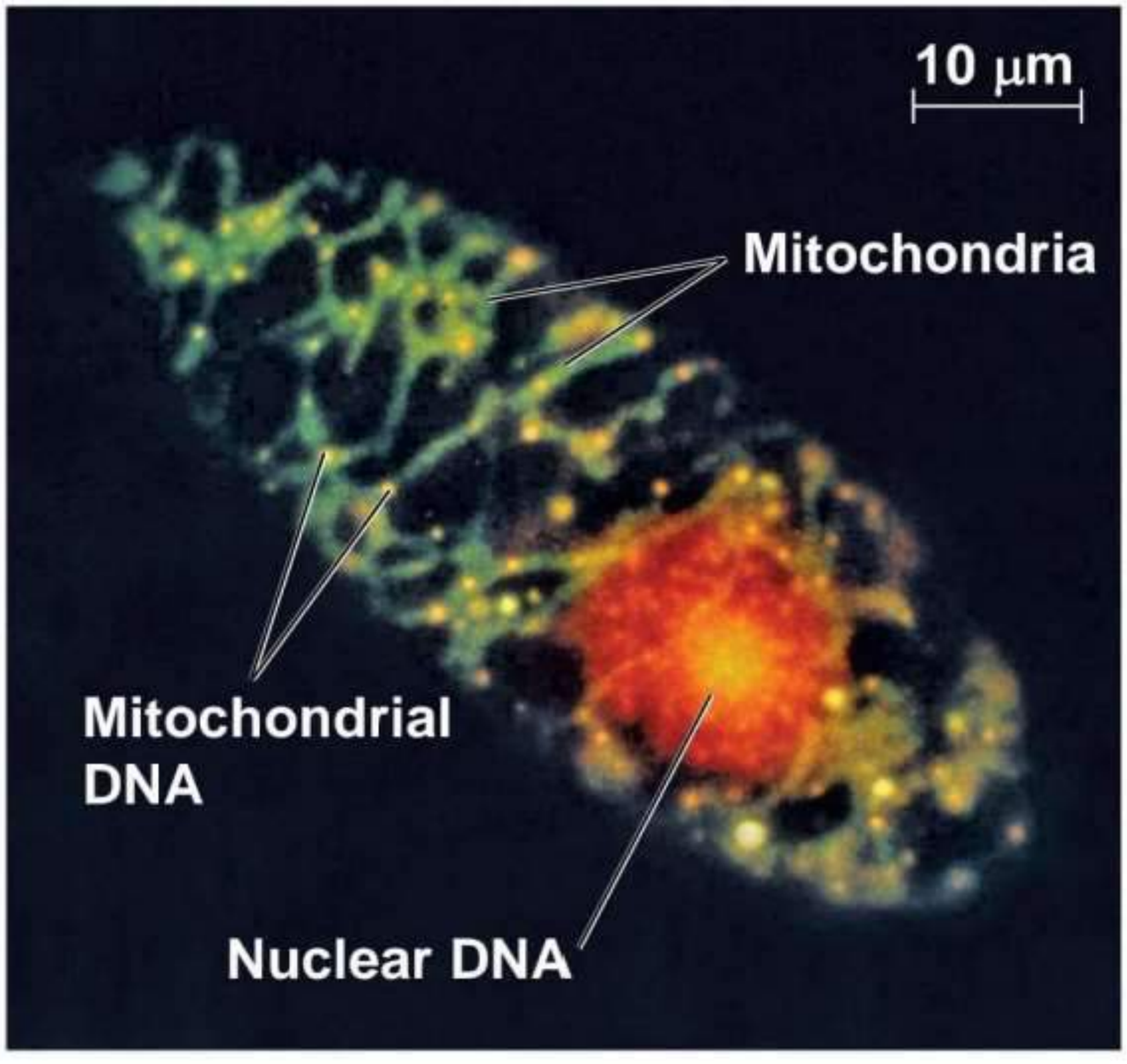
Figure 6.17b



(b) Network of mitochondria in a protist cell (LM)

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Chloroplasts: Capture of Light Energy

- Chloroplasts contain the green pigment chlorophyll, as well as enzymes and other molecules that function in photosynthesis
- Chloroplasts are found in leaves and other green organs of plants and in algae

plastids
- chloroplasts
- chromoplasts → to attract insects for pollination (نقل حبوب اللقاح من زهرة إلى أخرى)
- leucoplasts → colorless plastids for storage like: Amyloplasts (لتخزين النشا)

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- Chloroplast structure includes
  - **Thylakoids**, membranous sacs, stacked to form a **granum**
  - **Stroma**, the internal fluid
- The chloroplast is one of a group of plant organelles, called **plastids**

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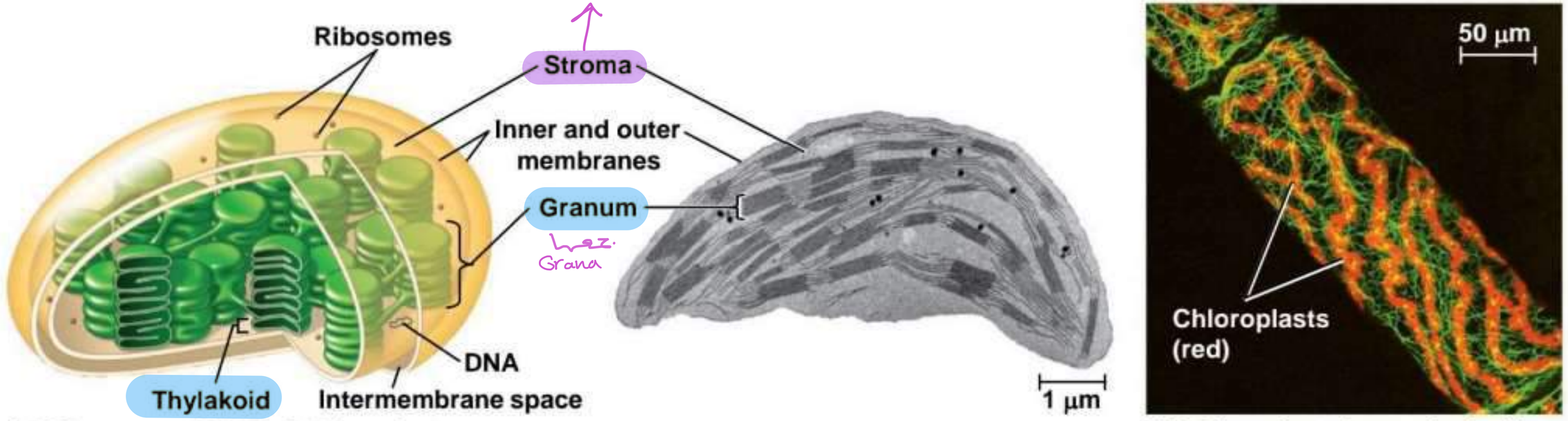
Figure 6.18

1 circular DNA
Free ribosomes
Thylakoids



(a) Diagram and TEM of chloroplast

(b) Chloroplasts in an algal cell

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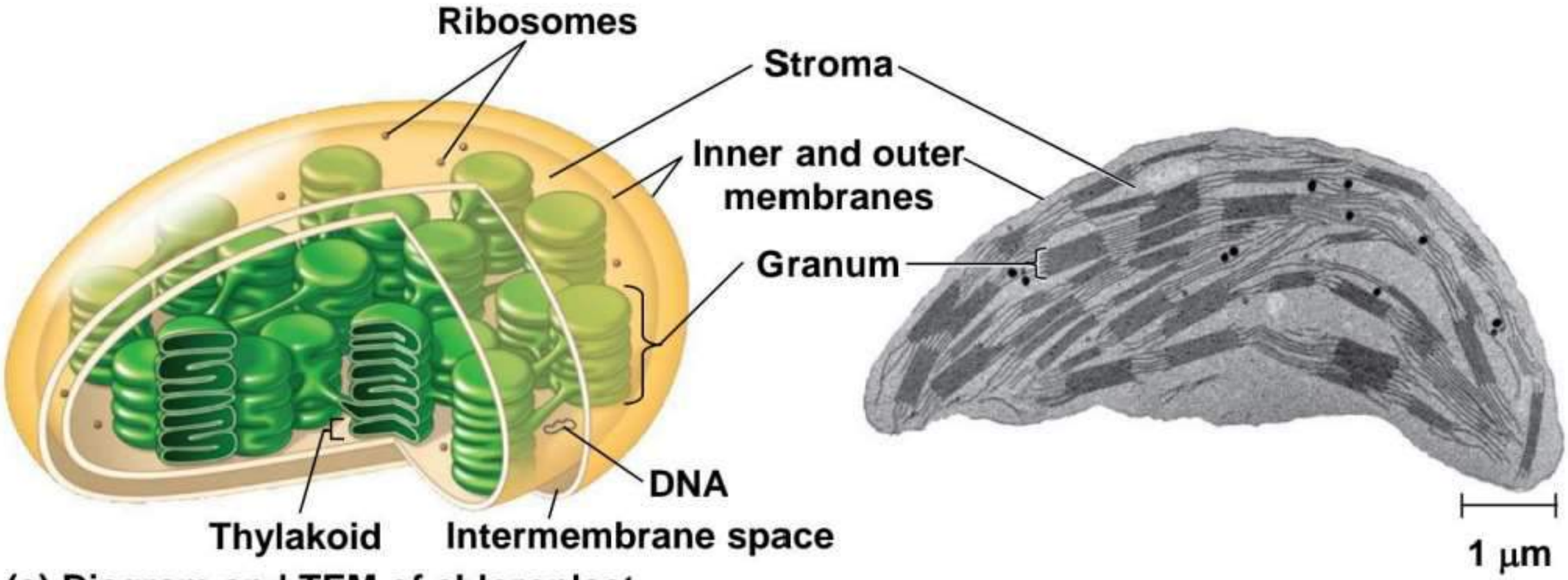
green pigment on the Thylakoid membrane

Figure 6.18a



(a) Diagram and TEM of chloroplast

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Figure 6.18aa

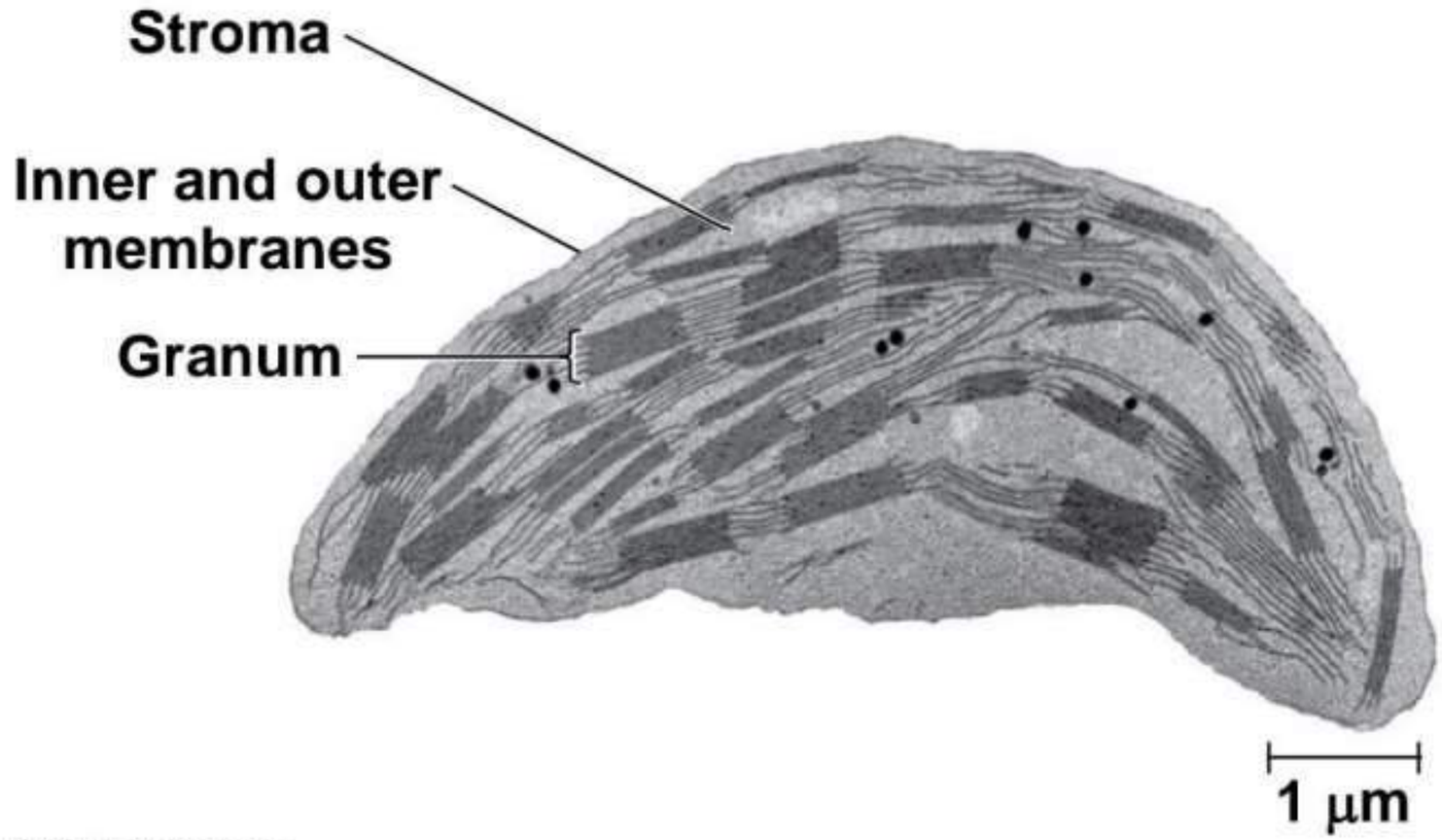

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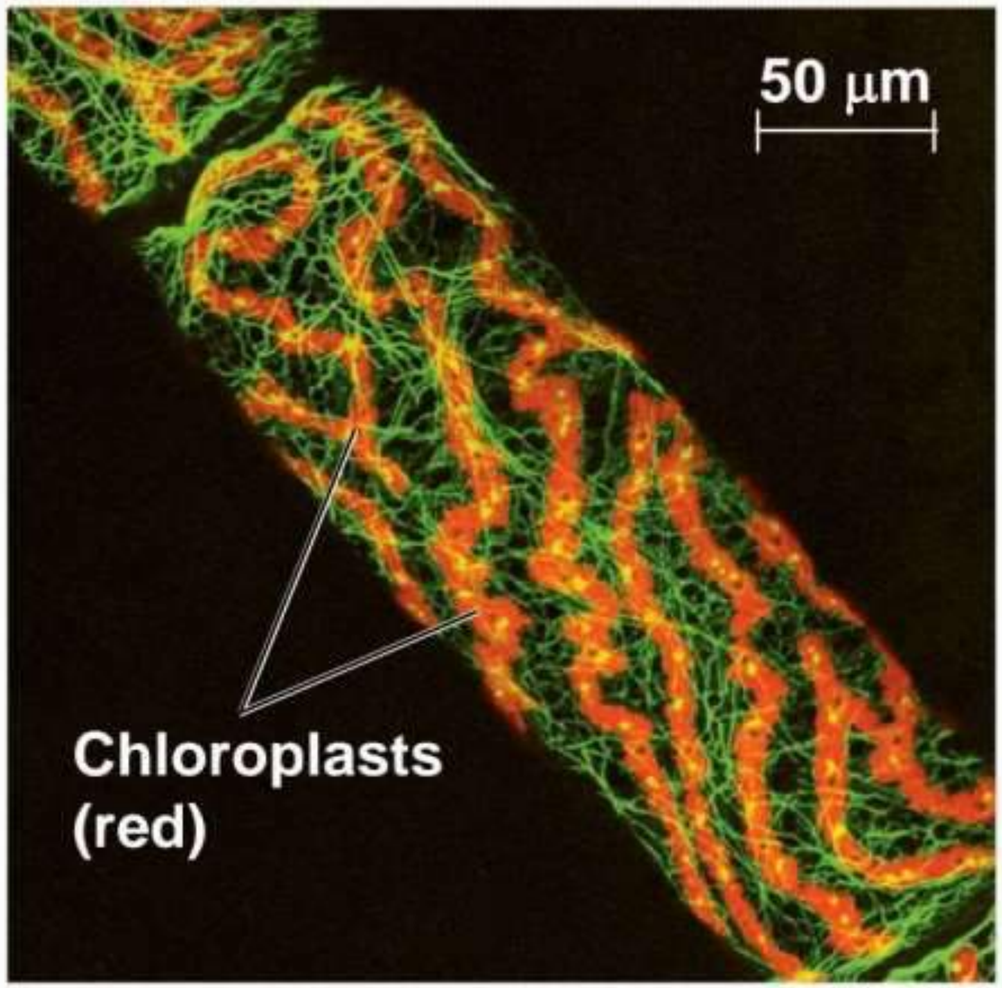
Figure 6.18b



(b) Chloroplasts in an algal cell

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Peroxisomes: Oxidation

difference between Peroxisomes and lysosomes

الأيض

- **Peroxisomes** are specialized metabolic compartments bounded by a single membrane
- Peroxisomes produce hydrogen peroxide and convert it to water
- Peroxisomes perform reactions with many different functions
- How peroxisomes are related to other organelles is still unknown

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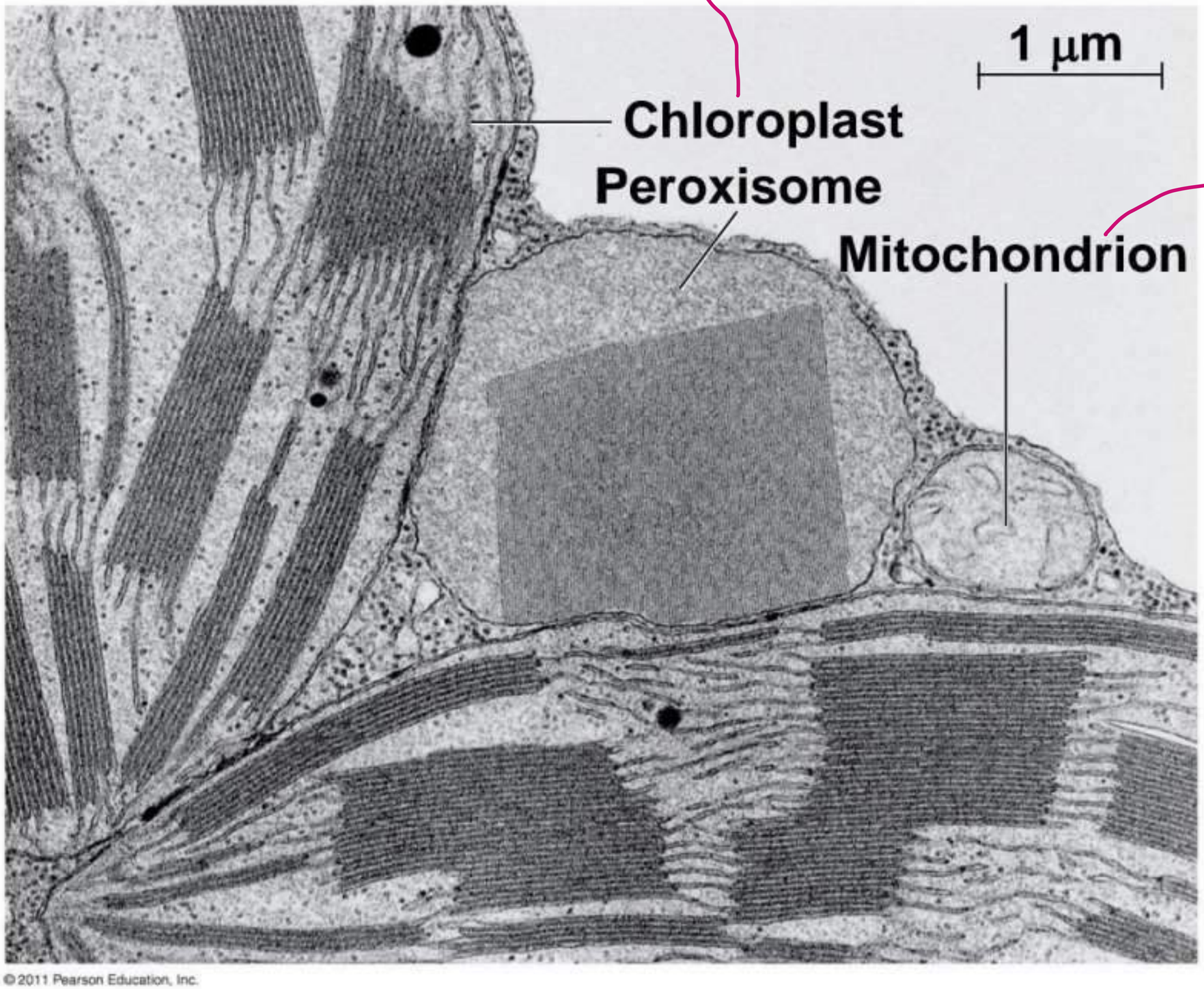
Figure 6.19

Photosynthesis
$CO_2 \rightarrow O_2$



cellular respiration
$O_2 \rightarrow CO_2$

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Type your text

Peroxisome Functions

في عمليات الايض في تعامل مع الاكسجين،بالتنفس الخلوي بتم استهلاكه وبالبناء الضوئي يتم انتاجه خلال هدول العمليتين قد ينتج اكسجين ضار as a byproduct مثل Hydrogen peroxide>> H2O2

يوجد مع صبغات الشعر وهو مادة حارقة

اذا تراكم هاد الاكسجين الضار في الخلية رح يحرقها عشان هيك اول ما يتكون الH2O2 بيجي الperoxisome وهو يحتوي على انزيم الكتاليز بفرز هاد الانزيم فبعمل الكتاليز على تحويل H2O2 السام الى اكسجين وماء فهيم هو ساهم بحماية الخلية

$$H_2O_2 \xrightarrow{Catalase} H_2O + O_2$$

يحتوي على انزيمات تقوم بتحويل lipids الى carbohydrates بهدف الحصول على مصدر طاقة سريع

الlipids مصدر عالي بالطاقة اما carbohydrates مصدر سريع للطاقة

فمثلا انحطت الخلية بموقف محتاجة فيه طاقة سريعة وما بتقدر تستنى حتى الدهون تعمل عملية Metabolism فهون بشتغل ال peroxisomal enzymes بحولوا الدهون الى كربوهيدرات لانتاج الطاقة

*Metabolism:chemical reactions that change food into energy للتوضيح

يوجد نوع خاص من peroxisomes اسمه glyoxysomes موجودين في plant seedlings

*بذرة النباتات هي التي تحتوي على الجنين Embryo

يعتمد الجنين على الغذاء المخزن على شكل دهون بالجذور وهون بشتغل ال glyoxysomes عشان تحول الدهون الى كربوهيدرات فهيك ال growing embryo بحصل على مصدر طاقة سريعة

Concept 6.6: The cytoskeleton is a network of fibers that organizes structures and activities in the cell

- The **cytoskeleton** is a network of fibers extending throughout the cytoplasm
- It organizes the cell's structures and activities, anchoring many organelles
- It is composed of three types of molecular structures
  - Microtubules
  - Microfilamentes
  - Intermediate filaments

مختلفون في نوع البروتين و diameter of the fiber

function

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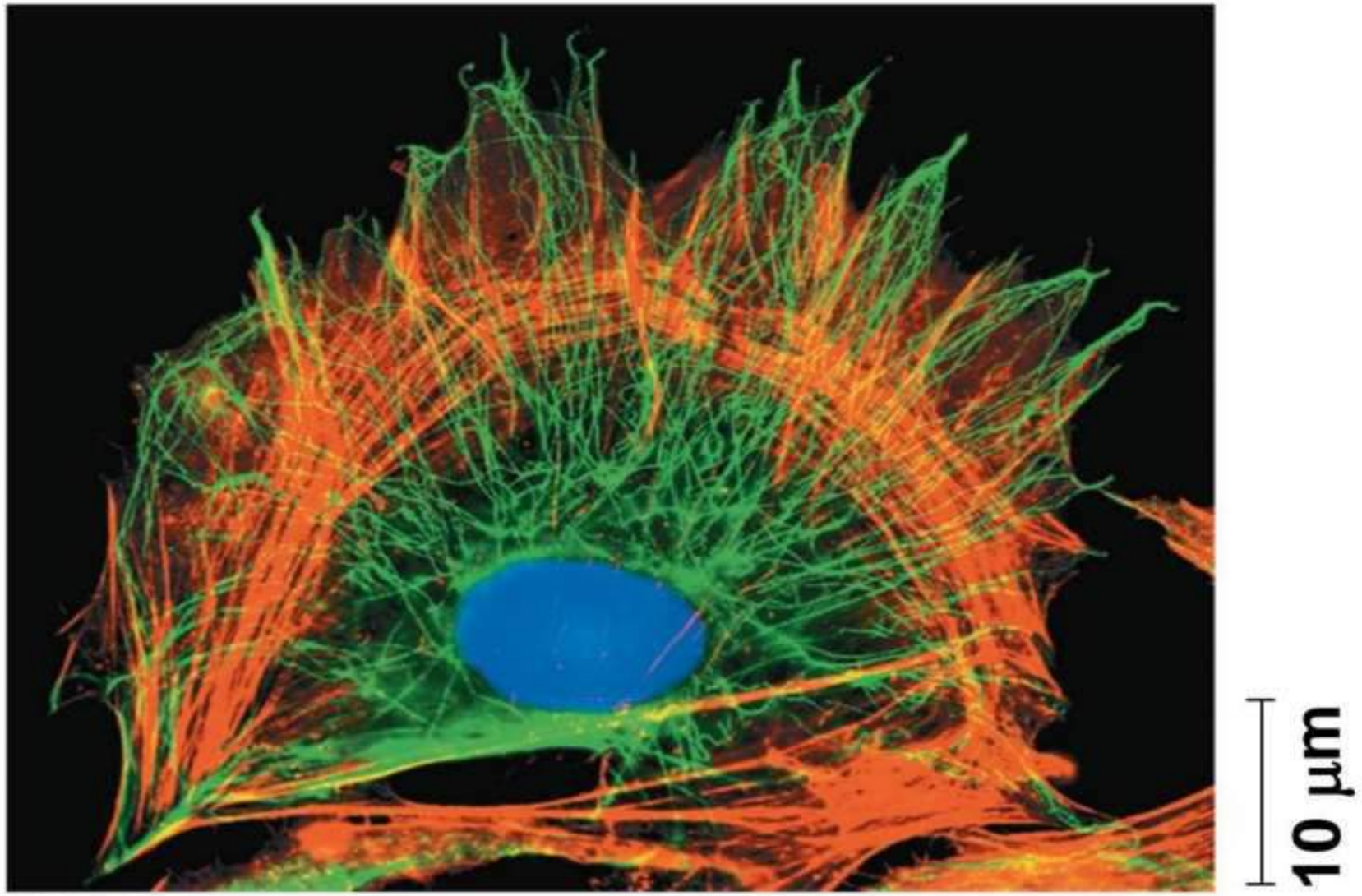
Figure 6.20



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Roles of the Cytoskeleton:

Support and Motility

دعامة حركة

most important function وبشتركوا فيها كلهم

- The cytoskeleton helps to support the cell and maintain its shape
- It interacts with **motor proteins** to produce motility
- Inside the cell, vesicles can travel along "monorails" provided by the cytoskeleton
- Recent evidence suggests that the cytoskeleton may help regulate biochemical activities

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Figure 6.21

Motility

عشان بمشي بحتاج لطاقة

Activation وهي بتعمل
motor protein للـ

ATP

Vesicle

Receptor for motor protein

Vesicle بحتاج له الـ
عشان يقدر يركب عليه

Motor protein (ATP powered)

Microtubule of cytoskeleton

زي حالنا شوارع بمشي عليها

Vesicle الـ تتحرك
باستخدام
وهي وحدة
من مكونات
Cytoskeleton

(a)

Microtubule

Vesicles

0.25 µm

(b)

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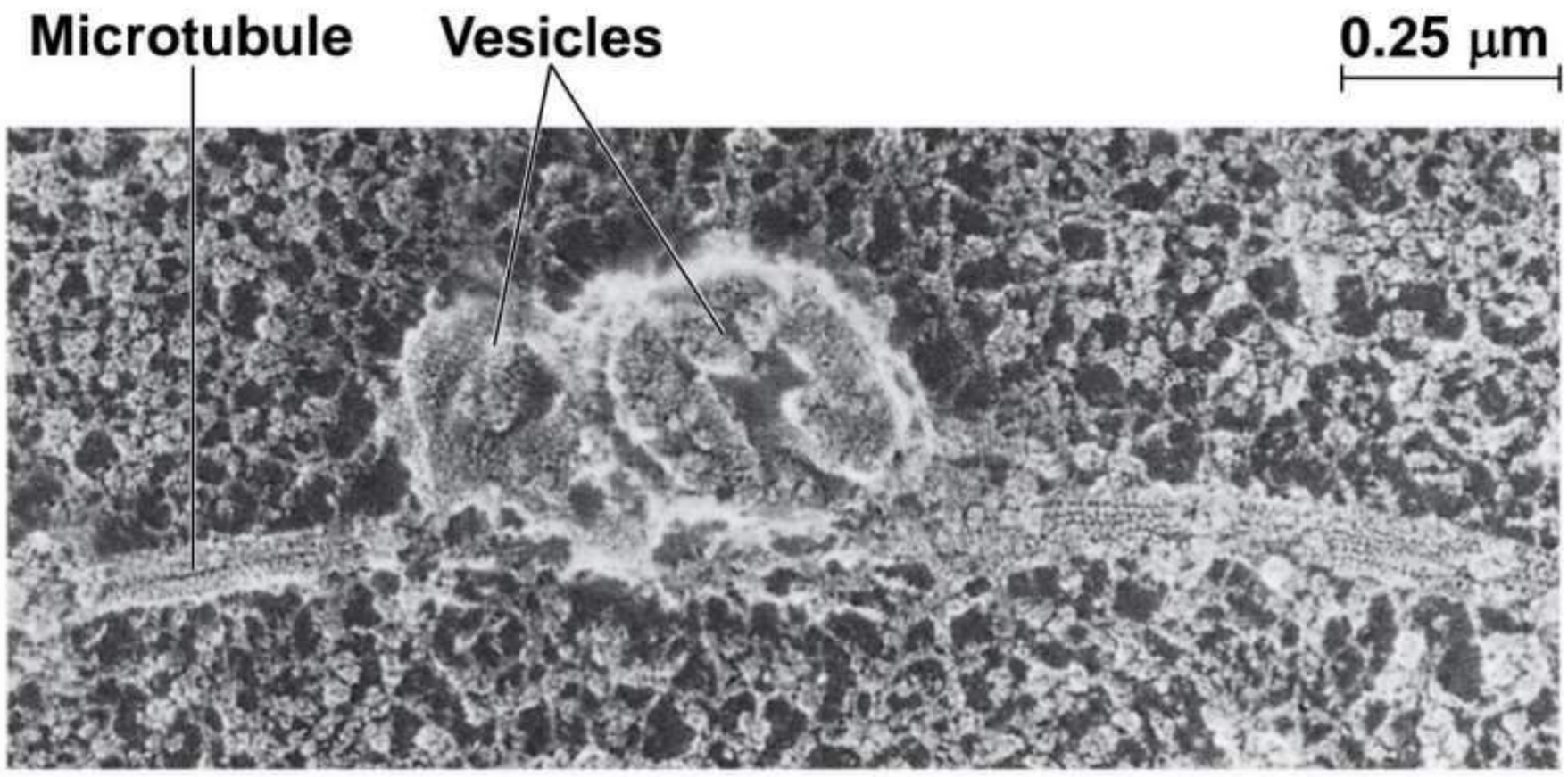
Figure 6.21a



(b)

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Components of the Cytoskeleton

- Three main types of fibers make up the cytoskeleton
  - *Microtubules* are the thickest of the three components of the cytoskeleton
  - *Microfilaments*, also called actin filaments, are the thinnest components
  - *Intermediate filaments* are fibers with diameters in a middle range

قطر الدائرة
diameter أكبر

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Table 6.1

Table 6.1 The Structure and Function of the Cytoskeleton

Property	Microtubules (Tubulin Polymers)	Microfilaments (Actin Filaments)	Intermediate Filaments
Structure	Hollow tubes; wall consists of 13 columns of tubulin molecules	Two intertwined strands of actin, each a polymer of actin subunits	Fibrous proteins supercoiled into thicker cables
Diameter	25 nm with 15-nm lumen	7 nm	8–12 nm
Protein subunits	Tubulin, a dimer consisting of α-tubulin and β-tubulin	Actin	One of several different proteins (such as keratins), depending on cell type
Main functions	Maintenance of cell shape (compression-resisting "girders") Cell motility (as in cilia or flagella) Chromosome movements in cell division Organelle movements	Maintenance of cell shape (tension-bearing elements) Changes in cell shape Muscle contraction Cytoplasmic streaming Cell motility (as in pseudopodia) Cell division (cleavage furrow formation)	Maintenance of cell shape (tension-bearing elements) Anchorage of nucleus and certain other organelles Formation of nuclear lamina

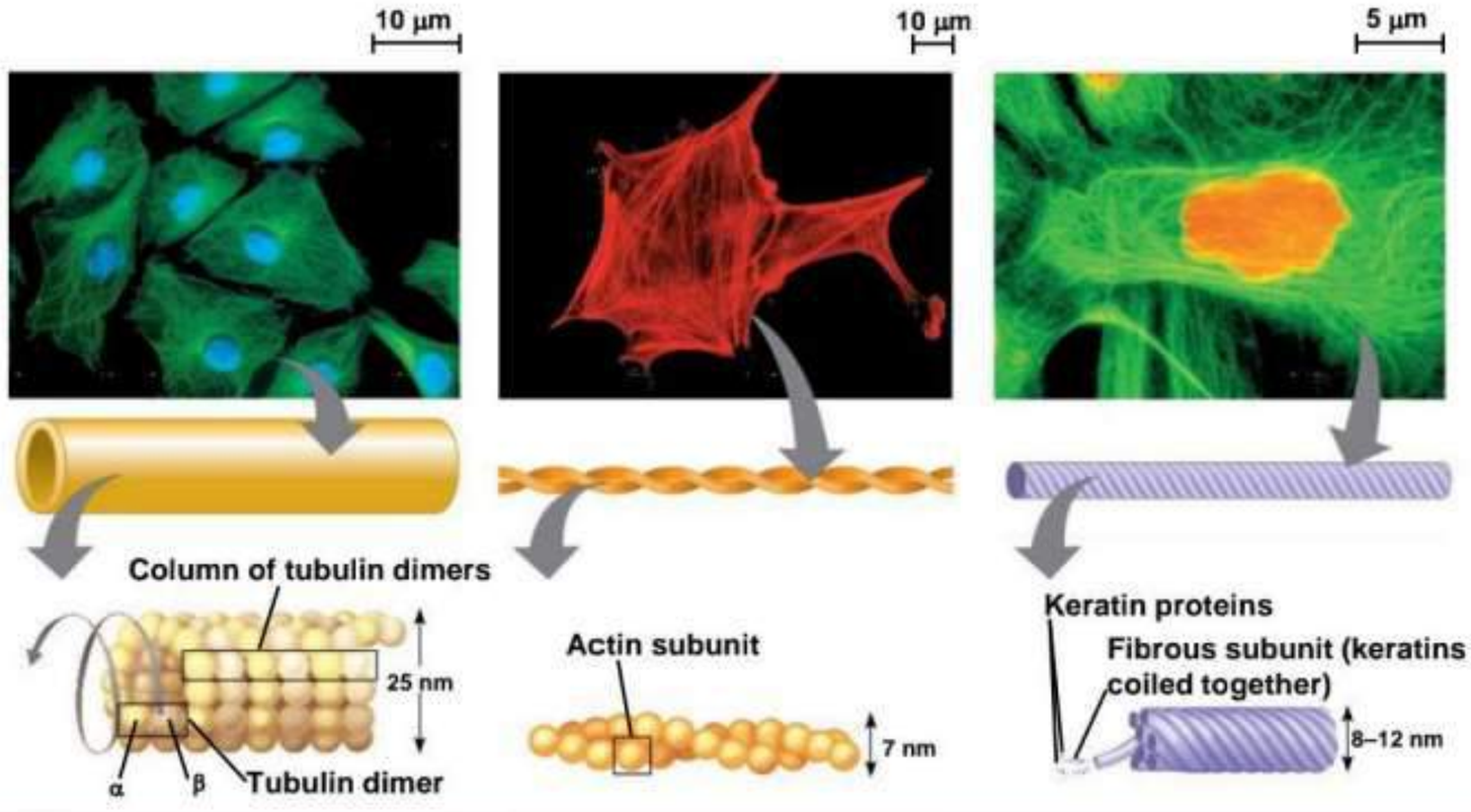

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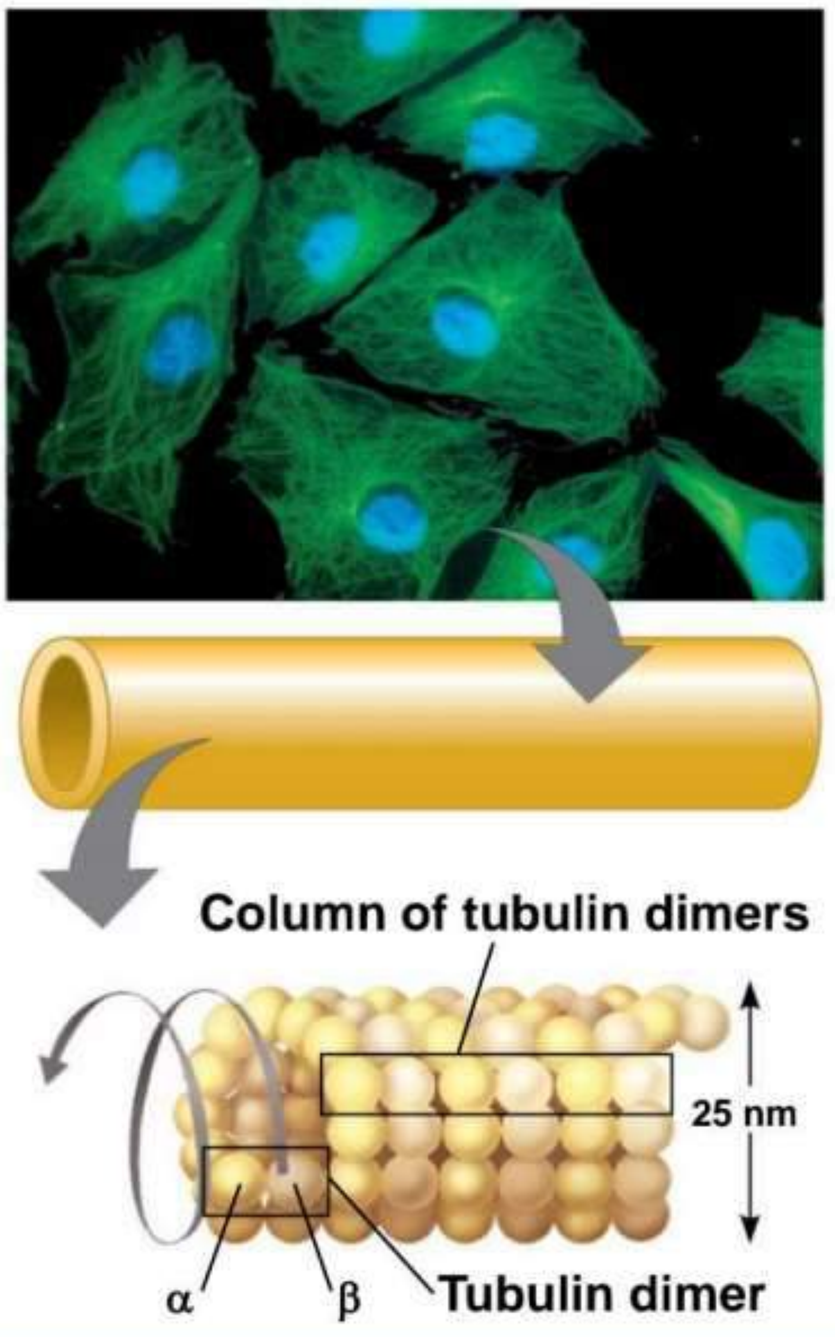
Table 6.1a

Property	Microtubules (Tubulin Polymers)
Structure	Hollow tubes; wall consists of 13 columns of tubulin molecules
Diameter	25 nm with 15-nm lumen
Protein subunits	Tubulin, a dimer consisting of α-tubulin and β-tubulin
Main functions	Maintenance of cell shape (compression-resisting "girders")
	Cell motility (as in cilia or flagella)
	Chromosome movements in cell division
	Organelle movements



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Microtubules

- **Microtubules** are hollow rods about 25 nm in diameter and about 200 nm to 25 microns long
- Functions of microtubules
  - Shaping the cell
  - Guiding movement of organelles
  - Separating chromosomes during cell division

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Centrosomes and Centrioles

- In many cells, microtubules grow out from a **centrosome** near the nucleus
- The centrosome is a "microtubule-organizing center"
- In animal cells, the centrosome has a pair of **centrioles**, each with nine triplets of microtubules arranged in a ring

9+0

9 عدد الأذرع

0 تدل على عدم وجود Microtubules في النص

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Figure 6.22

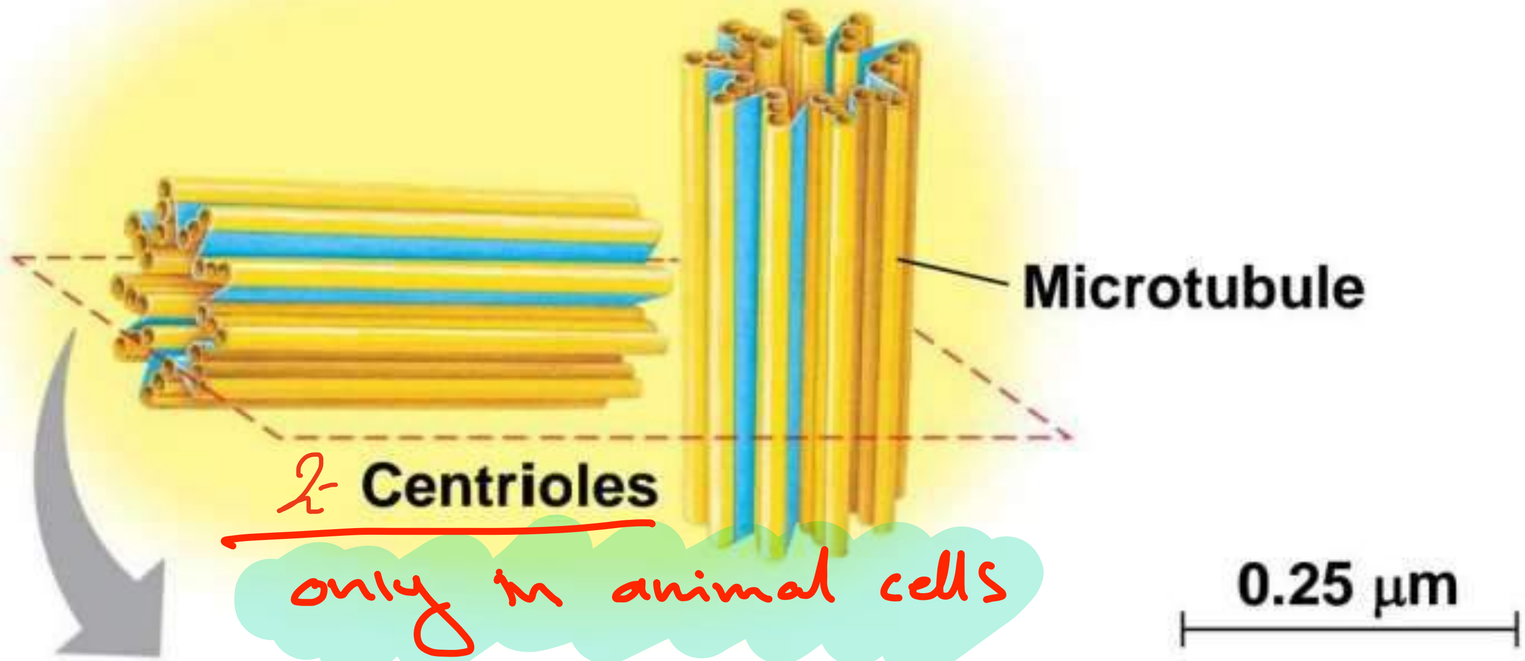
in both plant and animal cells

Centrosome

خلاصة حيوان كلها عبارة عن macrotubules

اللي هي الخيوط المغزلية spindle fibers

مسؤول عنها الـ Centrosome



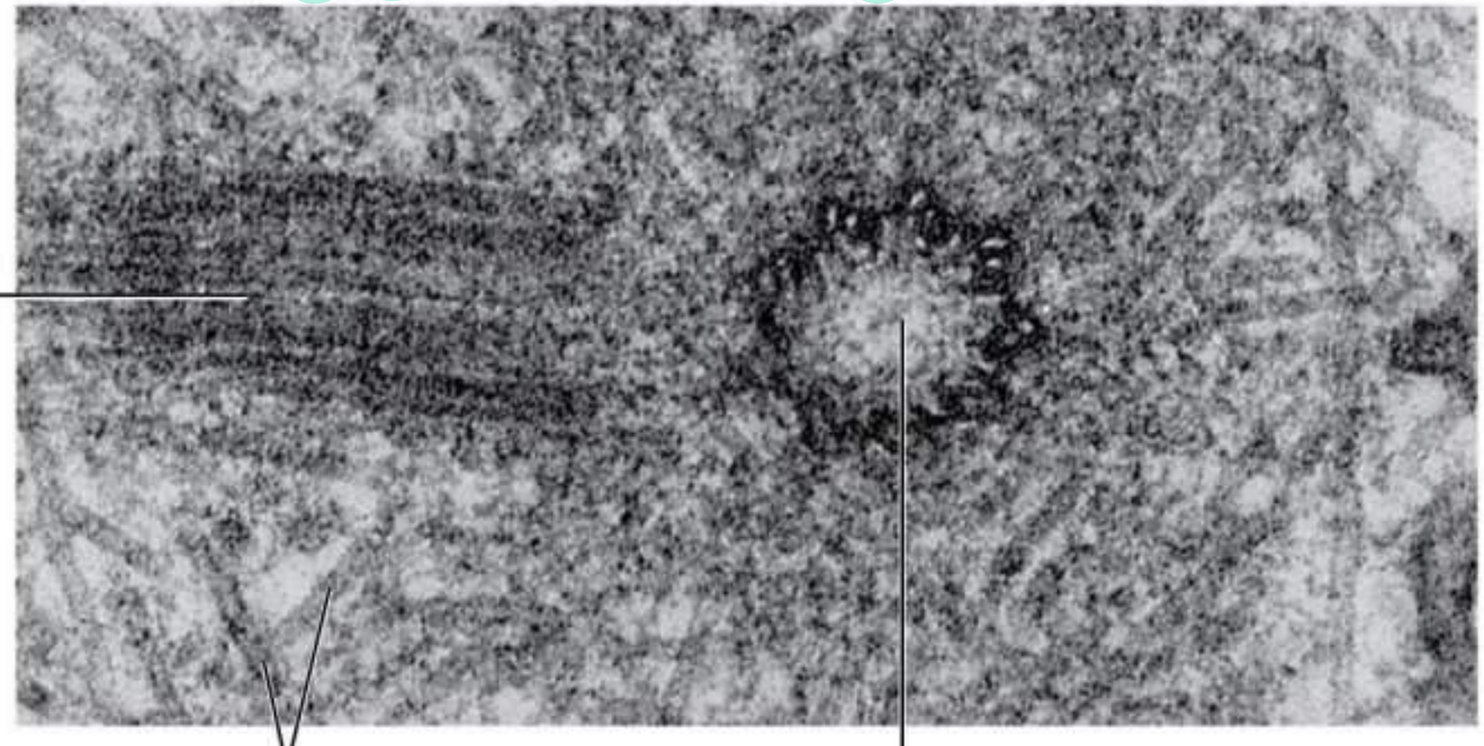


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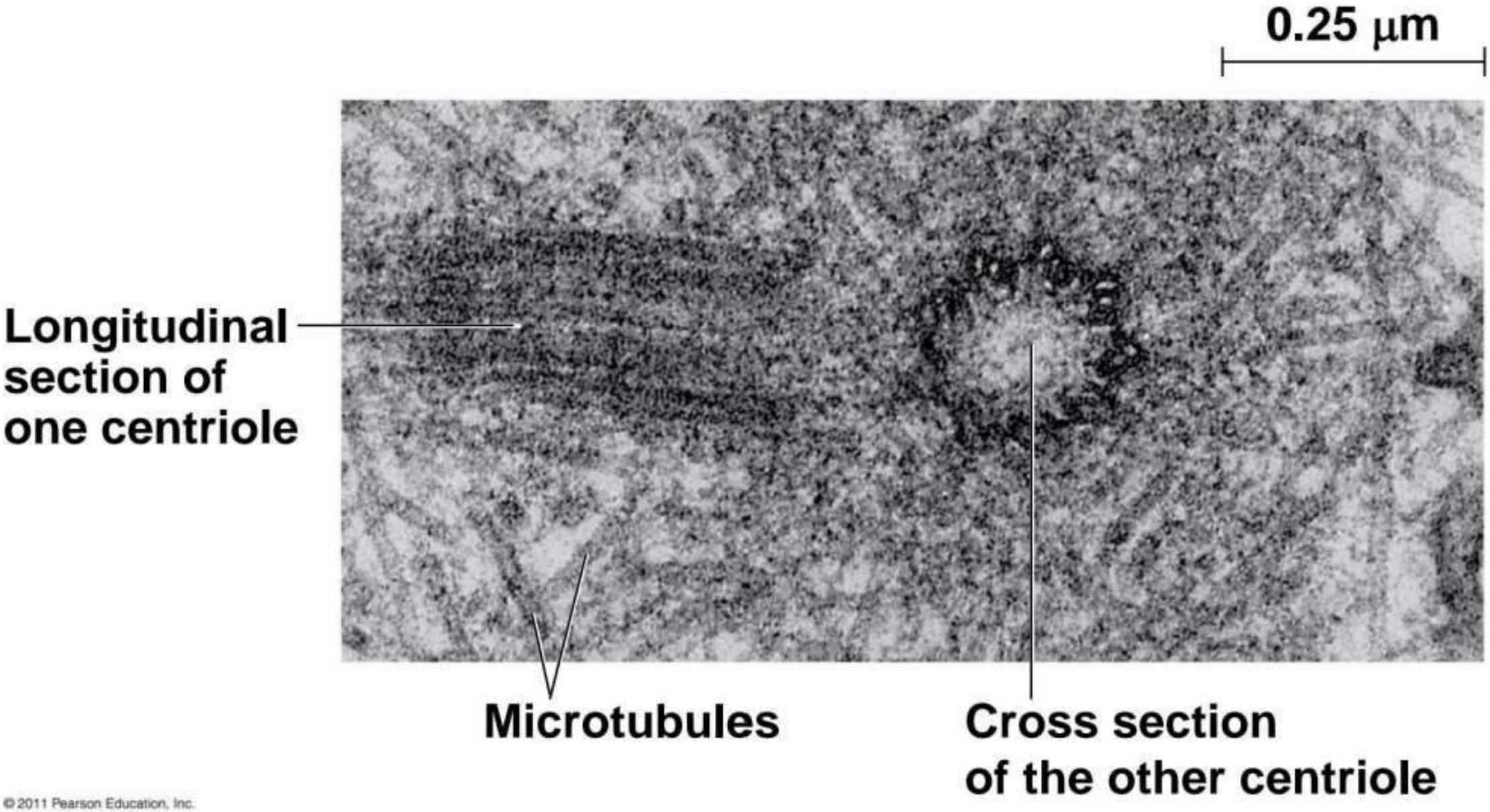
Figure 6.22a



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الاهداب　　الاسواط

Cilia and Flagella → for cell motility

- Microtubules control the beating of **cilia** and **flagella**, locomotor appendages of some cells
- Cilia and flagella differ in their beating patterns

PLAY Video: *Chlamydomonas*

PLAY Video: *Paramecium* Cilia

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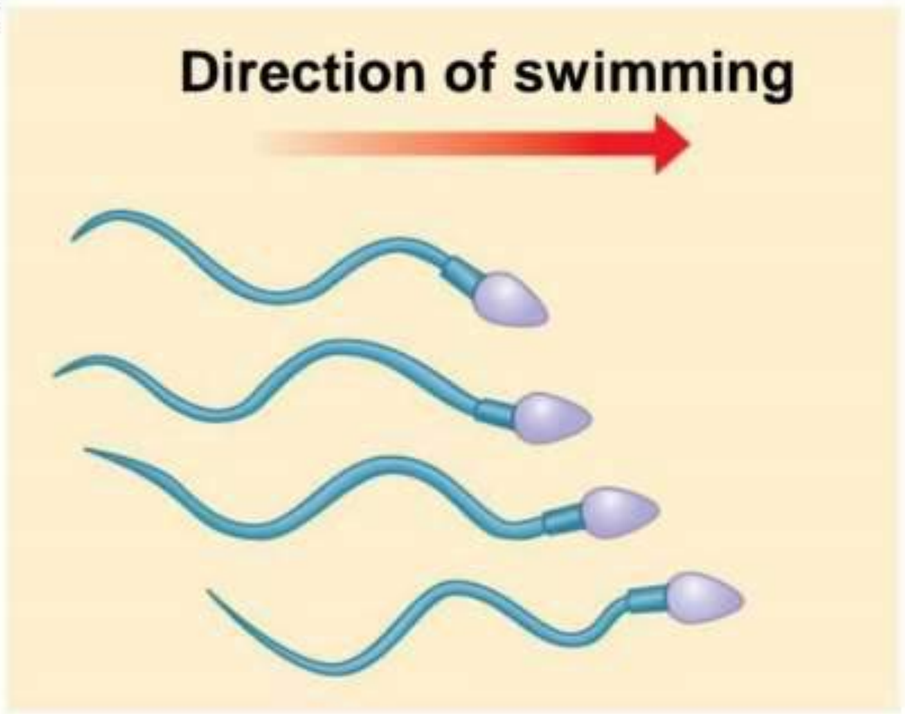
Figure 6.23

Same structure

They have the

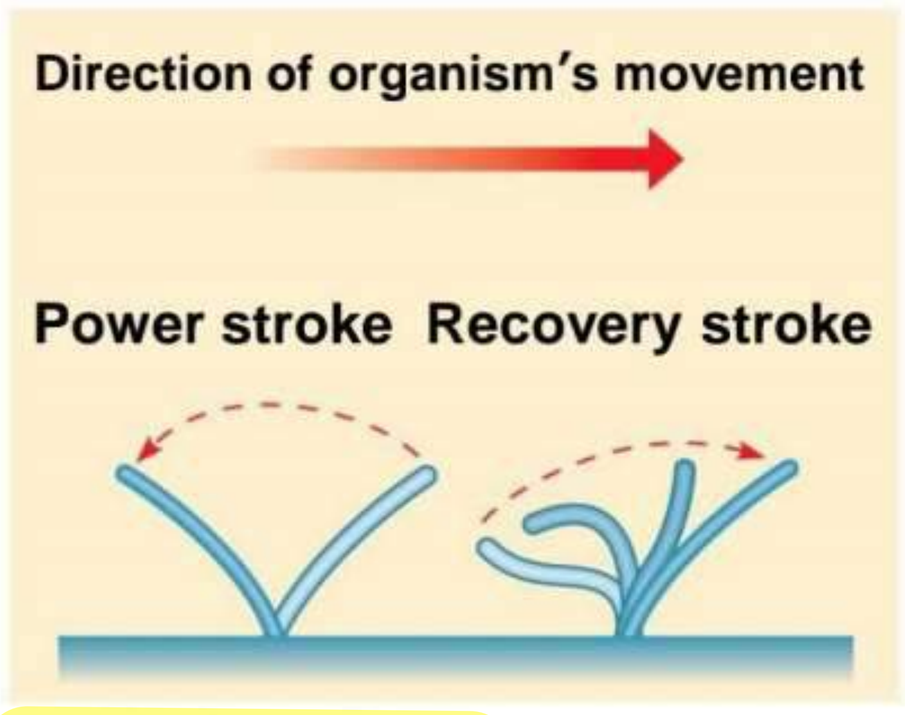


(a) Motion of flagella

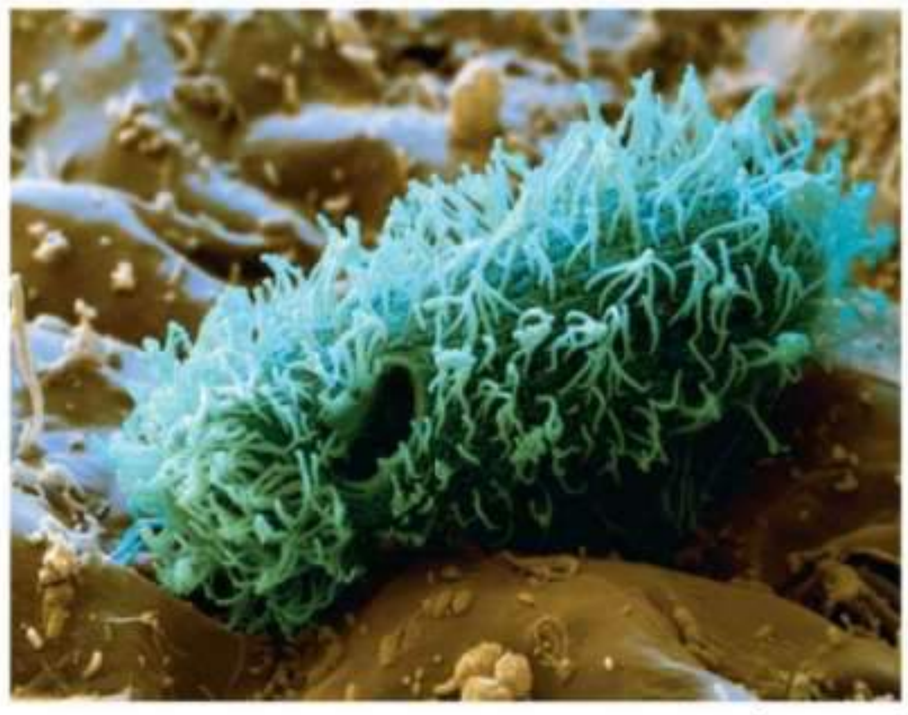
عدد محدود

أطول

حركة الخلية مع حركتها



(b) Motion of cilia



عدد كبير

أقصر

عكس اتجاه الحركة

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- Cilia and flagella share a common structure
  - A core of microtubules sheathed by the plasma membrane
  - A **basal body** that anchors the cilium or flagellum
  - A motor protein called **dynein**, which drives the bending movements of a cilium or flagellum

PLAY Animation: Cilia and Flagella

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Figure 6.24

Microtubules

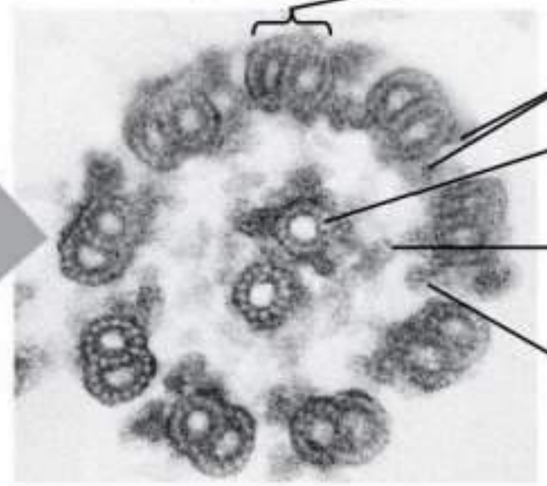
Plasma membrane

Basal body

0.5 μm

(a) Longitudinal section of motile cilium

0.1 μm



(b) Cross section of motile cilium

Outer microtubule doublet

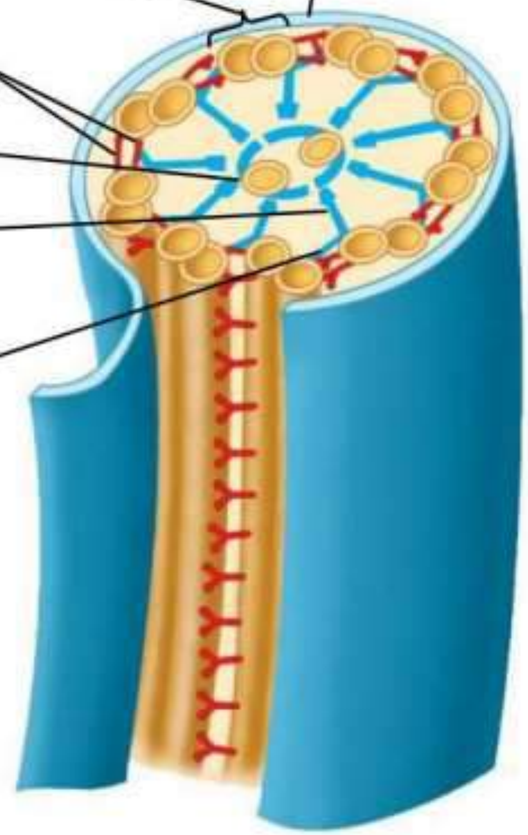
Dynein proteins

Central microtubule

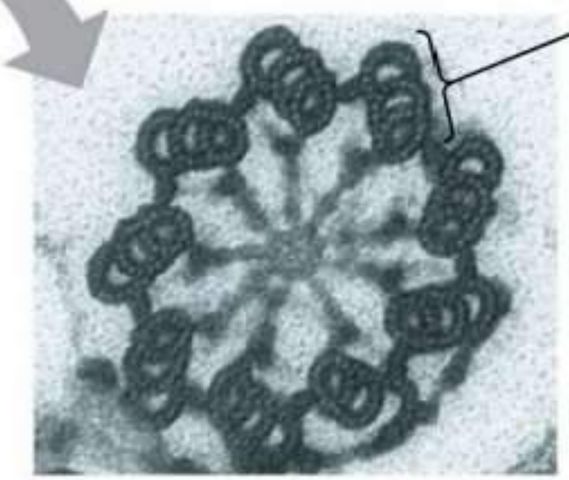
Radial spoke

Cross-linking proteins between outer doublets

Plasma membrane



0.1 μm



(c) Cross section of basal body

Triplet

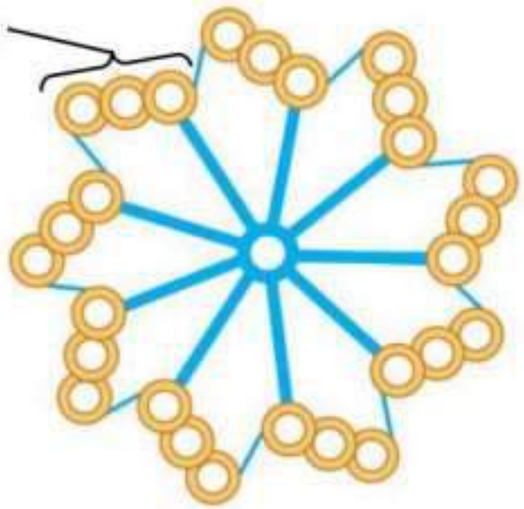


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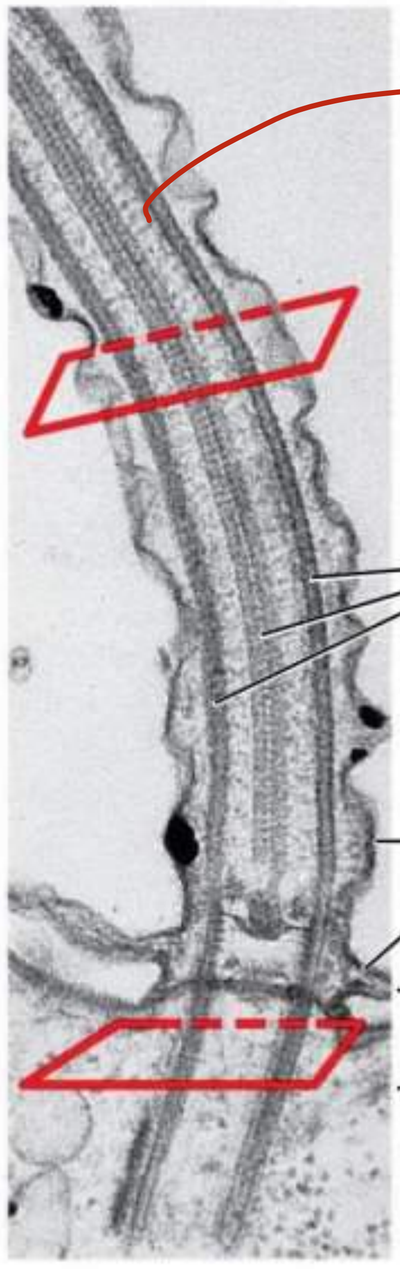
Figure 6.24a



Free part
مسؤول عن الحركة

Microtubules

Plasma membrane

Basal body

قاعدي ← Base in

attached to the plasma membrane

0.5 μm

(a) Longitudinal section of motile cilium

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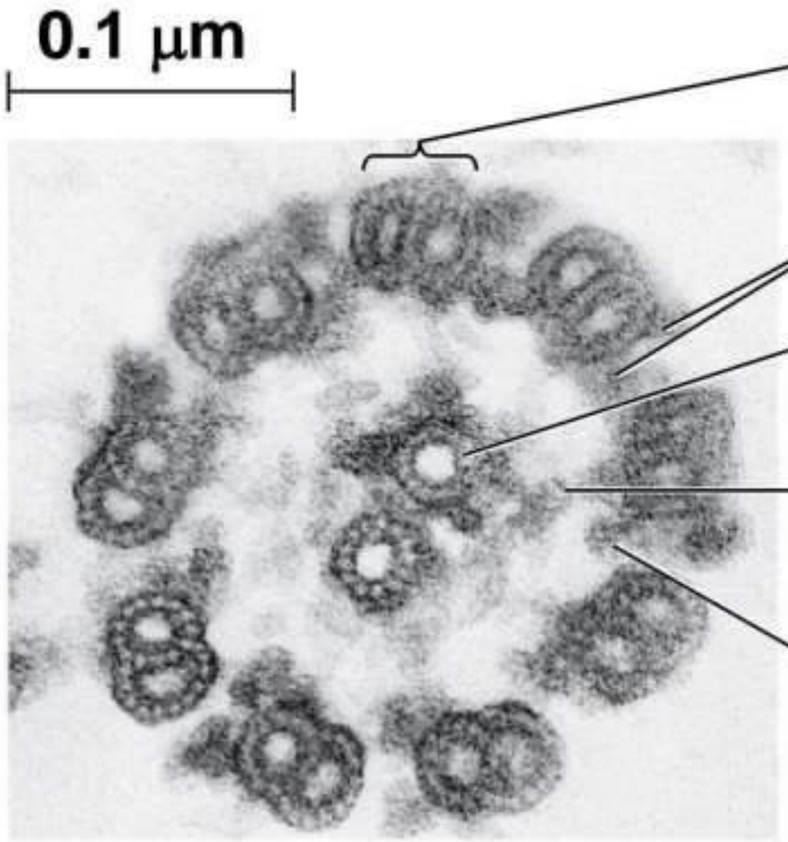
Figure 6.24b



(b) Cross section of motile cilium

الأهداب المتحركة
(Free part)

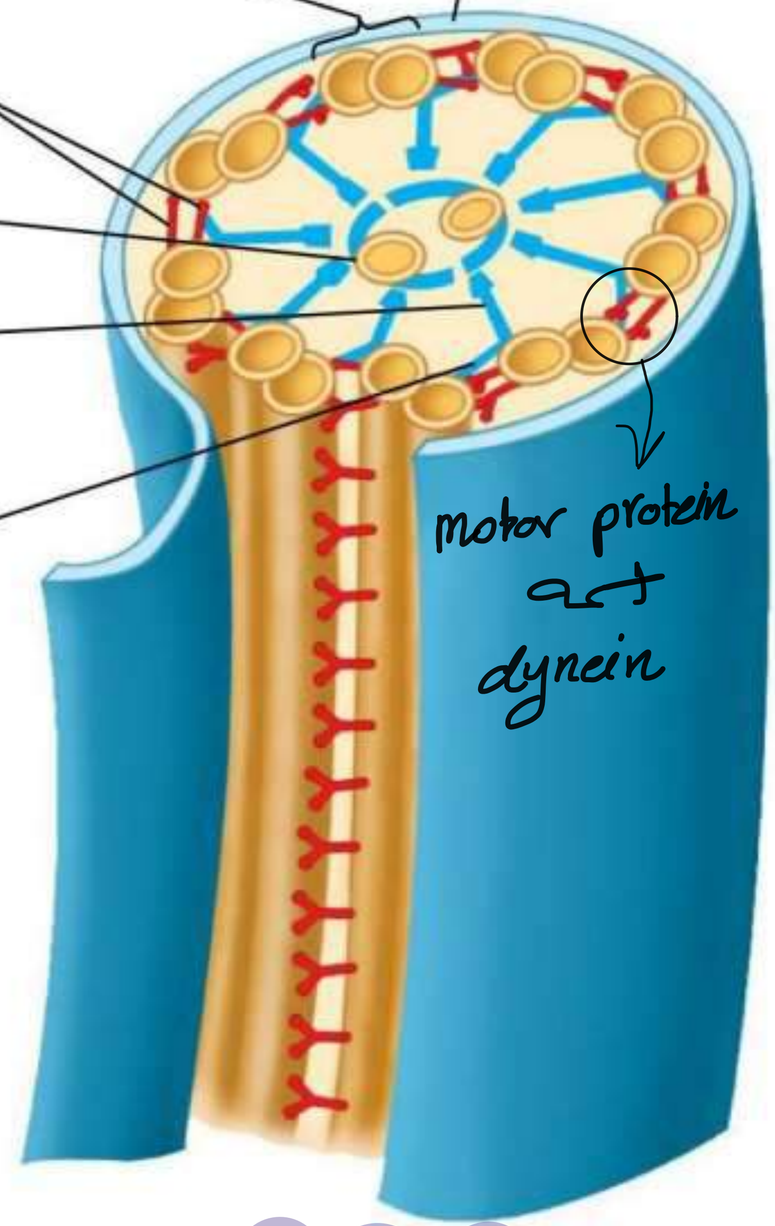
Outer microtubule doublet

Dynein proteins

Central microtubule

Radial spoke

Cross-linking proteins between outer doublets



9+2

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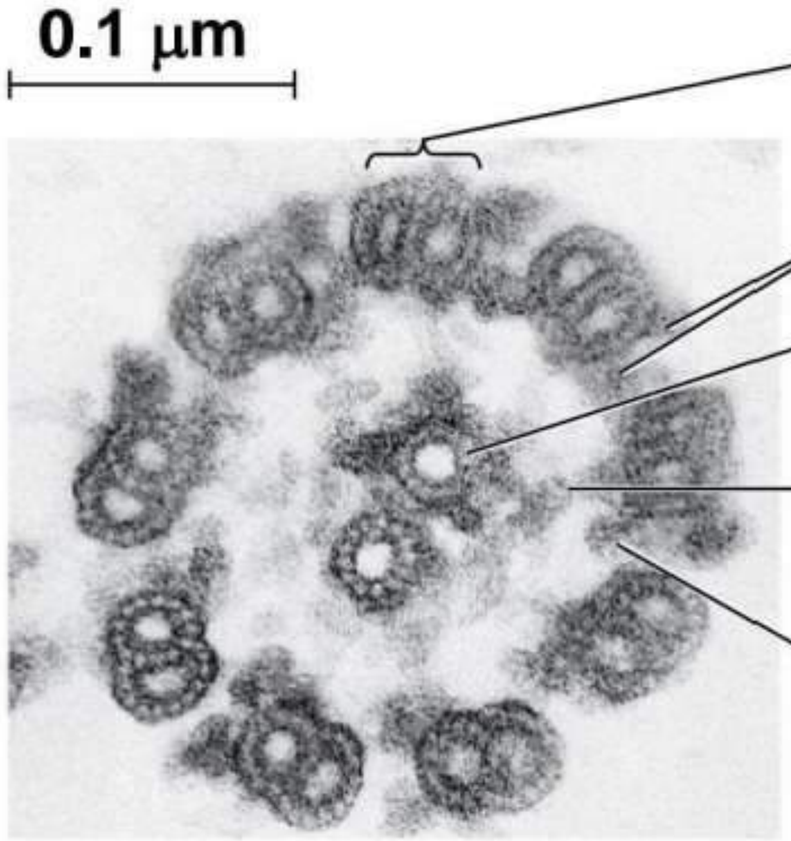
Figure 6.24ba



(b) Cross section of motile cilium

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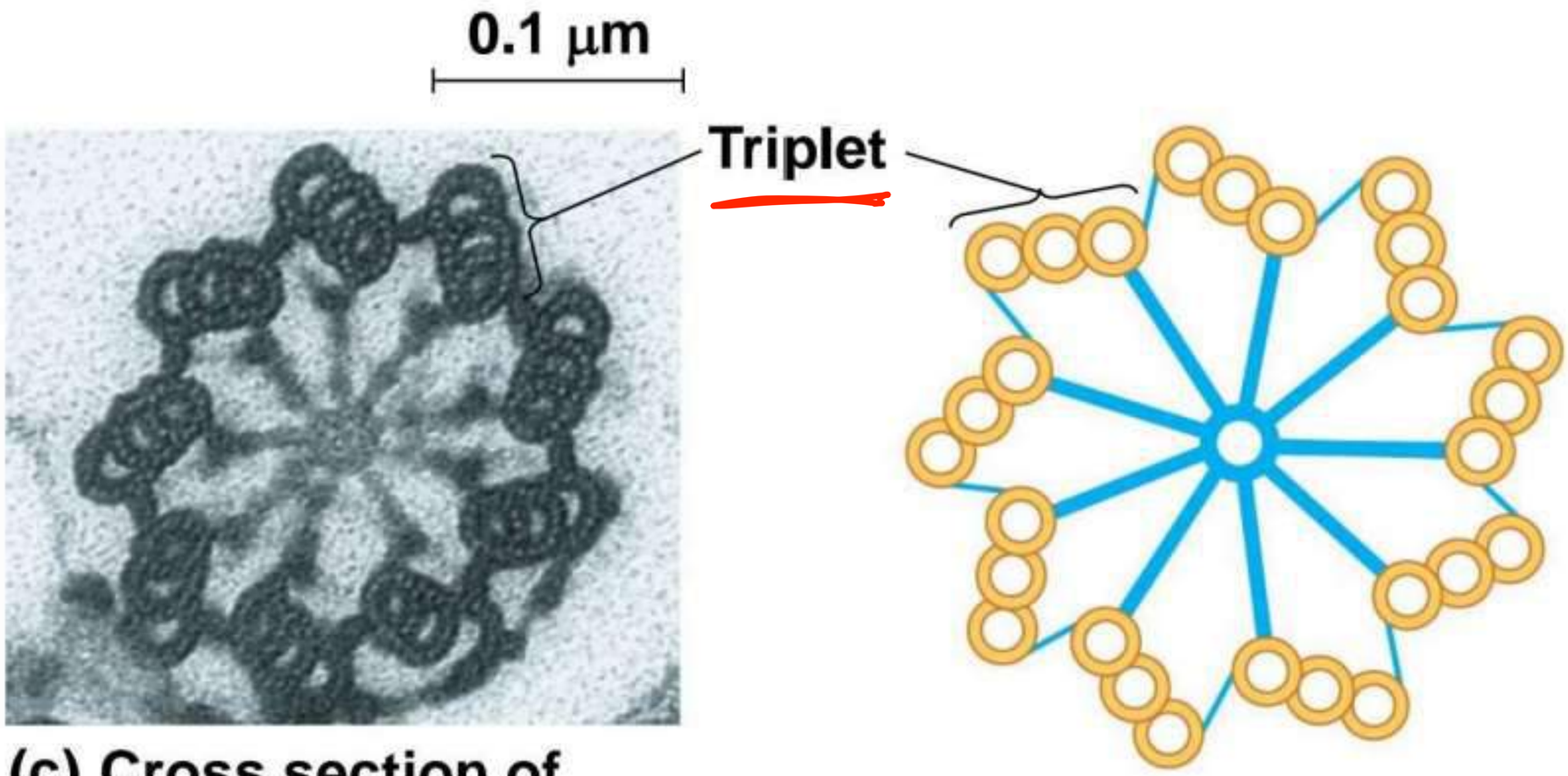
Figure 6.24c

9+0



(c) Cross section of basal body

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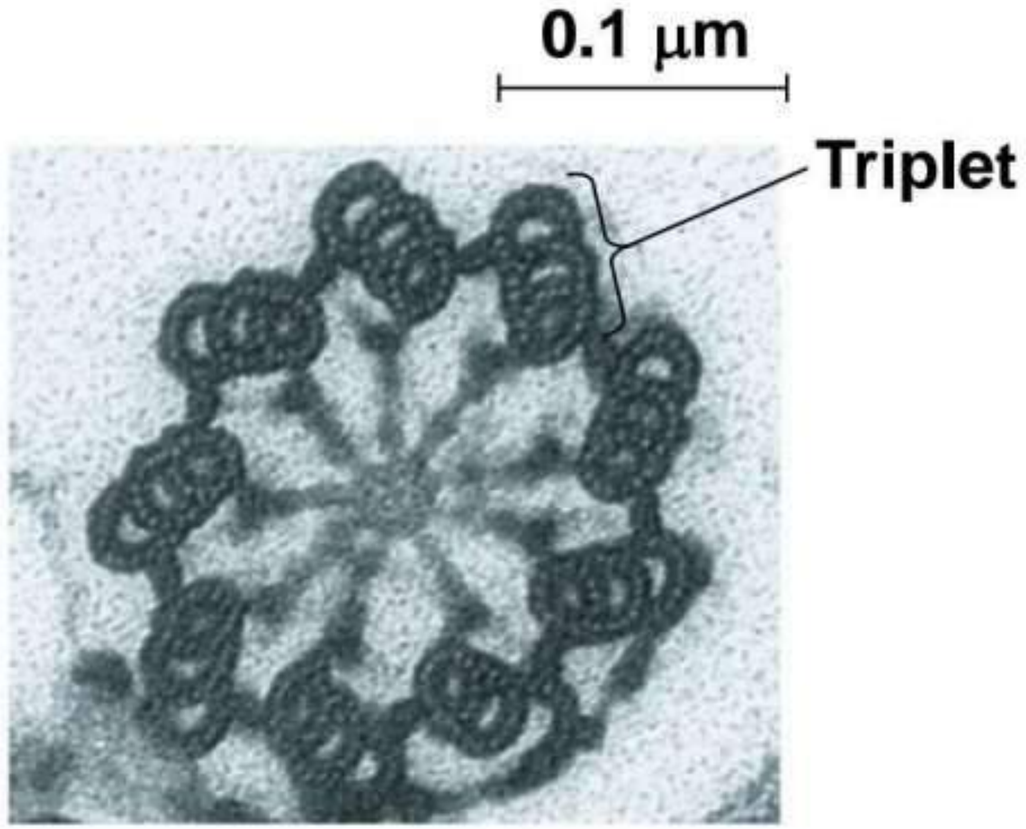
The organization of the microtubules in the basal body is the same as in the centrioles

هاد بدل على انهم من نفس المنشأ
وبثبت انهم في الخلايا الحيوانية فقط

Figure 6.24ca



(c) Cross section of basal body

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motor protein

- How dynein "walking" moves flagella and cilia
  - Dynein arms alternately grab, move, and release the outer microtubules تقوم الاذرع بالتناوب بامساك الانابيب الدقيقة الخارجية وتحريكها وتحريرها
  - Protein cross-links limit sliding الروابط المتقاطعة للبروتين تحد من الانزلاق
  - Forces exerted by dynein arms cause doublets to curve, bending the cilium or flagellum

تؤدي القوى التي تمارسها الاذرع الى انحناء الثنائيات مما يؤدي الى ثني الهدب او السوط

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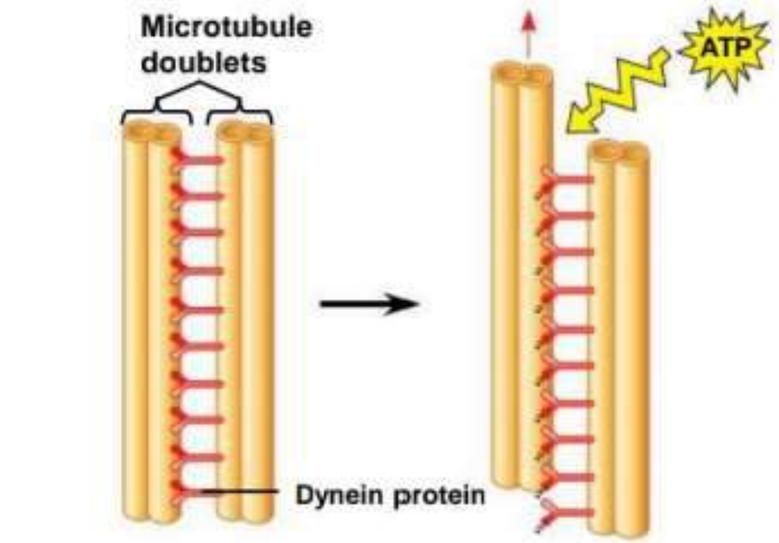
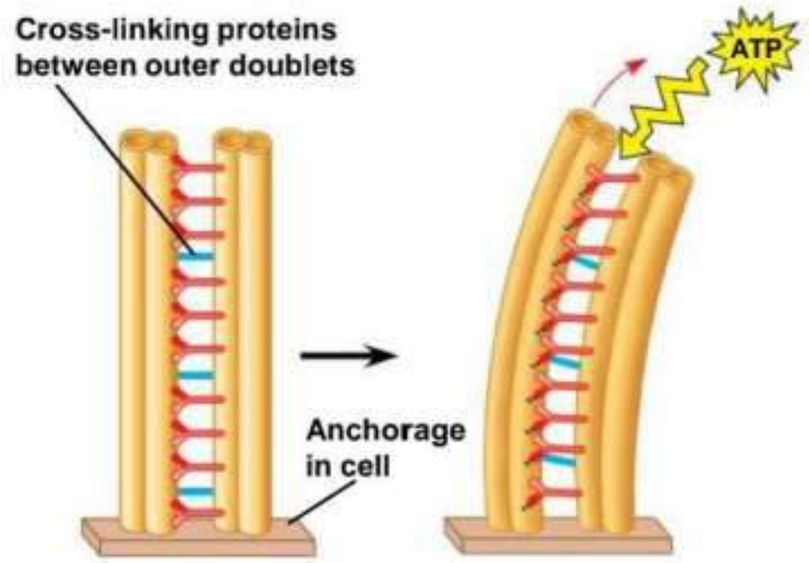
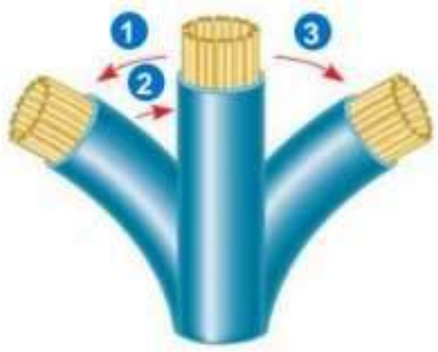
Figure 6.25



(a) Effect of unrestrained dynein movement



(b) Effect of cross-linking proteins



(c) Wavelike motion

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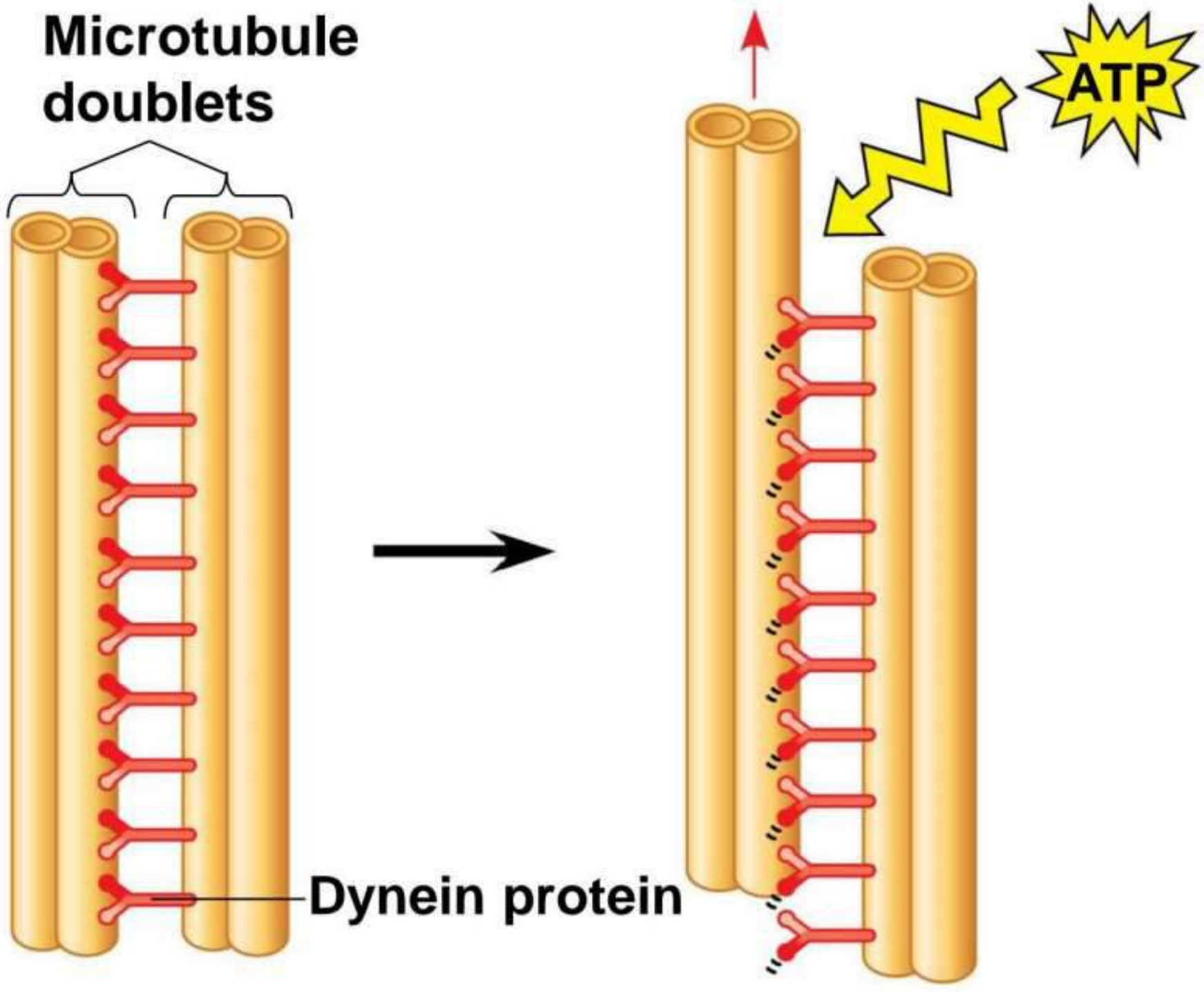
Figure 6.25a



(a) Effect of unrestrained dynein movement

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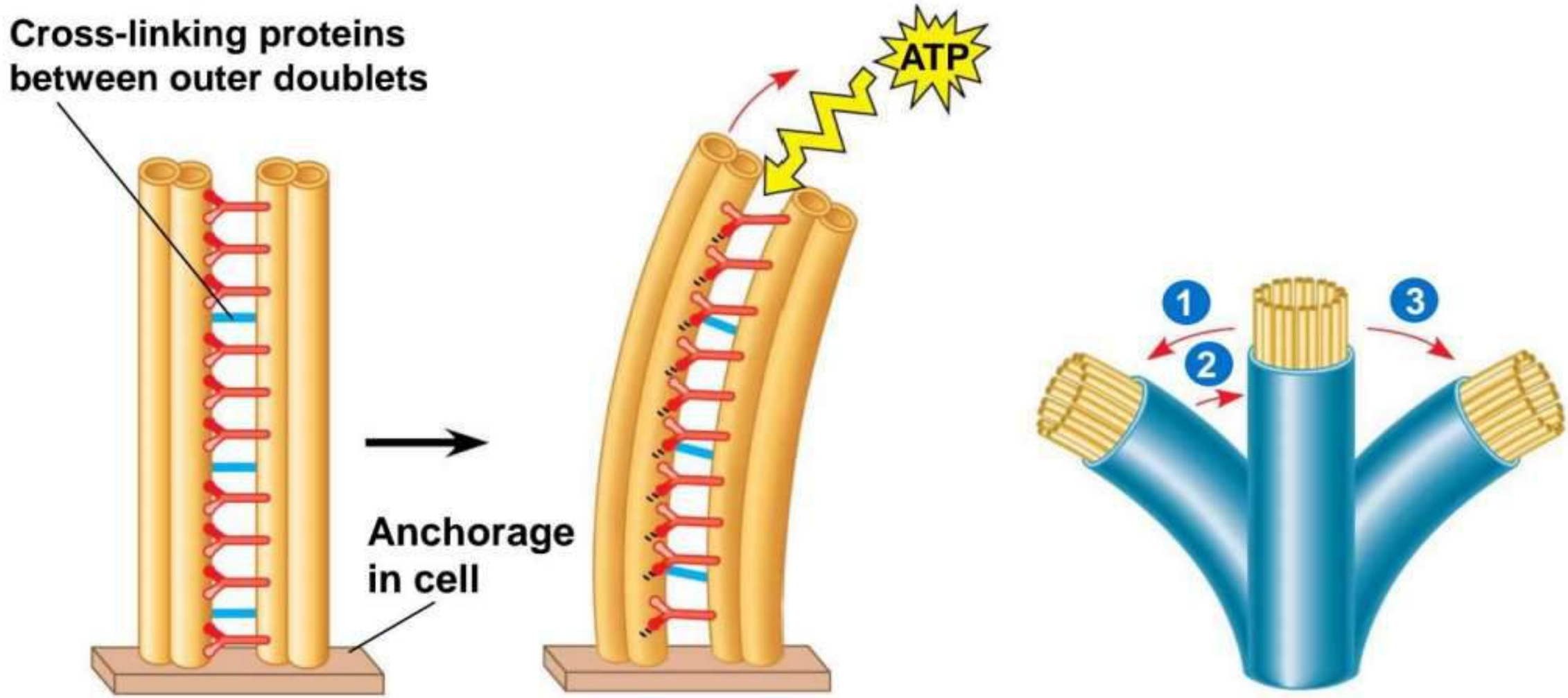
Figure 6.25b



(b) Effect of cross-linking proteins

(c) Wavelike motion

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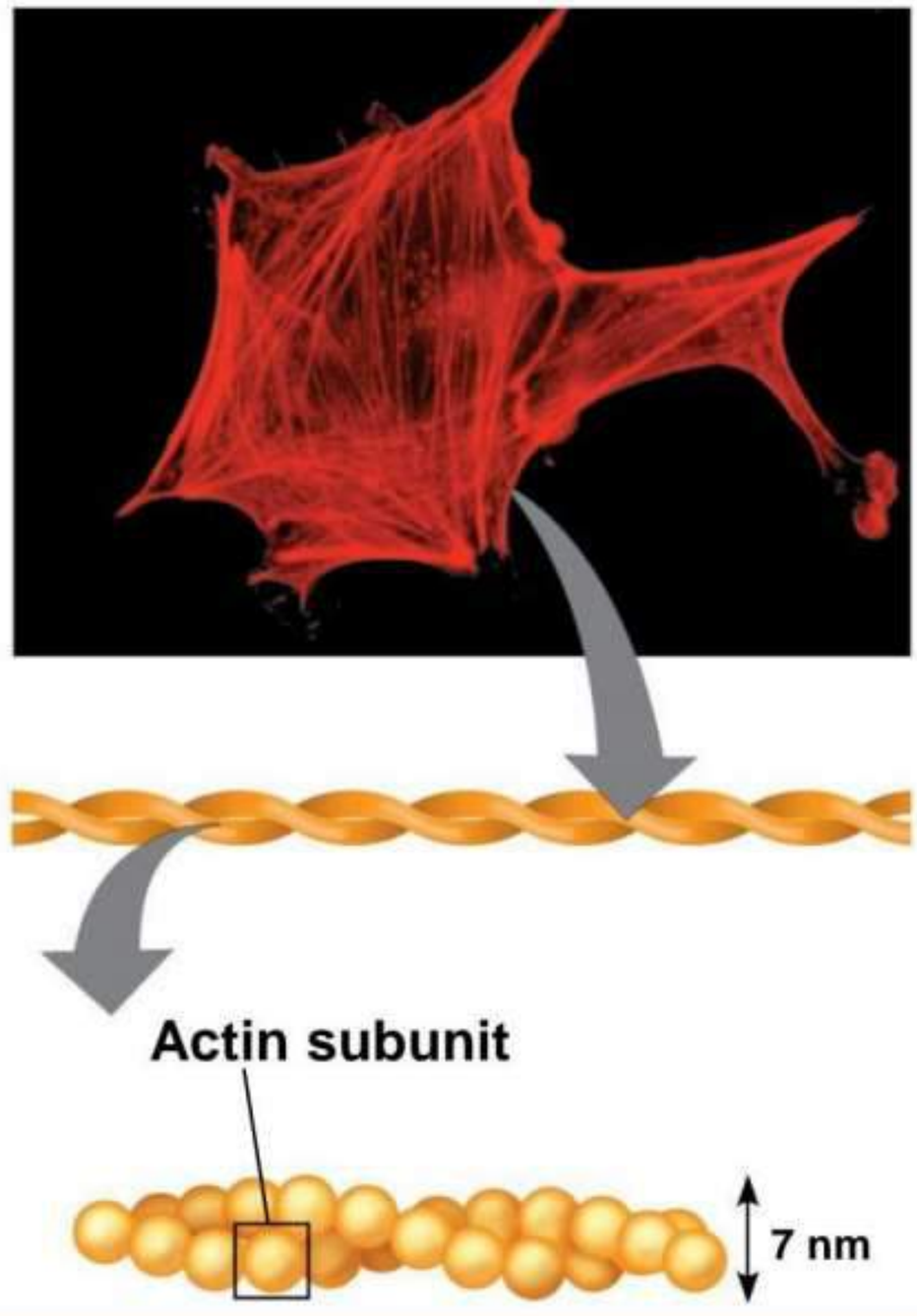
Table 6.1b

Property	Microfilaments (Actin Filaments)
Structure	Two intertwined strands of actin, each a polymer of actin subunits
Diameter	7 nm
Protein subunits	Actin
Main functions	Maintenance of cell shape (tension-bearing elements) Changes in cell shape Muscle contraction Cytoplasmic streaming Cell motility (as in pseudopodia) Cell division (cleavage furrow formation)



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Microfilaments (Actin Filaments)

- **Microfilaments** are solid rods about 7 nm in diameter, built as a twisted double chain of **actin** subunits
- The structural role of microfilaments is to bear tension, resisting pulling forces within the cell
- They form a 3-D network called the **cortex** just inside the plasma membrane to help support the cell's shape
- Bundles of microfilaments make up the core of microvilli of intestinal cells

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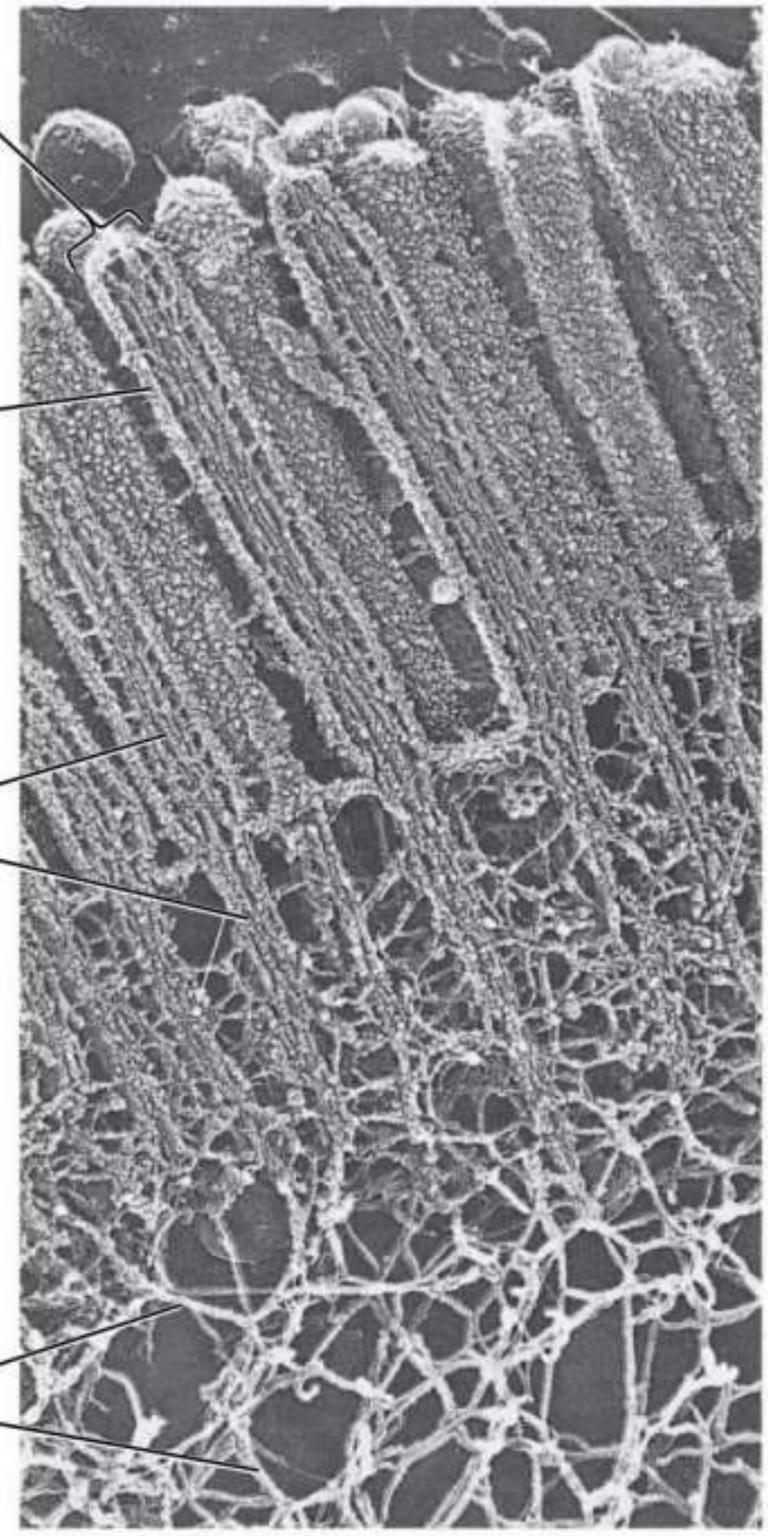
Figure 6.26



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- Microfilaments that function in cellular motility contain the protein **myosin** in addition to actin
- In muscle cells, thousands of actin filaments are arranged parallel to one another

متوازيه

- Thicker filaments composed of myosin interdigitate with the thinner actin fibers

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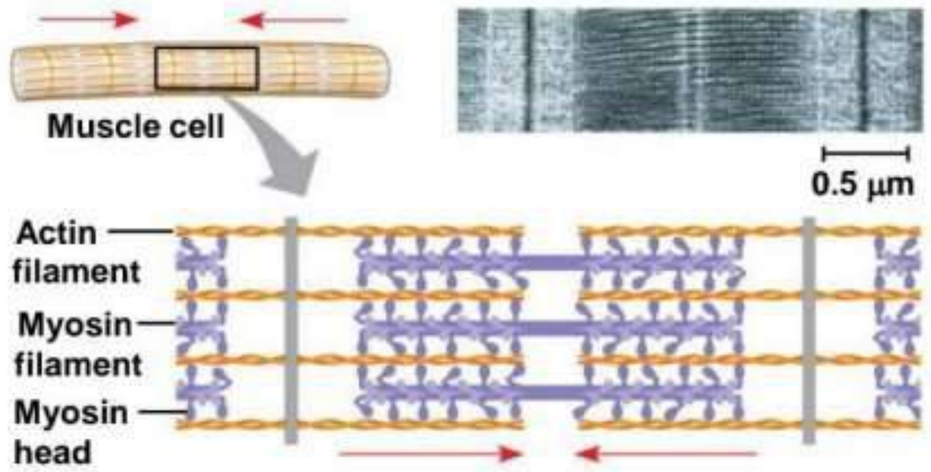
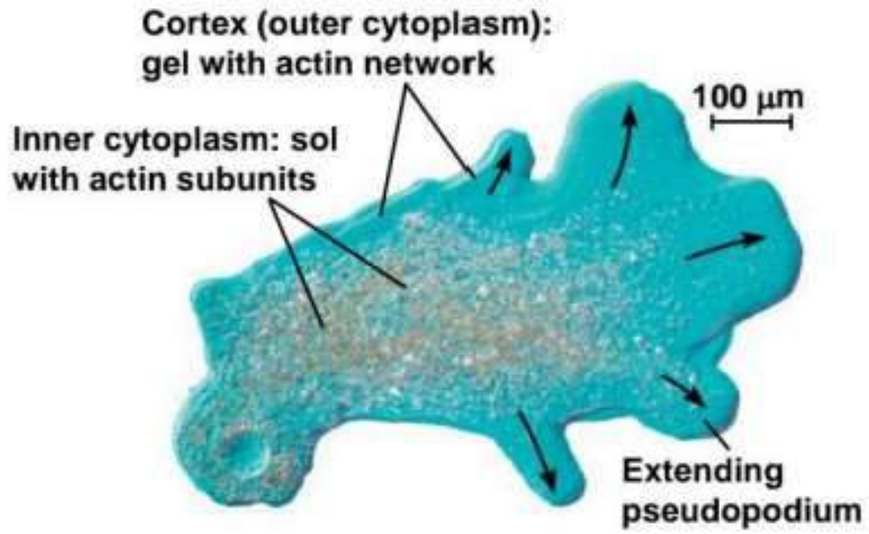
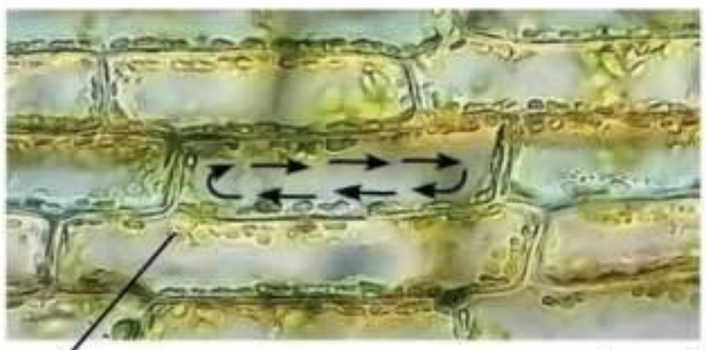
Figure 6.27



(a) Myosin motors in muscle cell contraction



(b) Amoeboid movement



(c) Cytoplasmic streaming in plant cells

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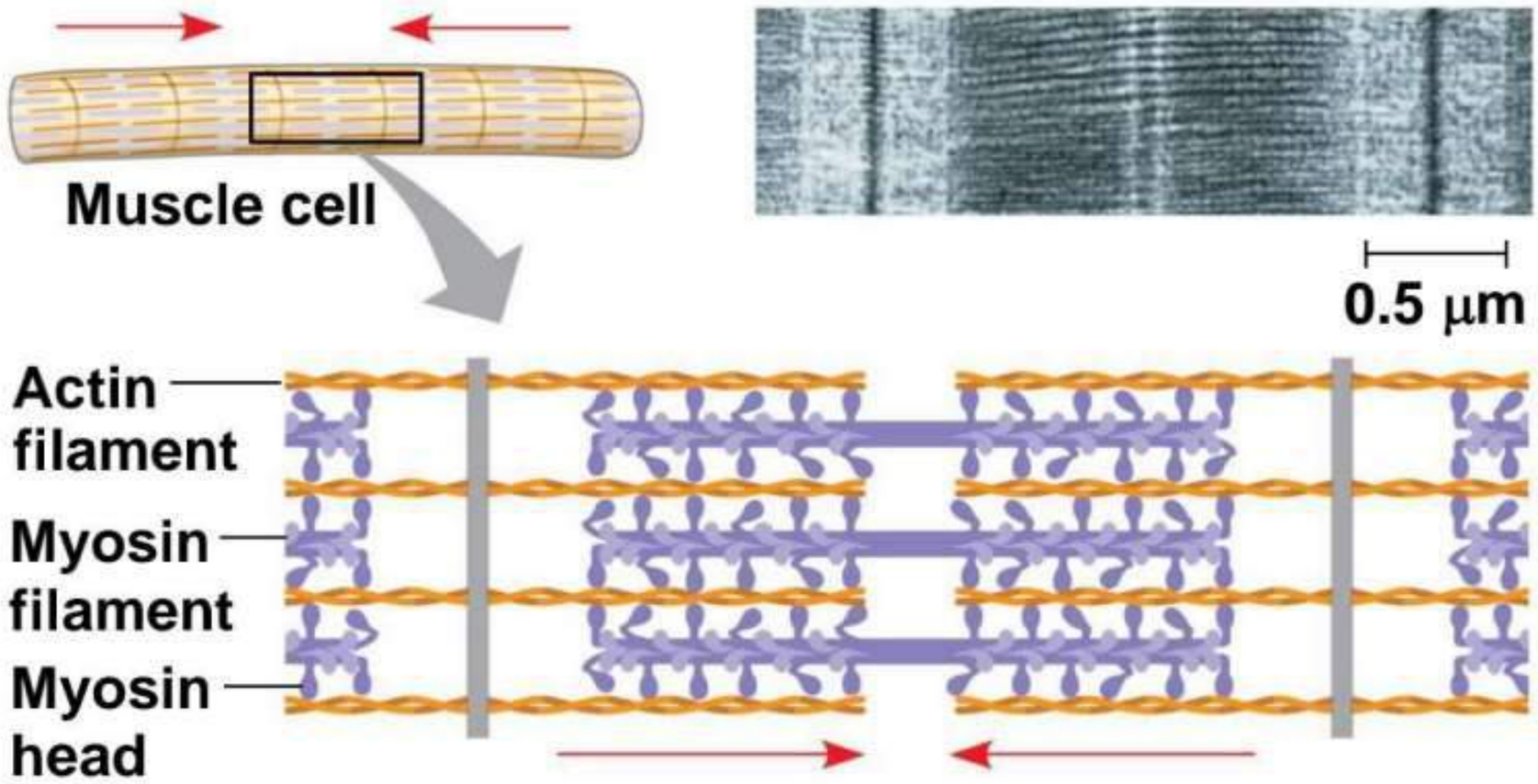
Figure 6.27a

شكل الحركة * sliding over each other



(a) Myosin motors in muscle cell contraction

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contraction + relaxation

Figure 6.27aa

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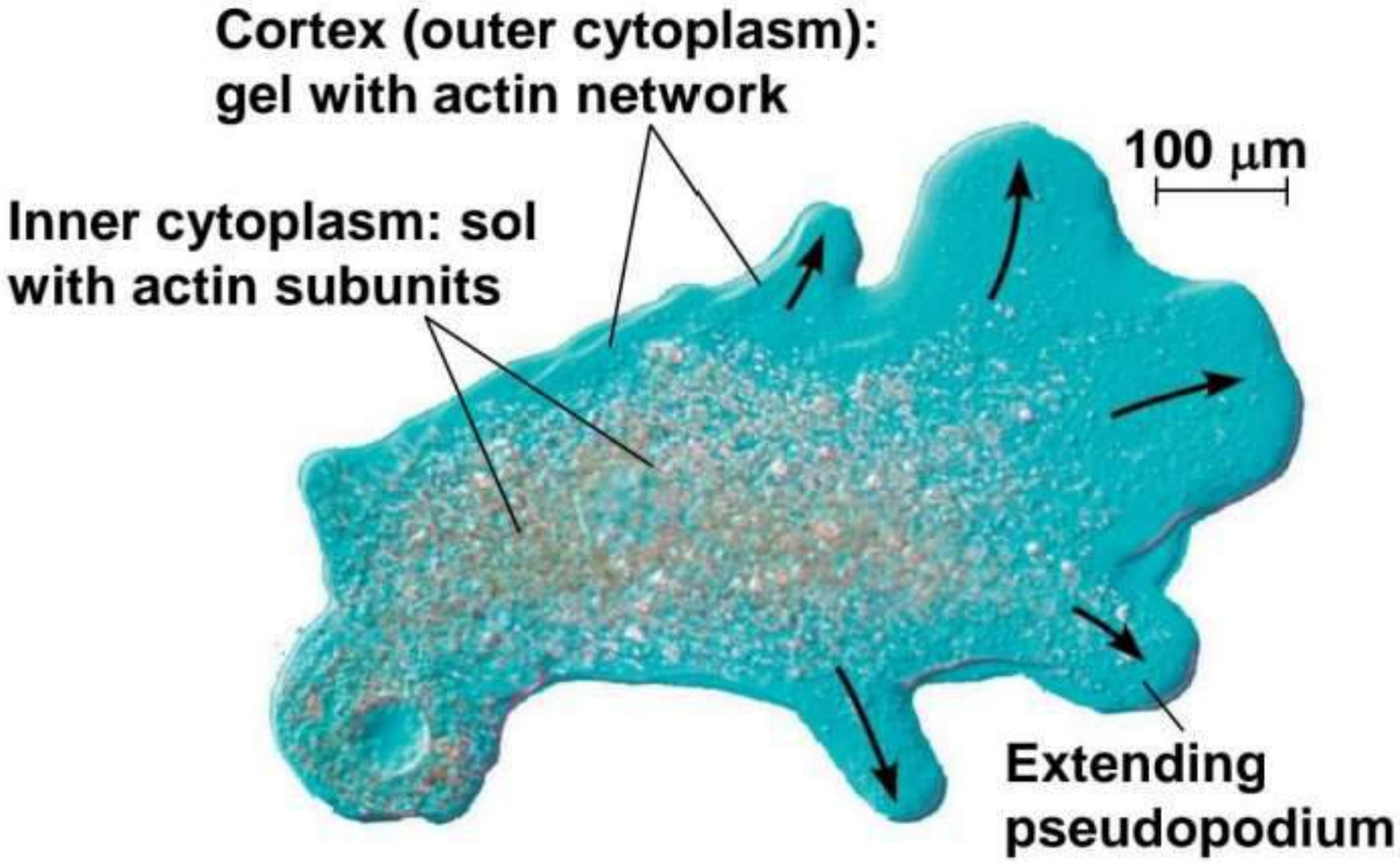
Figure 6.27b

السيتوبلازم تبعها مليان actin filament بس في مناطق بكون فيها thick وفي مناطق thin المنطقة الي بكون فيها كتير بتكون اكتر صلابة وتسمى sol اما الاقل تركيز فتسمى gel

بتحرك السيتوبلازم من منطقة sol الى gel وهيك بتتكون الاقدام الكاذبة



(b) Amoeboid movement

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عندما تتحرك الخلية بالاقدام الكاذبة
ستسمى حركتها Amoeboid mov.

يؤدي الانكماش الموضعي الناتج عن الاكتين والميوسين الى تحفيز amoeboid movement

- Localized contraction brought about by actin and myosin also drives amoeboid movement
- **Pseudopodia** (cellular extensions) extend and contract through the reversible assembly and contraction of actin subunits into microfilaments

تمتد الارجل الكاذبة وتتقلص من خلال التجميع العكسي من sol الى gel وتقلص وحدات الاكتين

بنقسم السيتوبلازم في الخلايا الحيوانية عن طريق خيوط الاكتين بتلف حويلين نص الخلية فبتعمل خصر اسمه creevagh ferro بساهم في animal cell division فبتضل خيوط الاكتين تلف حتى تنقسم السيتوبلازم ويصير عندي خليتين

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only in the plant cells

- **Cytoplasmic streaming** is a circular flow of cytoplasm within cells
- This streaming speeds distribution of materials within the cell يعمل على تسريع توزيع المواد والغذاء داخل الخلية
- In plant cells, actin-myosin interactions (1) and sol-gel transformations (2) drive cytoplasmic streaming

انتقال السيتوسول من منطقة sol الى gel

محفزات تدفق السيتوبلازم

PLAY Video: Cytoplasmic Streaming

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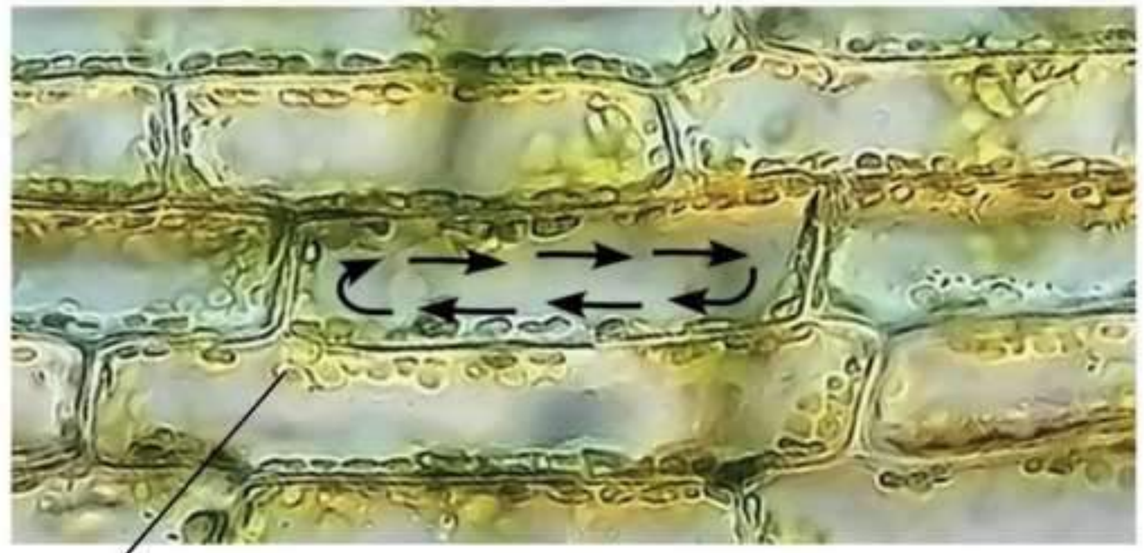
Figure 6.27c



(c) Cytoplasmic streaming in plant cells

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حركة السيتوبلازم في
الخلايا النباتية
الهدف منها توزيع الغذاء