



تَوِير

BIOLOGY

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وَقُلْ رَبِّ زِدْنِي عِلْمًا



Biology : chapter 40, part 1

done by: leen Al-Ashraam

shaylah 2023

LECTURE PRESENTATIONS

For CAMPBELL BIOLOGY, NINTH EDITION

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Chapter 40

Basic Principles of Animal Form and Function



Lectures by
Erin Barley
Kathleen Fitzpatrick

Overview: Diverse Forms, Common Challenges

- مرتبطتين ببعض
- **Anatomy** is the study of the biological form of an organism [is the علم التشريح science of dissection]
- علم وظائف الأعضاء
- **Physiology** is the study of the biological functions an organism performs
- The comparative study of animals reveals that form and function are closely correlated

Figure 40.1



Concept 40.1: Animal form and function are correlated at all levels of organization

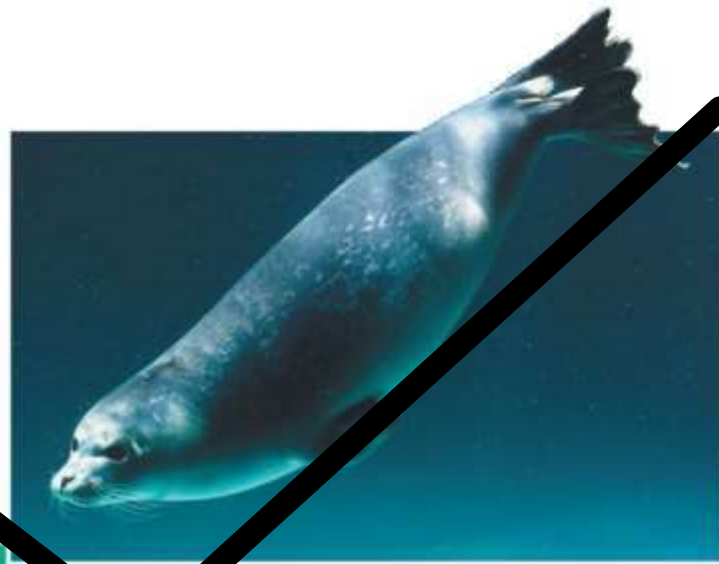
always the form & function is related

- Size and shape affect the way an animal interacts with its environment
- Many different animal body plans have evolved and are determined by the genome

Evolution of Animal Size and Shape

- Physical laws constrain strength, diffusion, movement, and heat exchange
- As animals increase in size, their skeletons must be proportionately larger to support their mass
- Evolutionary convergence reflects different species' adaptations to a similar environmental challenge

Figure 40.2



▲ Seal



▲ Penguin



▲ Tuna

Figure 40.2a



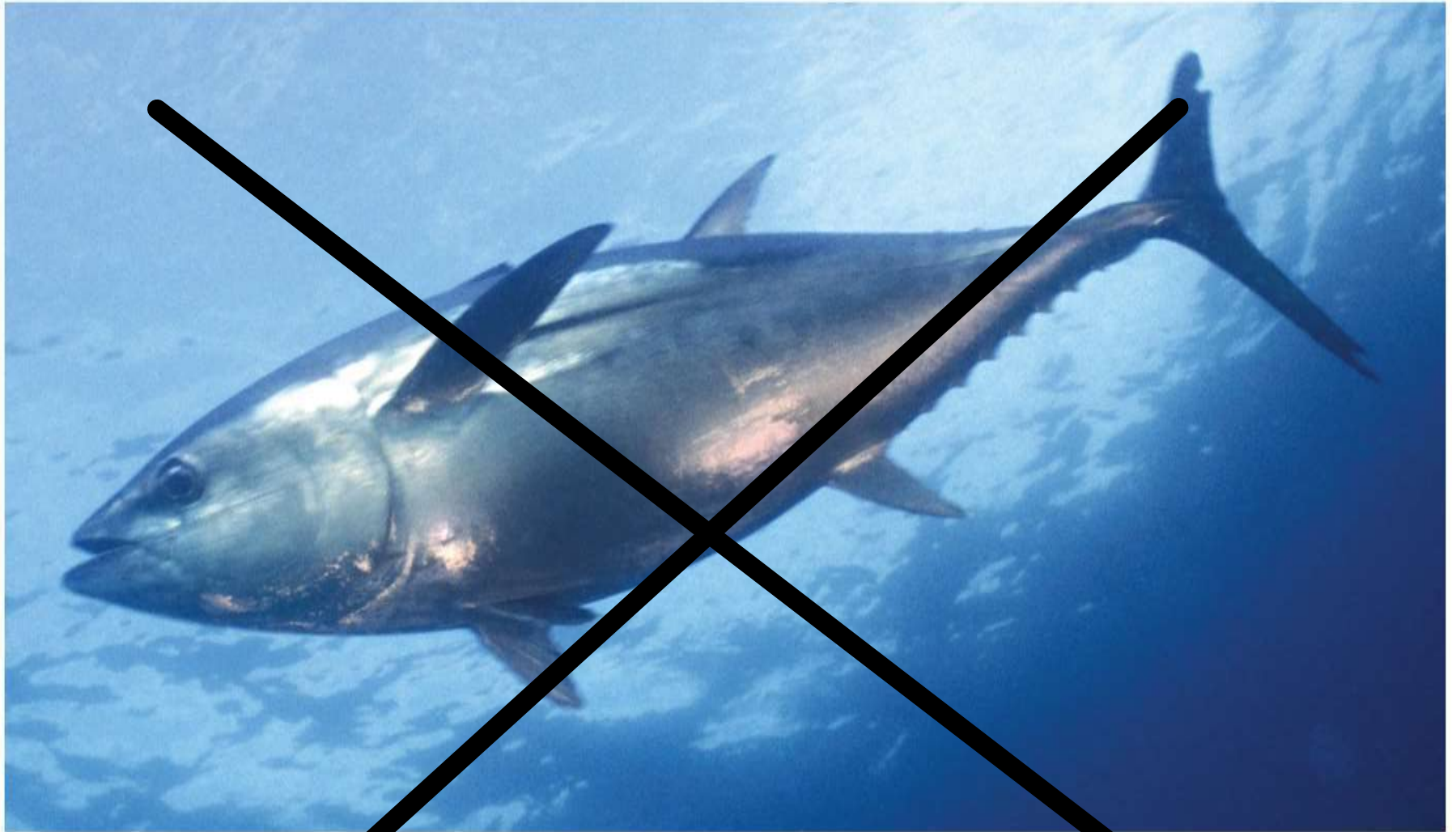
 Seal
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▲ Penguin

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Figure 40.2c



 **Tuna**
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If it could make good

Exchange with the Environment, then it is the perfect situation.

- Materials such as nutrients, waste products, and gases must be exchanged across the cell membranes of animal cells
- Rate of exchange is proportional to a cell's surface area while amount of exchange material is proportional to a cell's volume

- A single-celled protist living in water has a sufficient surface area of plasma membrane to service its entire volume of cytoplasm
- Multicellular organisms with a saclike body plan have body walls that are only two cells thick, facilitating diffusion of materials

increase
rate
of
exchange
with
its
enviro-
ment

in hydra, for example "ANIMALS"

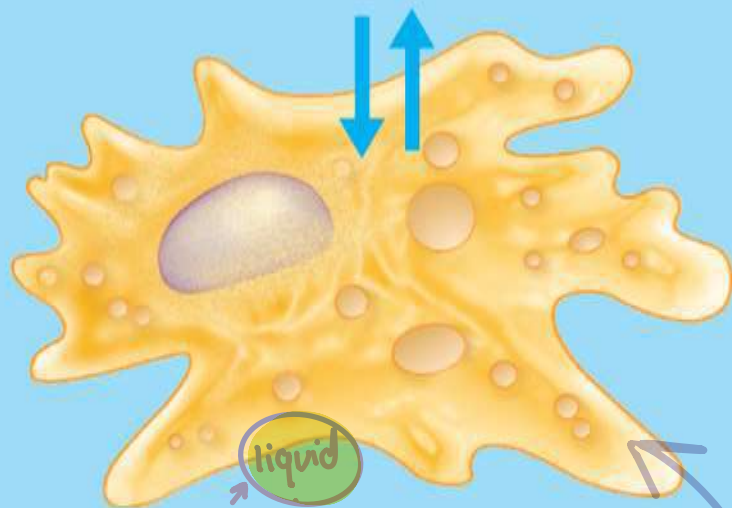
"simple diffusion"



Figure 40.3

* protists
* Not animals

Exchange



lives in water: it has the chance to exchange successfully with the environment

0.1 mm

By its cell membrane
* protists * / not animals

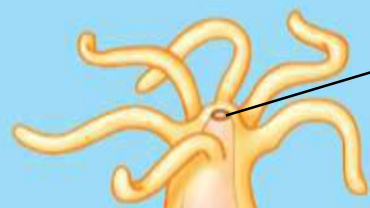
uni-cellular

(a) Single cell [amoeba]

paramecium
euglena

ما ينطبق عليه ينسب له

الهيدرا تتغذى على الحيوانات الأصغر منها / تدخله
عنه طريقة



Mouth

Gastrovascular cavity
التجويف الهجوي

Exchange

by simple diffusion

Exchange by simple diffusion

1 mm

تنتمي إلى مجموعة حيوانات التجوف
called: coelenterata/hydra
or
cnidaria

(b) Two layers of cells

ei: hydra, lives in freshwater

- In flat animals such as tapeworms, the distance between cells and the environment is minimized
- More complex organisms have highly folded internal surfaces for exchanging materials

Figure 40.4

الجسم بهل طبقيين
من الخلايا : عم يتكون
system... organs
[multicellular]

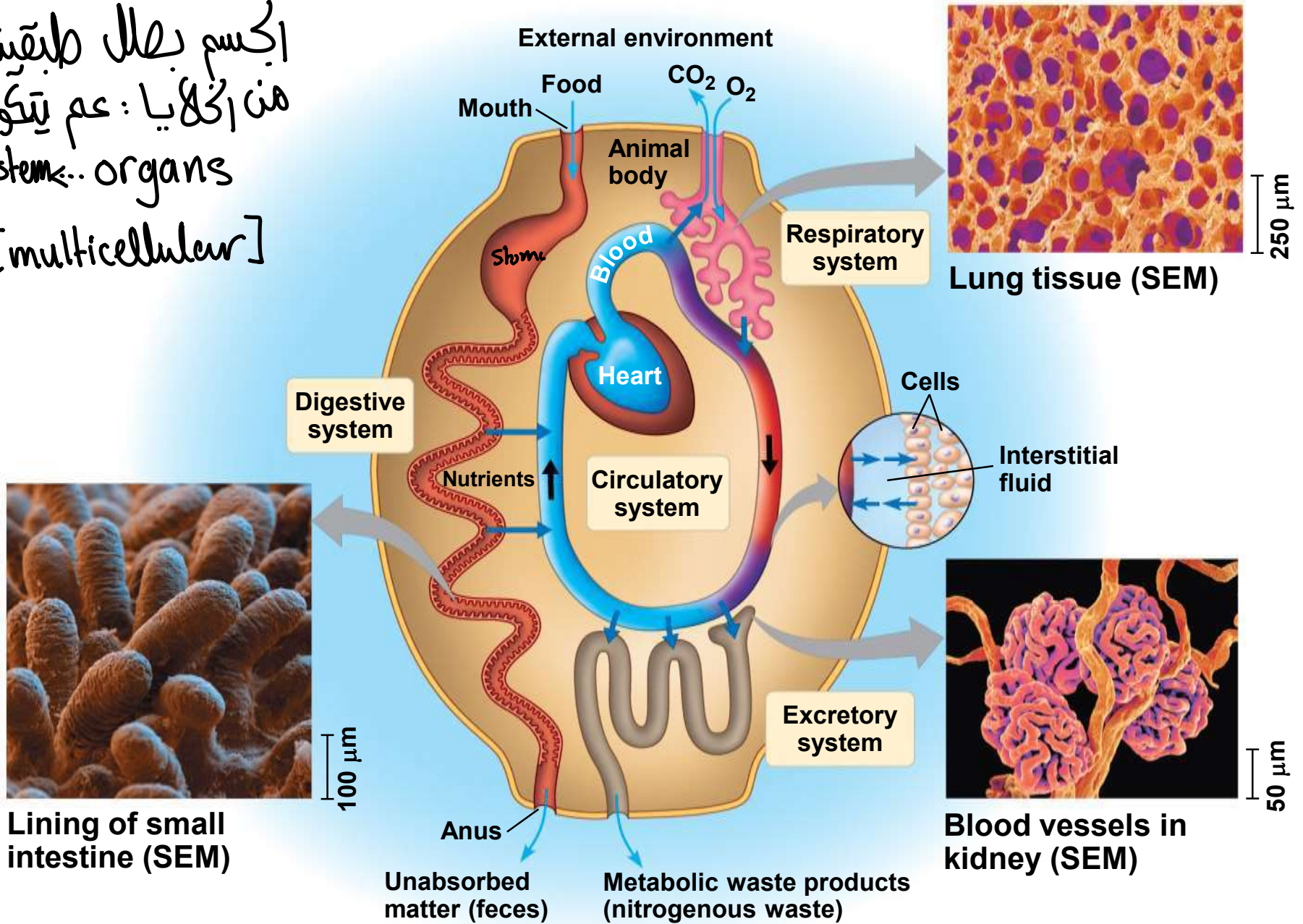
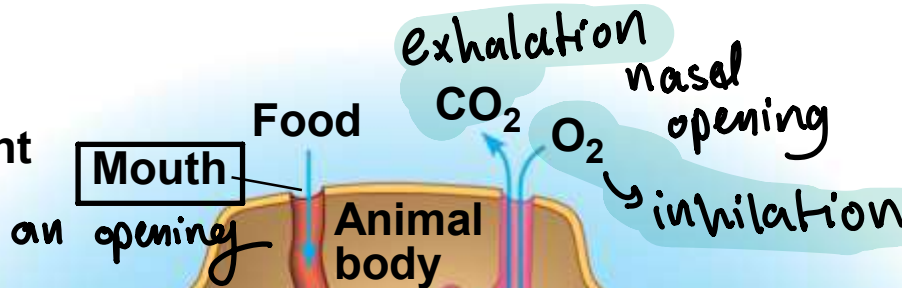
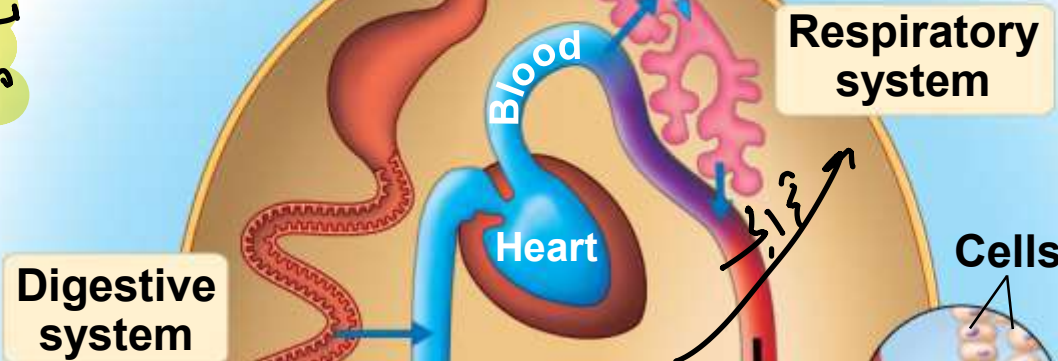
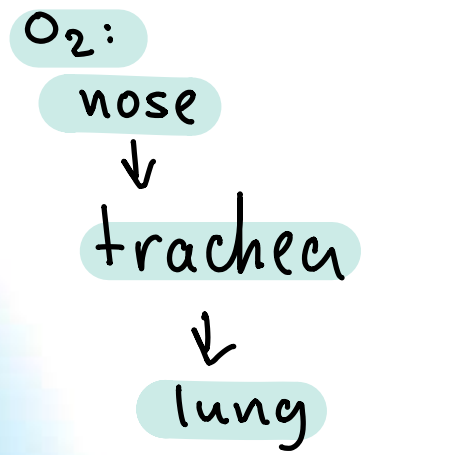


Figure 40.4a

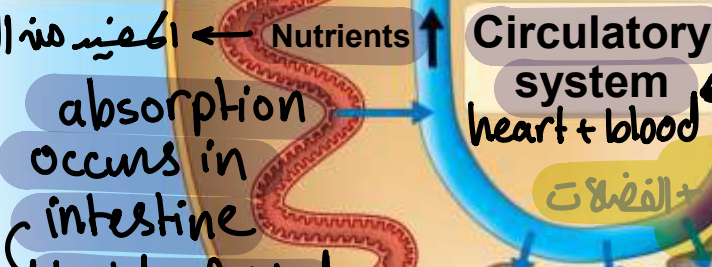
External environment



مستكلم كل جزء بالجسم
يستطيع تبادل المواد
مع البيئة مباشرة
ولذلك في فتحات
في الجسم



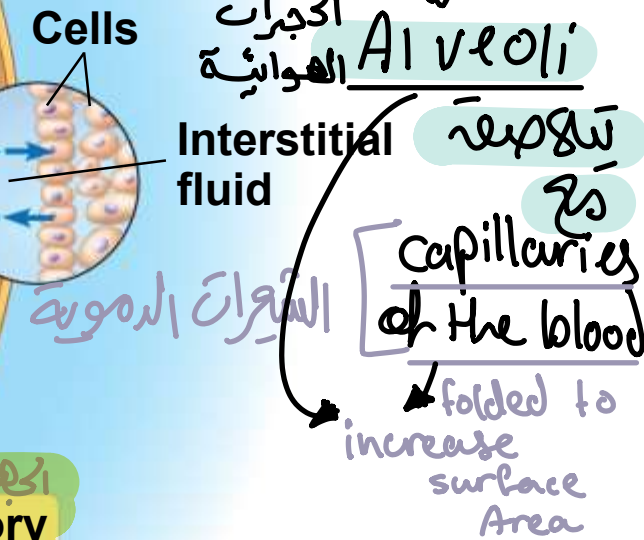
الكبدية من الطعام ينقل إلى الدم
circulatory system



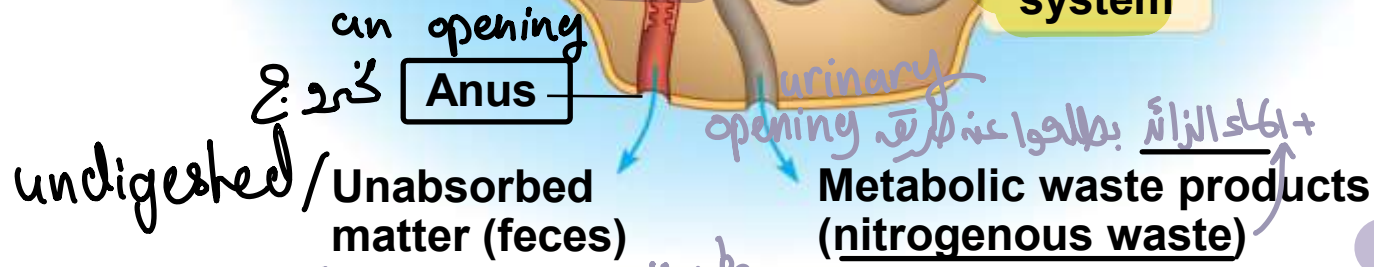
absorption occurs in intestine
also has villus

highly folded
increases surface area
volume

الدم يعطي O₂ والفضلات
ويأخذ CO₂



exchange of gases
btw blood & respiratory system



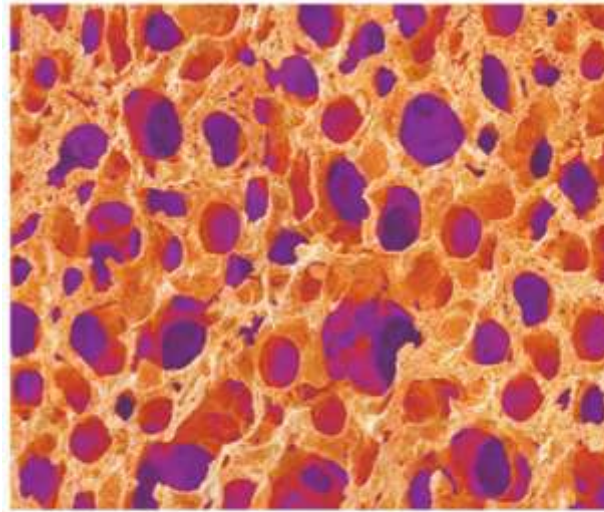
الدم يعطي الجهاز التنفسي CO₂ ويأخذ O₂: الدم يعطي ويأخذ O₂ ويأخذ CO₂



villus : to
increase
absorption

100 μm

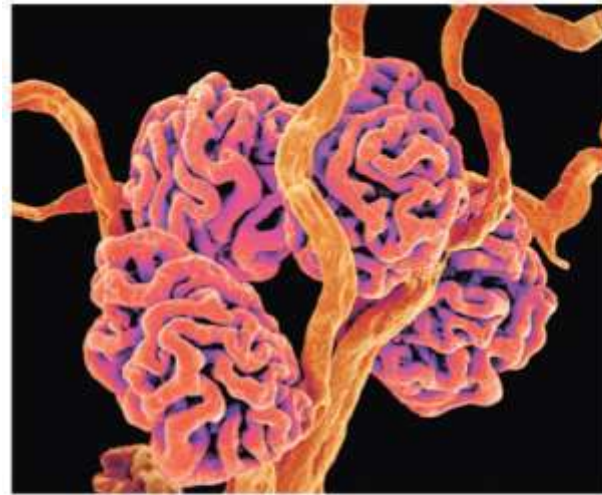
**Lining of small
intestine (SEM)**



250 μm

Lung tissue (SEM)

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50 μm

**Blood vessels in
kidney (SEM)**

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- In **vertebrates**, the space between cells is filled with **interstitial fluid**, which allows for the **movement of material into and out of cells**
- A complex body plan helps an animal living in a variable environment to maintain a relatively **stable internal environment**

نصلح الي ما بدنا اياه
ونخلي الي بدنا ايه

الهدف منه
عمليات ال exchange

ترتيب هرمي / تدرج

Hierarchical Organization of Body Plans

- Most animals are composed of specialized cells organized into **tissues** that have different functions
- Tissues make up **organs**, which together make up **organ systems**
- Some organs, such as the **pancreas**, belong to more than one organ system

produces enzymes critical to the function of the digestive system but also regulates the level of sugar in the blood as a vital part of the endocrine system

يفرز
إنزيمات هاضمة
مثل الأميليز

②

يفرز هرمونات
مثل

جهاز الغدد الصماء
Glucagon
- Insulin

• Our bodies and those of most other animals are composed of compact masses of cells, with an internal organization much more complex than that of a hydra or a tapeworm. For such a body plan, increasing the number of cells reveals the multilayered basis of specialization. Organ systems include specialized organs made up of specialized tissues and cells

المجدول ٤٠

[أهم أجهزة الجسم
وأهم أعضاؤه
وأهم وظائفه]

Table 40.1 Organ Systems in Mammals

Organ System	Main Components	Main Functions
Digestive (chapter 42)	Mouth, pharynx, esophagus, stomach, intestines, liver, pancreas, anus	Food processing (ingestion, digestion, absorption, elimination) → 1. تناول 2. 3. 4.
Circulatory	Heart, blood vessels, blood	Internal distribution of materials
Respiratory	Lungs, trachea, other breathing tubes	Gas exchange (uptake of oxygen; disposal of carbon dioxide)
Immune and lymphatic	Bone marrow, lymph nodes, thymus, spleen, lymph vessels, white blood cells	Body defense (fighting infections and cancer) + حماية الجسم من الأمراض + الدفاع
Excretory جهاز الإفراج	Kidneys, ureters, urinary bladder, urethra	Disposal of metabolic wastes; <u>regulation of osmotic balance of blood</u> التخلص من الفضلات الأيضية - تنظيم التوازن الأسموزي
Endocrine	Pituitary, thyroid, pancreas, adrenal, and other <u>hormone-secreting gland</u>	<u>Coordination of body activities</u> (such as digestion and metabolism) - تنظيم عمليات الجسم
Reproductive	Ovaries or testes and associated organs	Reproduction
Nervous	Brain, spinal cord, nerves, sensory organs	<u>Coordination of body activities</u> ; detection of stimuli and formulation of responses to them
Integumentary ← نغلف الجسم	Skin and its derivatives (such as hair, claws, skin glands)	<u>Protection against</u> [mechanical injury, infection, dehydration; thermoregulation]
Skeletal الهيكلية	<u>Skeleton</u> (bones, tendons, ligaments, cartilage) → 1. 2. 3. 4.	Body support, protection of internal organs, movement
Muscular	Skeletal muscles	Locomotion and other movement الحركة

Exploring Structure and Function in Animal Tissues

- Different tissues have different structures that are suited to their functions
- ^{ANIMAL} Tissues are classified into four main categories:
 - ① epithelial, _{إبواب}
 - ② connective, _{صيام}
 - ③ muscle, _{عضلي}
 - ④ nervous, _{عصبية}

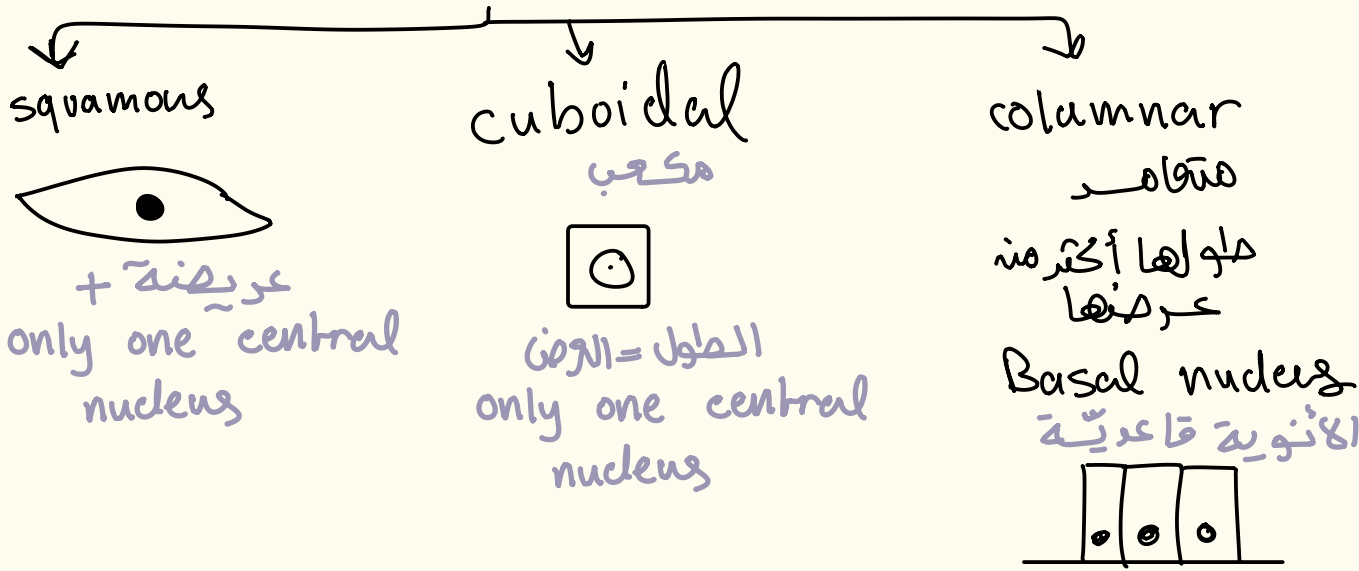
Two methods to
classify epithelial
Tissue

Epithelial Tissue [→]

- **Epithelial tissue** ^① covers ^{تأويف} the outside of the body and ^② ^{يغطى} lines the organs and cavities within the body
- It contains cells that are closely joined ^{not scattered, ملازمته بيوض}
- The shape of epithelial cells may be cuboidal (like dice), columnar (like bricks on end), or squamous (like floor tiles)

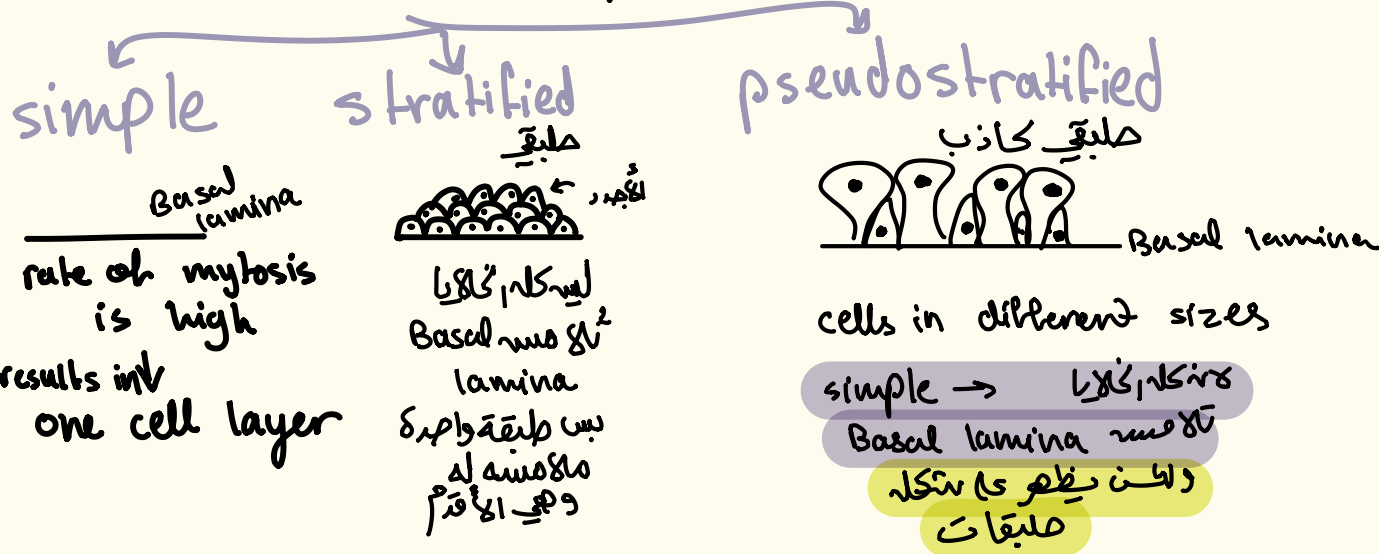
- The arrangement of epithelial cells may be simple (single cell layer), stratified (multiple tiers of cells), or pseudostratified (a single layer of cells of varying length)

shape of cells



complexity

حسب عدد الطبقات



لما ينبي زائف

Epithelial tissue

نسيج التقريني صفاً

e.i:

stratified cuboidal

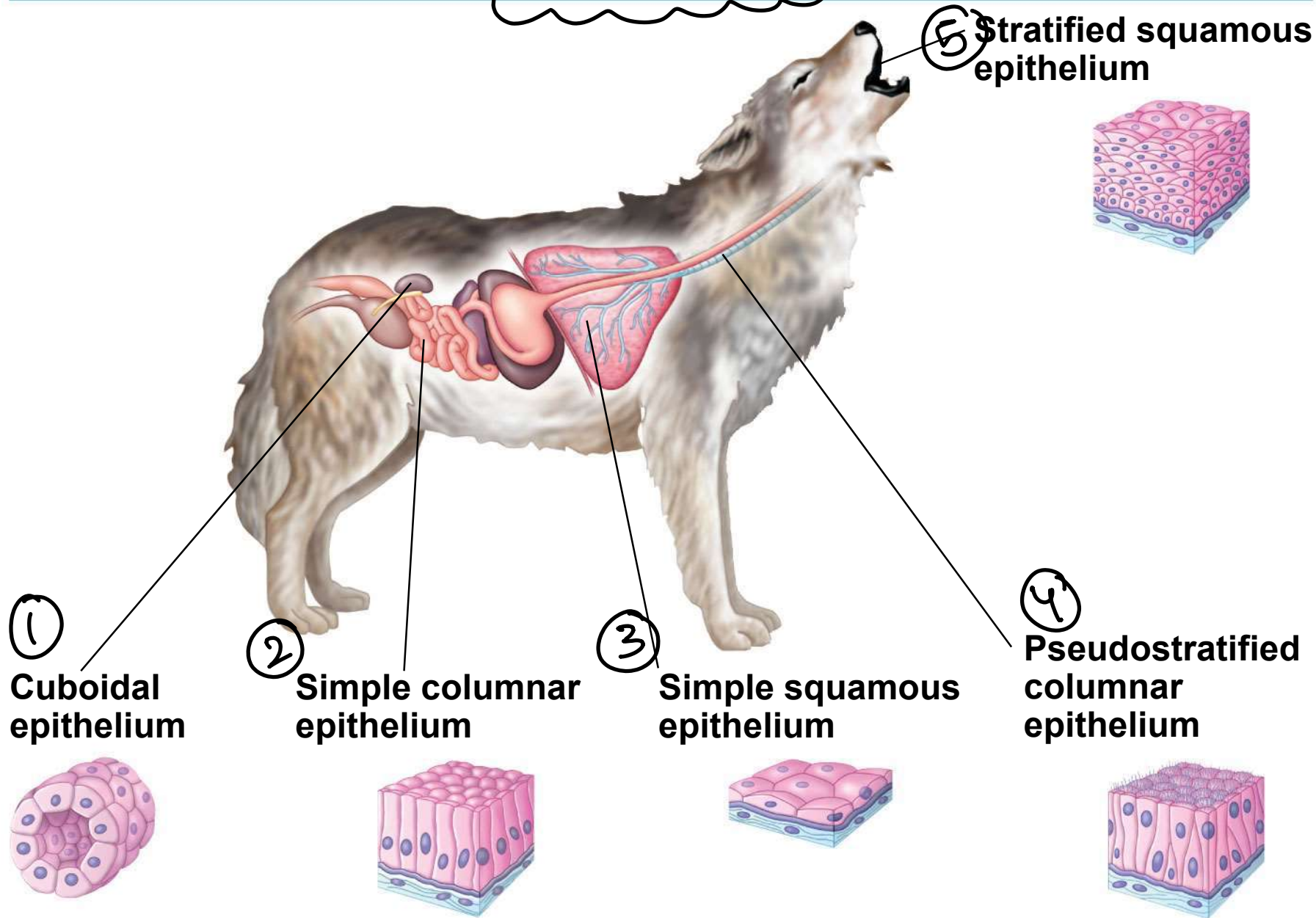
simple columnar

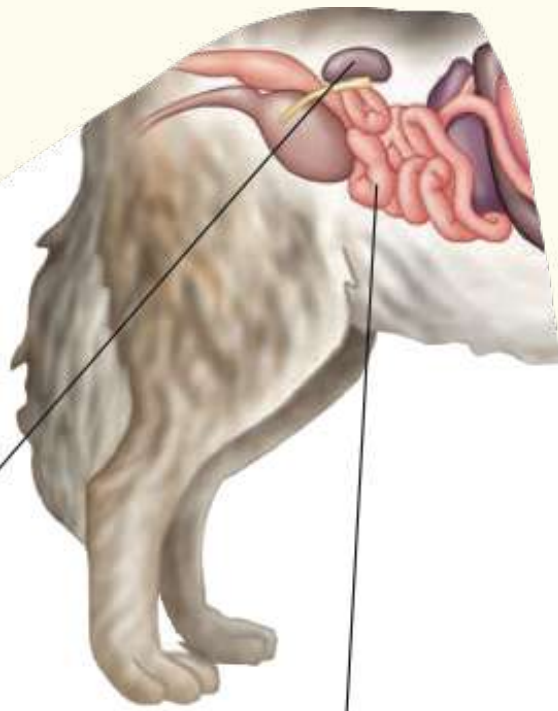
وهذا أيضاً

complexity

بالأول

Epithelial Tissue

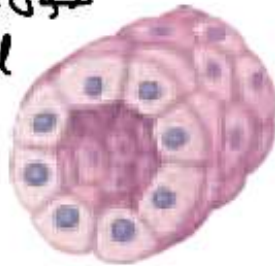




simple

Cuboidal epithelium

ضول = العرض
* central
nucleus



A cuboidal epithelium, with dice-shaped cells specialized for secretion, makes up the epithelium of kidney tubules and many glands (including the thyroid gland and salivary glands).

and absorption

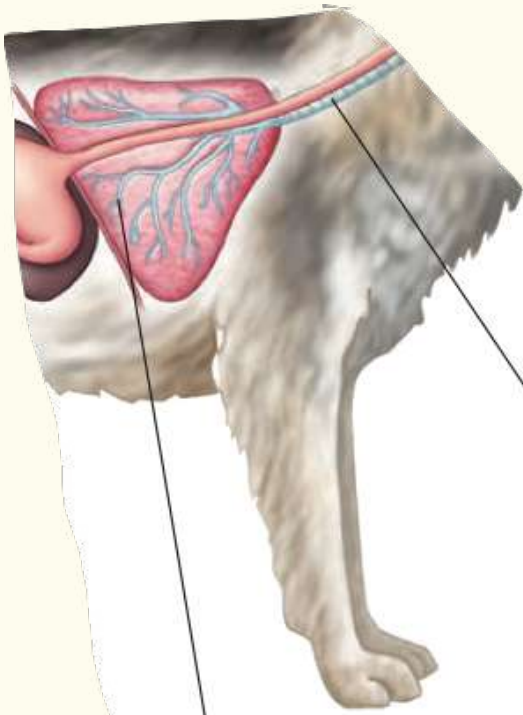
functional units
is nifron

Simple columnar epithelium



Basal lamina

The large, brick-shaped cells of simple columnar epithelia are often found where secretion or active absorption is important. For example, a simple columnar epithelium lines the intestines, secreting digestive juices and absorbing nutrients.



Simple squamous epithelium



واسعة

The single layer of platelike cells that form a simple squamous epithelium functions in the exchange of material by diffusion. This type of epithelium which is thin and leaky, lines blood vessels and the air sacs of the lungs, where diffusion of nutrients and gases is critical.

→ exchange or filtration مكان فيه عملية انتقال المواد عبر plasma membrane فتكون الخلايا المرطبة له simple squamous epithelium → يعمل بحويات الانتقال

Pseudostratified columnar epithelium

& its usually ciliated



A pseudostratified epithelium consists of a single layer of cells varying in height and the position of their nuclei. In many vertebrates, a pseudostratified epithelium of ciliated cells forms a mucous membrane that lines portions of the respiratory tract.

cells in → different size

The beating cilia sweep the film of mucus along the surface.

→ [trachea as a part of it]

← للتخلص من أي أوساخ "found in air passages"

قالب that is covered by mucus

* عندها نأخذ شرايين، الأوكسجين الذي دخل إلى lung سوف ينتقل إلى الدم عن طريق capillaries جداره يتكون من simple squamous epithelium tissue

[exchange btw alveoli & capillaries]

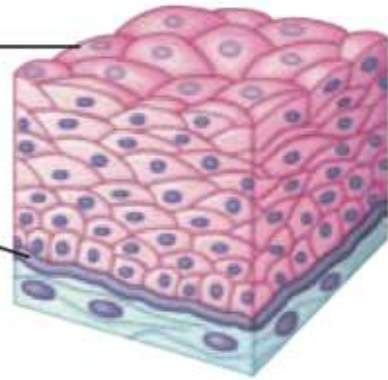
Both of them consist of simple squamous epithelium tissue



Stratified squamous epithelium

Apical surface

Basal surface



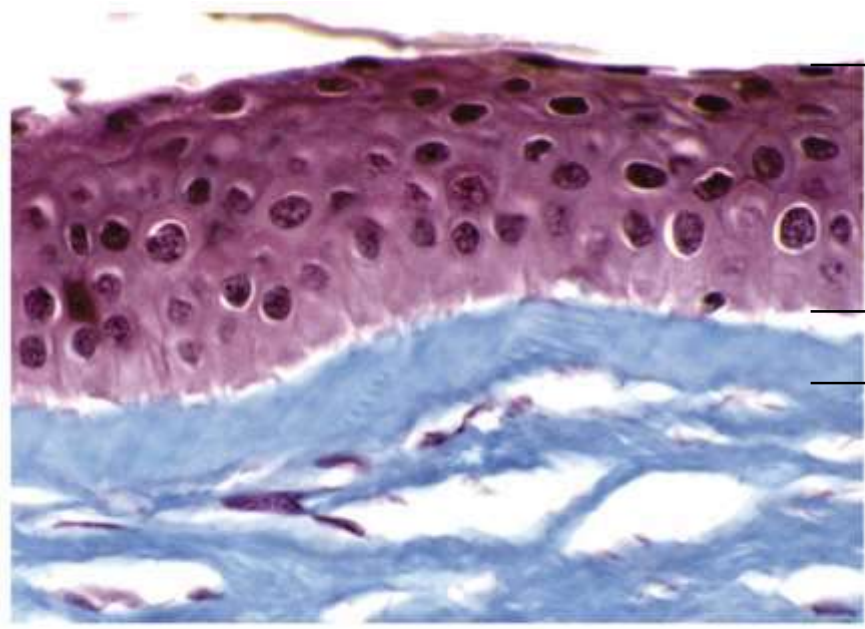
هو سطح و صلب،
الأكثر عرضة للتلف

A stratified squamous epithelium is **multilayered** and **regenerates rapidly**. New cells formed by division near the basal surface (see micrograph below) push outward, replacing cells that are sloughed off. This epithelium is **commonly found on surfaces subject to abrasion, such as the outer skin and the linings of the mouth, anus, and vagina.**

found in
the **openings**
of the body

وهذا الطبقة هي
الأكثر عرضة للتلف

Stratified squamous epithelium



Apical surface new cells
منه نبتت اكثر

Basal surface

Basal lamina

40 μ m

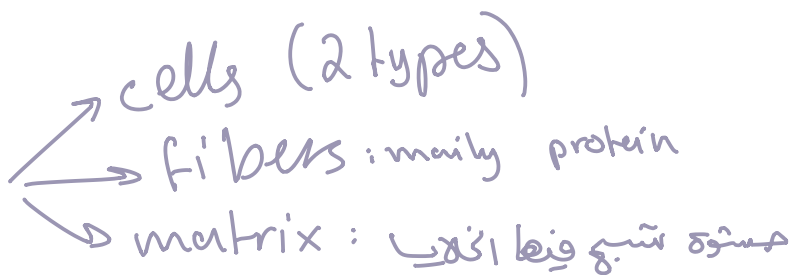
Polarity of epithelia

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النسيج الضام

يتكون من

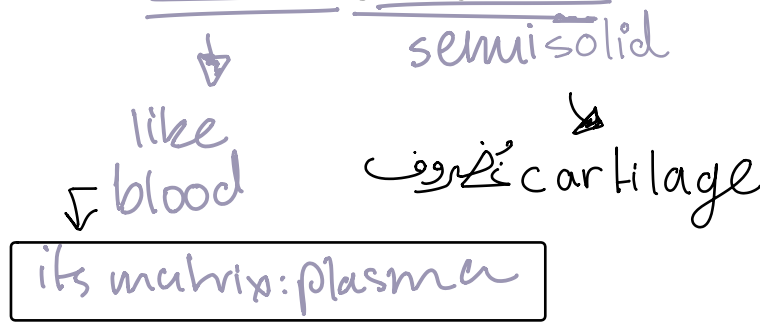
Connective Tissue



- **Connective tissue** mainly binds and supports other tissues
 ↳ connects

- It contains sparsely packed cells scattered throughout an extracellular matrix

- The matrix consists of fibers in a ^①liquid, ^②jellylike, or solid foundation
 ↳ er: bonds



- There are three types of connective tissue fiber, all made of protein: ^{→ its main component}
 - Collagenous fibers provide strength and flexibility
 - مطالمة (مرونة أكثر) – Elastic fibers stretch and snap back to their original length
 - شكوي – Reticular fibers join connective tissue to adjacent tissues

- Connective tissue contains cells, including
 - **Fibroblasts** that secrete the protein of extracellular fibers
 - **Macrophages** that are involved in the immune system

نوع من
white blood
cell

الخلايا الملتصقة
كبيبة في الدم +
have high rate
of phagocytosis

connective tissue أفتام
6 main parts

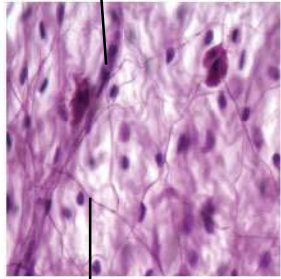
- In vertebrates, the fibers and foundation combine to form six major types of connective tissue:
 - ① – Loose connective ^{Areolar} tissue binds epithelia to underlying tissues and holds organs in place
 - ② – **Cartilage** is a strong and flexible support material
 - ③ – Fibrous connective tissue is found in **tendons**, which attach muscles to bones, and **ligaments**, which connect bones at joints

- ④ – **Adipose tissue** stores fat for insulation and fuel
- ⑤ – **Blood** is composed of blood cells and cell fragments in blood plasma
- ⑥ – **Bone** is mineralized and forms the skeleton

Connective Tissue

Loose connective tissue

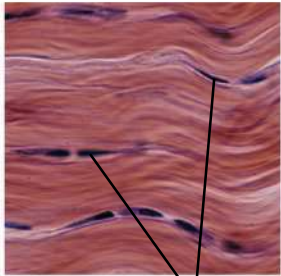
Collagenous fiber



120 μm

Elastic fiber

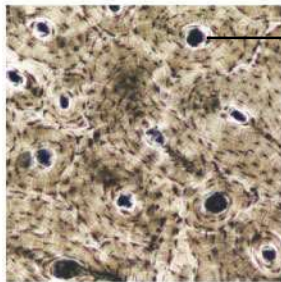
Fibrous connective tissue



30 μm

Nuclei

Bone

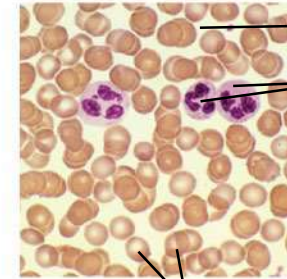


700 μm

Central canal

Osteon

Blood



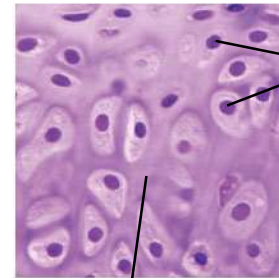
Plasma

White blood cells

55 μm

Red blood cells

Cartilage

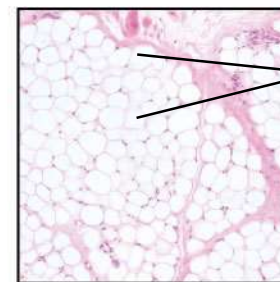


Chondrocytes

100 μm

Chondroitin sulfate

Adipose tissue



Fat droplets

150 μm

رخو/فضفاهن

Loose connective tissue

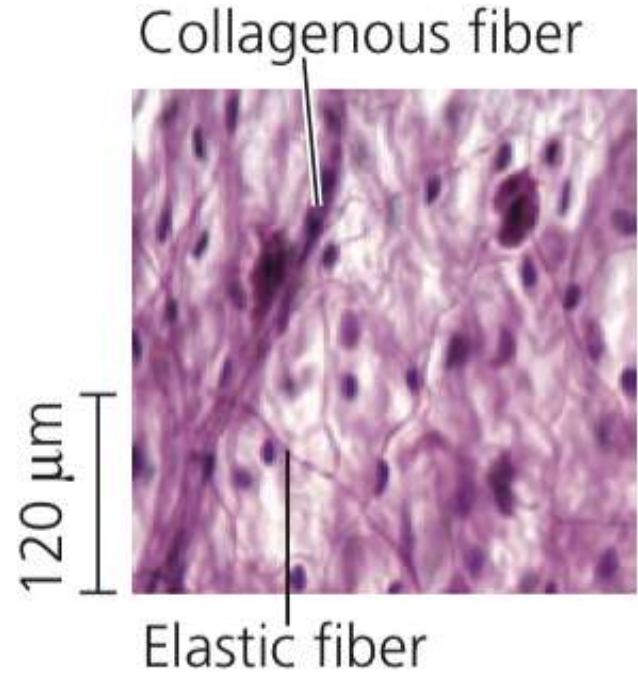
The most widespread connective tissue in the vertebrate body is *loose connective tissue*, which binds epithelia to underlying tissues and holds organs in place. * Loose connective tissue gets its name from the loose weave of its fibers, which include all three types. It is found in the skin and throughout the body.

* وظيفته

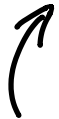
هوائي

→ also called areolar tissue

↳ has air spaces



* يتوي أنواع ال fibers الثلاثة
* = = خلايا كلها



دعامة
أكثر من
مرونة

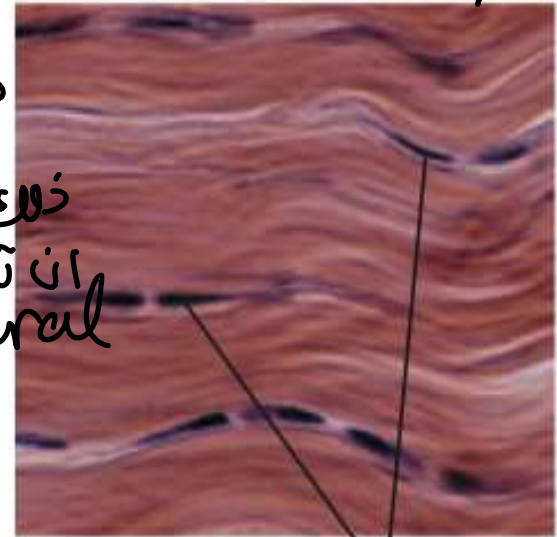
Fibrous connective tissue

doesn't have any air spaces

Fibrous connective tissue is **dense** with **collagenous fibers**. It is found in **tendons**, which attach muscles to bones, and in **ligaments**, which connect bones at joints.

مرونة
رصد
ذلك يؤدي إلى
ان تكون أنوية
peripheral

30 μm

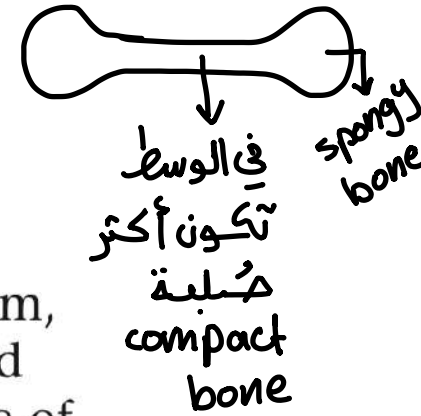


Nuclei

[بالرسمه فوقه مأخوذ من tendon]

Bone

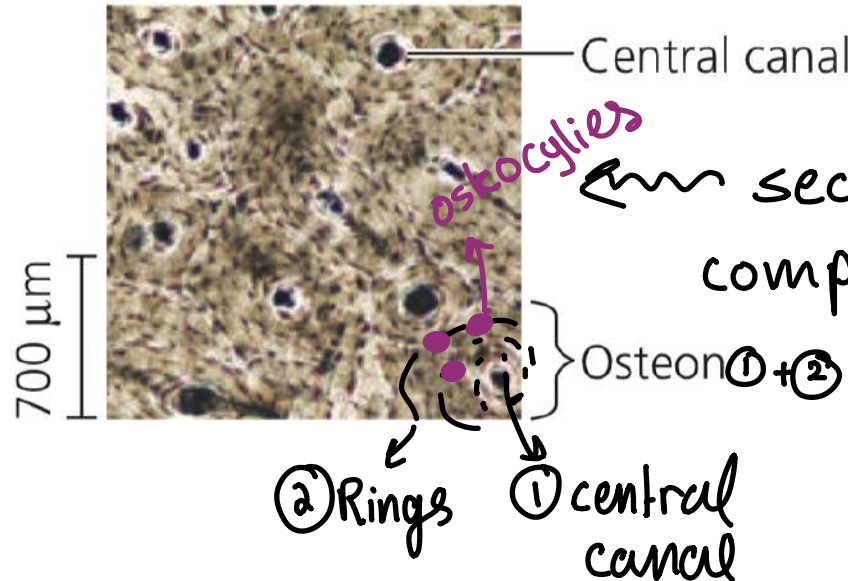
The skeleton of most vertebrates is made of **bone**, a mineralized connective tissue. Bone-forming cells called osteoblasts deposit a matrix of collagen. Calcium, magnesium, and phosphate ions combine into a hard mineral within the matrix. The microscopic structure of hard mammalian bone consists of repeating units called osteons. Each osteon has concentric layers of the mineralized matrix, which are deposited around a central canal containing blood vessels and nerves.



matrix: solid in appearance & filled with minerals

skull bones

osteoplast: cells of the bone



osteocytes

section in the compact bone

② Rings
① central canal

Adipose tissue

مسؤولة عن
الدخافة والسمنة

هو جود في كل مكان
تخزن دهون في الجسم

Adipose tissue is a specialized loose connective tissue that stores fat in adipose cells distributed throughout its matrix.

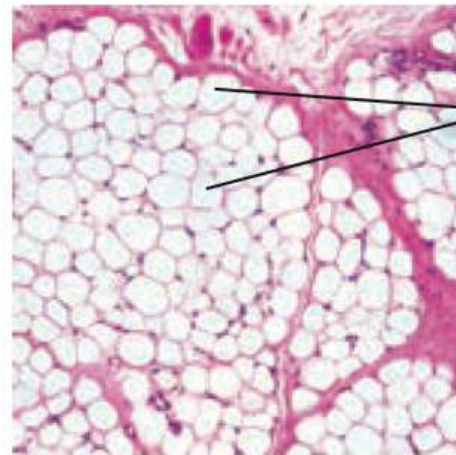
like a cushion
لحمايتها

الحفاظ على الحرارة

Adipose tissue pads and insulates the body and stores fuel as fat molecules. Each adipose cell contains a large fat droplet that swells when fat is stored and shrinks when the body uses that fat as fuel.

طريقة
تخزين
الدهون

من أكثر ما تخزنه fats
سوف يفتت النواة و
تصبح peripheral
nucleus



Lipid droplets

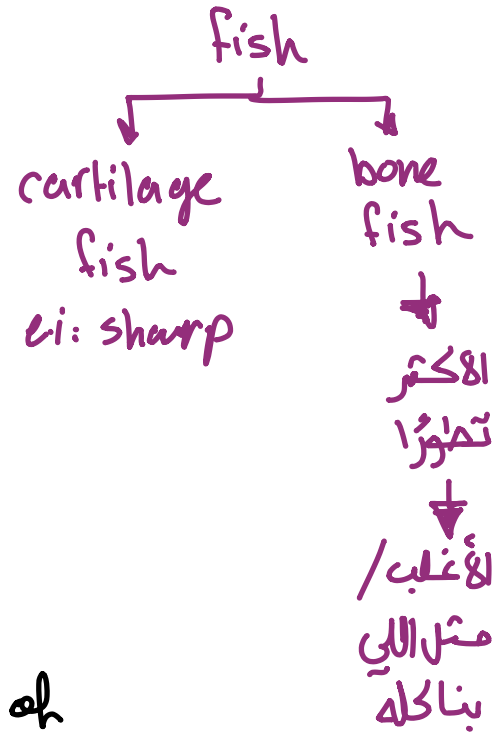
150 μm

Cartilage

Cartilage contains collagenous fibers embedded in a rubbery [protein-carbohydrate] complex called chondroitin sulfate.

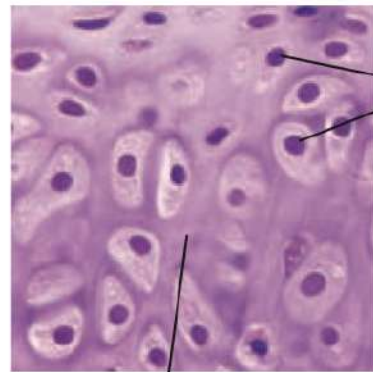
Cells called *chondrocytes* secrete the collagen and chondroitin sulfate, which together make cartilage a strong yet flexible support material. The skeletons of many vertebrate embryos contain cartilage that is replaced by bone as the embryo matures. Cartilage remains in some locations, such as the disks that act as cushions between vertebrae.

يوجد بعض الحيوانات التي يكون ال skeleton لها هو عبارة عن cartilage فقط مثل: sharp



مثل شحمة الأذن / الأنف
مثل trachea
وتوجد أيضًا بين العظام لمنع احتكاكه، أيضًا يوجد في

أظنه



means cartilage
Chondrocytes: cells of cartilage; everyone is surrounded with air spaces

inter vertebral disk
العود الفقري

Chondroitin sulfate, most important component of matrix: semisolid

والمسؤول عن ذلك which is

Blood ①+②+③

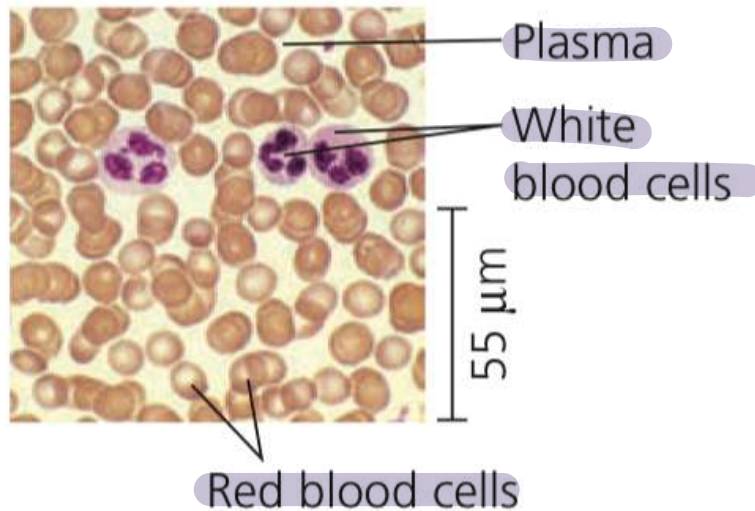
Blood has a liquid extracellular matrix called plasma, which consists of water, salts, and dissolved proteins. Suspended in plasma are erythrocytes (red blood cells), leukocytes (white blood cells), and cell fragments called platelets. Red cells carry oxygen, white cells function in defense, and platelets aid in blood clotting.

qol. ←

disc-shaped / biconcave
not nucleated

bigger than red blood cells, nucleated
أكبر

③
جلب



الحركة : motility

Muscle Tissue

• **Muscle tissue** consists of long cells called muscle fibers, which contract in response to nerve signals

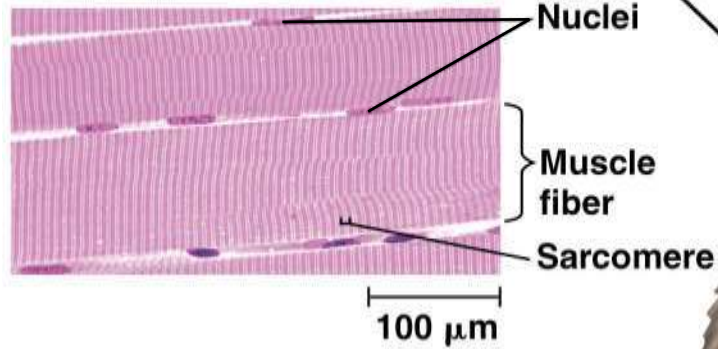
تكون مطاولة على شكل خيوط

All muscle cells consist of filaments containing the proteins actin and myosin, which together enable muscles to contract. There are three types of muscle tissue in the vertebrate body: skeletal, smooth, and cardiac.

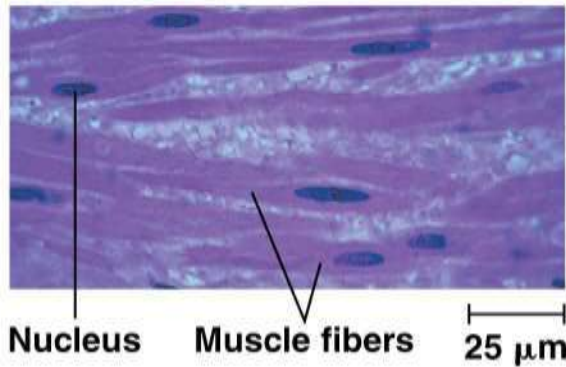
- It is divided in the vertebrate body into three types:
 - **Skeletal muscle**, or striated muscle, is responsible for voluntary movement
 - **Smooth muscle** is responsible for involuntary body activities
 - **Cardiac muscle** is responsible for contraction of the heart

Muscle Tissue

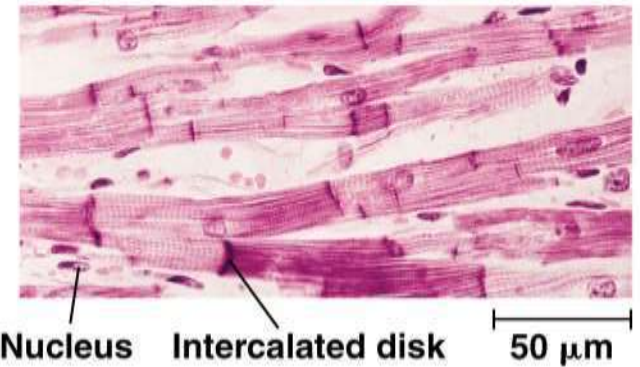
Skeletal muscle



Smooth muscle



Cardiac muscle



هيكلية
 Skeletal muscle
 عند الفخذ
 also called

الحركات الإرادية

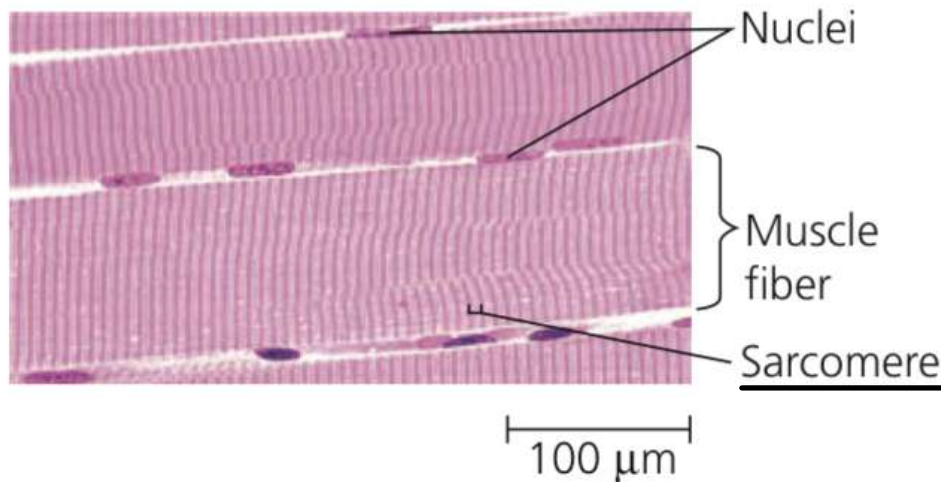
Attached to bones by tendons, skeletal muscle, or *striated muscle*, is responsible for voluntary movements. Skeletal muscle consists of bundles of long cells that are called muscle fibers. During development, skeletal muscle fibers form by the fusion of many cells, resulting in multiple nuclei in each muscle fiber. The arrangement of contractile units, or sarcomeres, along the fibers gives the cells a striped (striated) appearance. In adult mammals, building muscle increases the size but not the number of muscle fibers.

① *cylindrical in shape

↓
 اسطوانية الشكل

② striated

③ peripheral multi-nucleated



منه الأمعاء

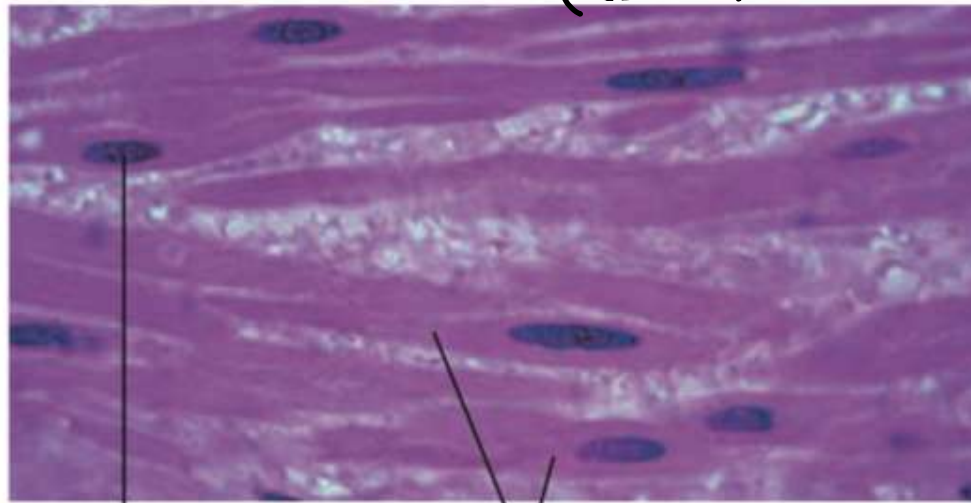
Smooth muscle, not striated

Smooth muscle, which lacks striations, is found in the walls of the digestive tract, urinary bladder, arteries, and other internal organs. The cells are spindle-shaped. Smooth muscles are responsible for involuntary body activities, such as churning of the stomach and constriction of arteries.

طويلة جدًا

الحركات اللاإرادية كلها
معدة
heart
خطوه لحاله

انقباضات لا
المعدة (في الجوف)



One central Nucleus

Muscle fibers

25 μm

هاخذ من التنين
اللي قبله / عنان
هيك حطوه
طاله

Cardiac muscle

major function: contraction of heart → pump blood in symphonic

① + ②
حضانة
حاضنة فيها
فقط

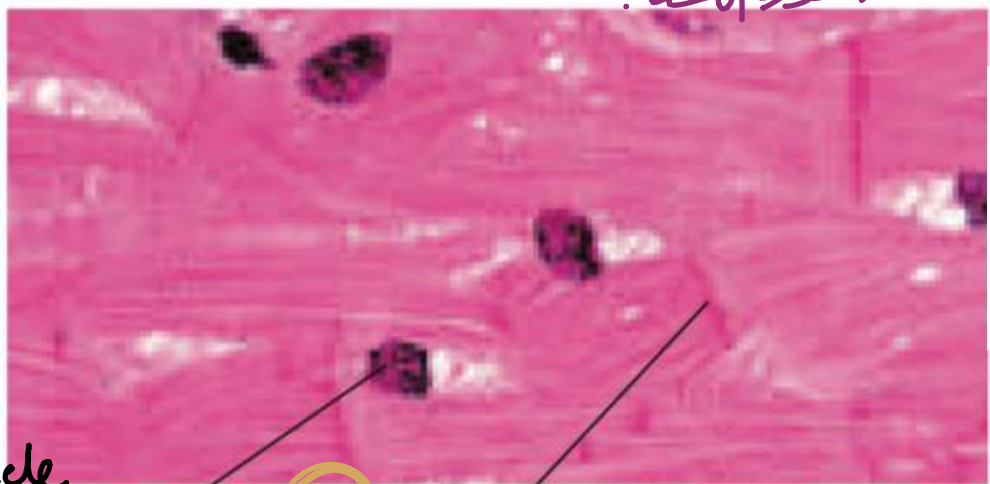
Cardiac muscle forms the contractile wall of the heart. It is striated like skeletal muscle and has similar contractile properties. Unlike skeletal muscle, however, cardiac muscle has branched fibers that interconnect via intercalated disks, which relay signals from cell to cell and help synchronize heart contraction.

like smooth in two things
① involuntary
② one central nucleus

also it is cylindrical like it

صورة الكتاب

صورة الانسجة



each muscle fibre contains one central

Nucleus

②

intercalated disk:

25 μm

gap junctions: harmony in heart beating (symphonic) because of it

نقل الإحساس ويؤدي

الاستجابة Nervous Tissue

- **Nervous tissue** senses stimuli and transmits signals throughout the animal

two types of cells • Nervous tissue contains

① **Neurons**, or nerve cells, that transmit nerve impulses

② **Glial cells**, or **glia**, that help nourish, insulate, and replenish neurons

Neurons

Neurons are the basic units of the nervous system. A neuron receives nerve impulses from other neurons via its cell body and multiple extensions called dendrites. Neurons transmit impulses to neurons, muscles, or other cells via extensions called axons, which are often bundled together into nerves.

Glia

The various types of glia help nourish, insulate, and replenish neurons, and in some cases, modulate neuron function.

Nervous Tissue

Neurons

Neuron:

Dendrites

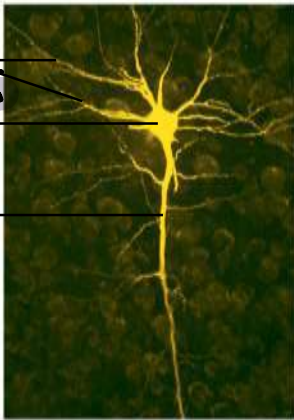
extensions: **تفرعات**

Cell body

Axon

طويل

40 μm



(Fluorescent LM)



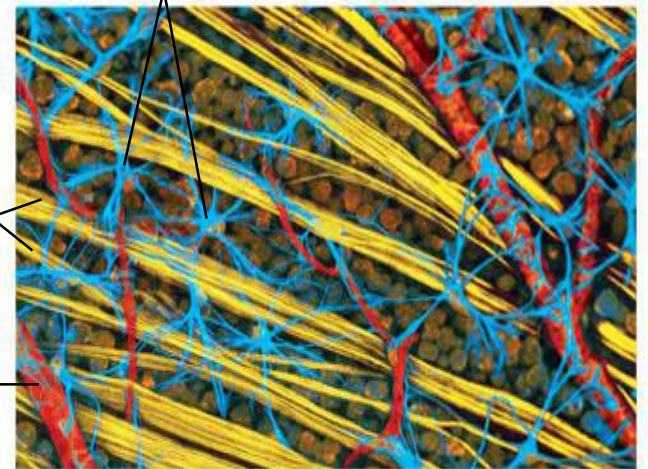
Glia

Glia

15 μm

Axons of neurons

Blood vessel



(Confocal LM)

Figure 40.5db

Neuron:

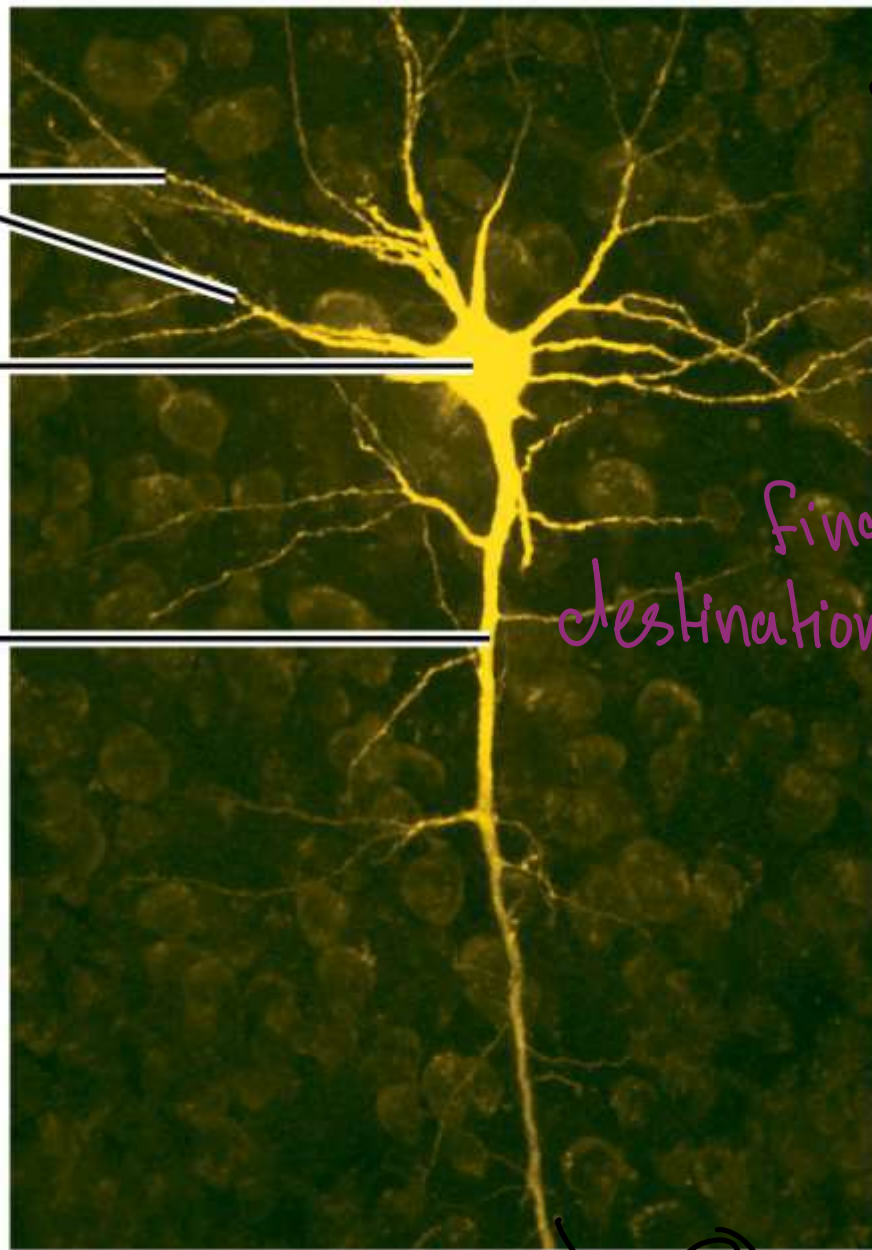
①
الزوائد
الشجرية
Dendrites

②
Cell body

③
الأسبون
Axon
long

40 μm

(Fluorescent LM)



طريقة انتقال
السيال العصبي

① → ② → ③

→ ④ → إلى

Other

Axon

terminals

Final destination:
other neuron
gland
muscle

③ Axon terminal
نهاية الأسبون

Axons bond together
nerve

يُحَوِّمُ نِيورُونِ وَيُغْذِيهِمْ

Glia

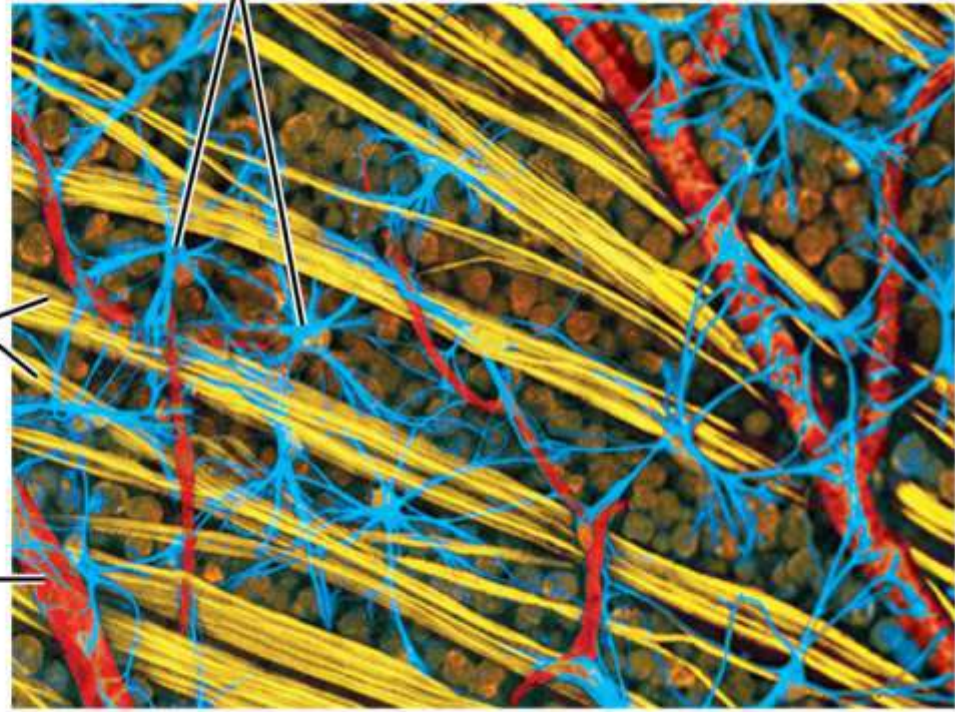
نِيورُونِ
nerve cells

15 μm

ويَرْبِطُهُمْ إِذَا حَارَ أَيُّ
خَلَّ فِي نَقْلِ الإِشَارَاتِ
أَدَّ فِي التَّفْرِيقَةِ

Axons of
neurons
nerve cells

Blood
vessel



(Confocal LM)