PLANT ANATOMY

PLANT ORGANS

Root Structure

Plant organ: Root

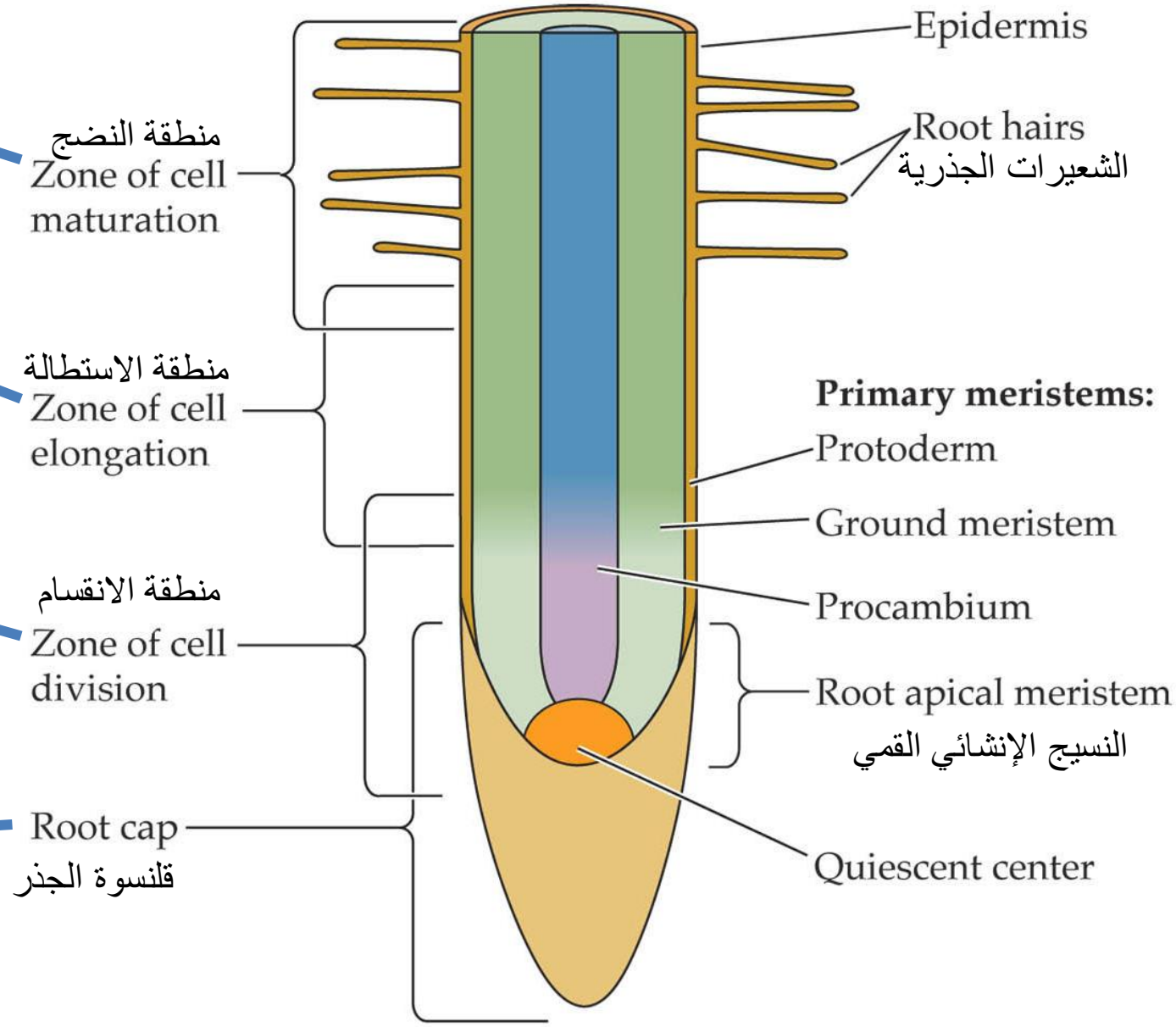
Root Tip Zones

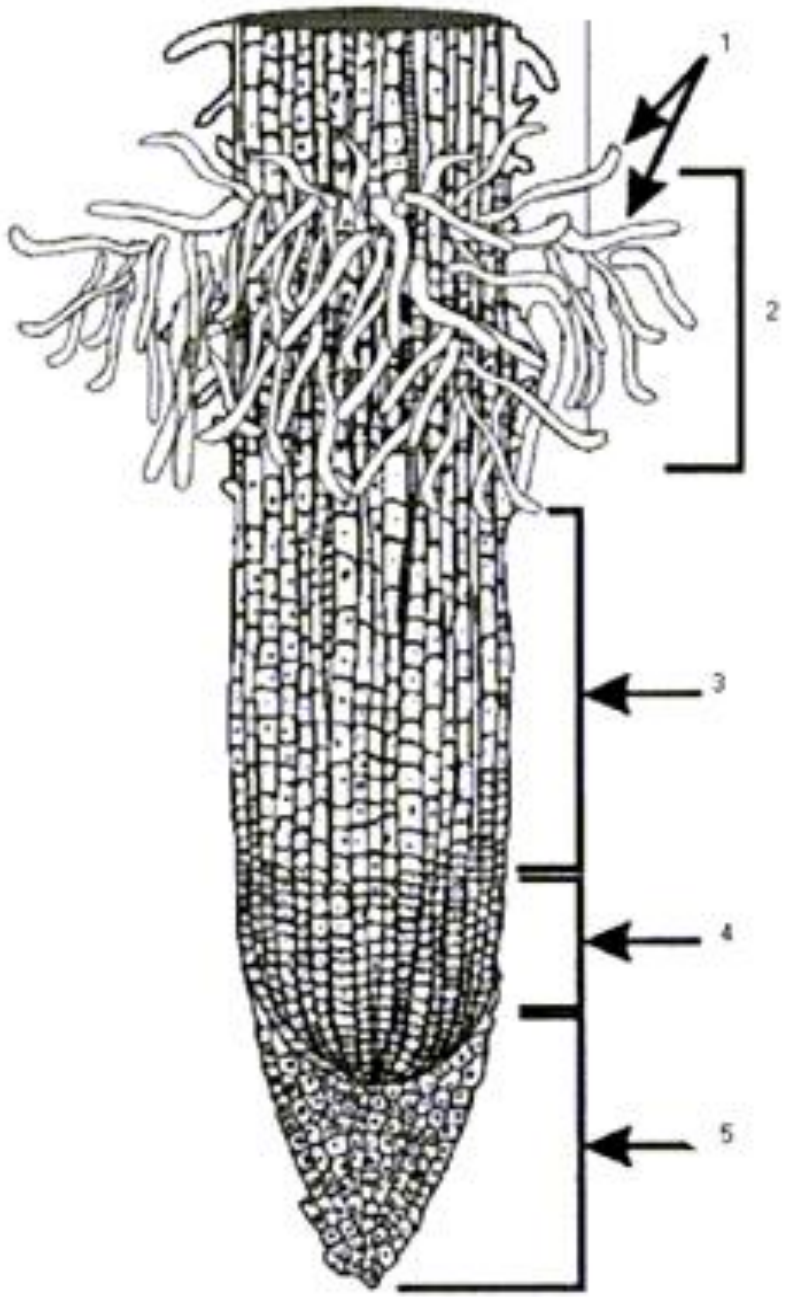
In the Zone of maturation
The cells complete maturation, and become fully functional

In the Zone of elongation, the root cells elongate, pushes root tip further into soil

Zone of cell division is a actively dividing region, produces root cap cells

The root tip is covered by a root cap, which protects the delicate apical meristem as the root pushes through soil during primary growth





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Root hairs

Zone of cell maturation

Zone of cell elongation

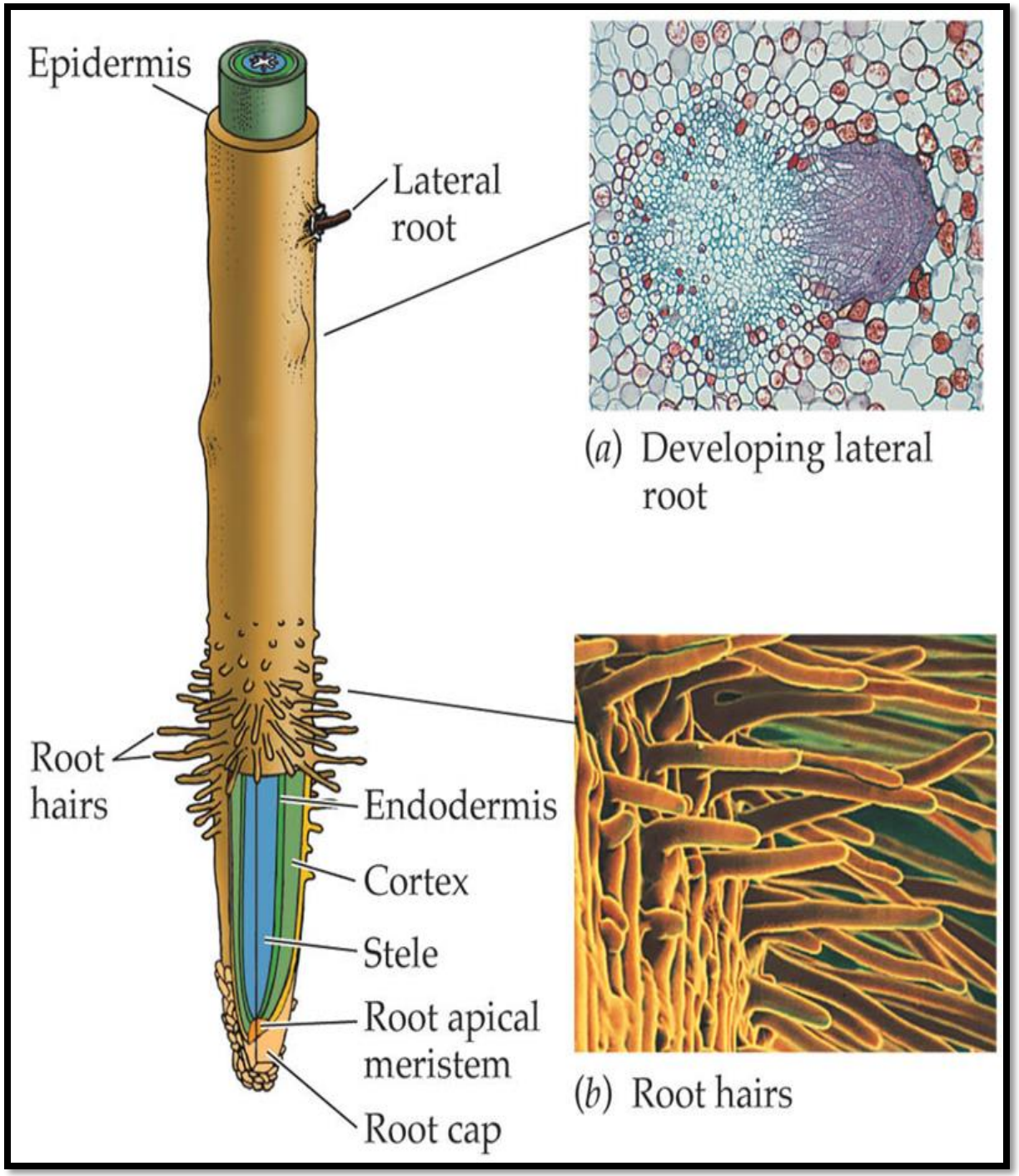
Zone of cell division

root cap

Structure of the Root:

- **Root cap** covers the apical meristem (growth tissue) at the tip of the root & produces a **slimy substance** so roots can more easily grow through the ground
- **Apical meristem** replaces cells of the **root cap** as they are damaged
- **Epidermis** covers the outside of the root & has extensions called **root hairs** that absorb water & minerals and increase the surface area of the root

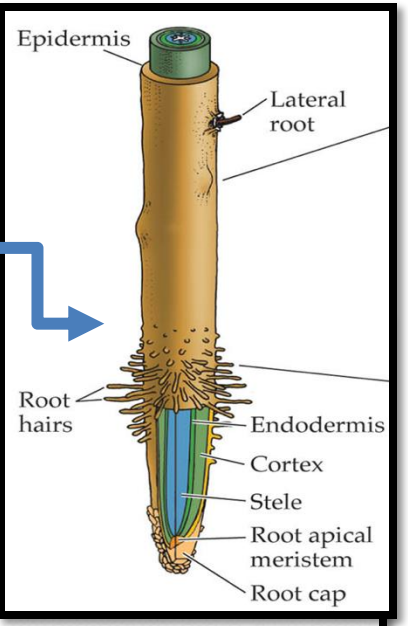
قلنسوة الجذر تغطي النسيج الإنشائي القمي (انسجة النمو) في قمة أو طرف الجذر تفرز او تنتج مادة لزجة تمكن الجذور من النمو بسهولة أكبر خلال تربة الأرض
النسيج الإنشائي القمي يعوض خلايا قلنسوة الجذر عند عطبها وتهتكها بسبب احتكاكها بالتربة
البشرة تغطي السطح الخارجي للجذر ويمتد منها زوائد دقيقة تسمى الشعيرات الجذرية التي تمتص الماء والمعادن وتزيد مساحة سطح الجذر

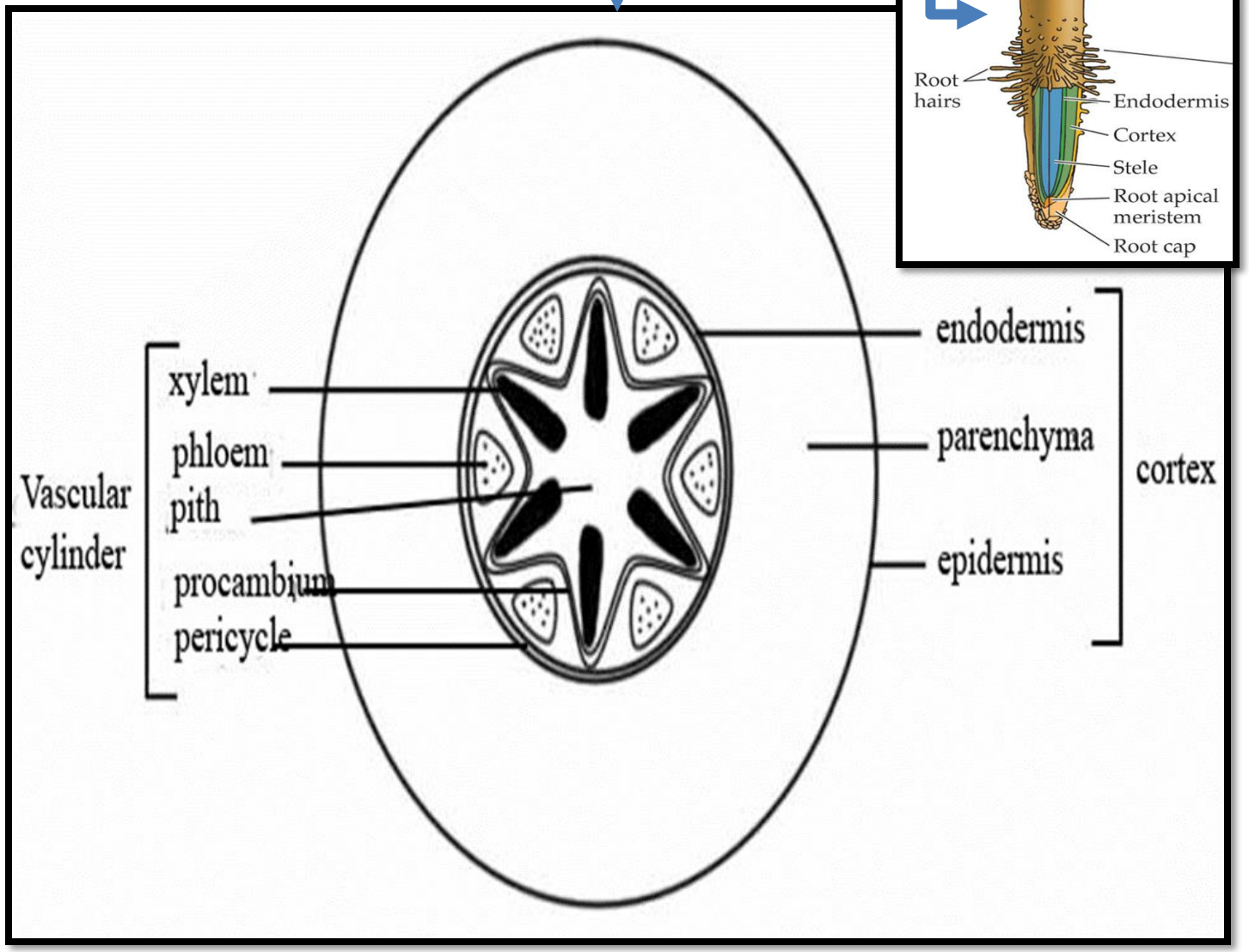


Structure of the Root:

- **The outermost cell is called as epidermis** البشرة
- **The tissues in the central region (core of the root) is called the vascular cylinder** الاسطوانة الوعائية**, contains xylem** خشب **& phloem** اللحاء
- **A ground tissue called cortex** القشرة **surrounds the vascular cylinder**
- **A single cell layer called endodermis** البشرة الداخلية **separates the cortex & vascular tissue**

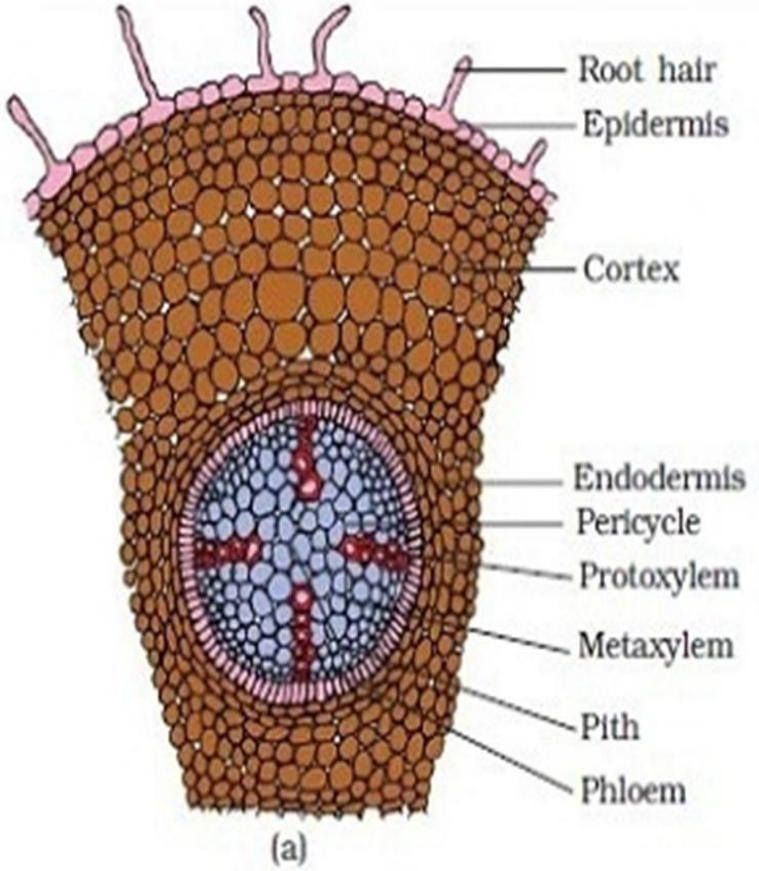
مقطع عرضي
Transverse section



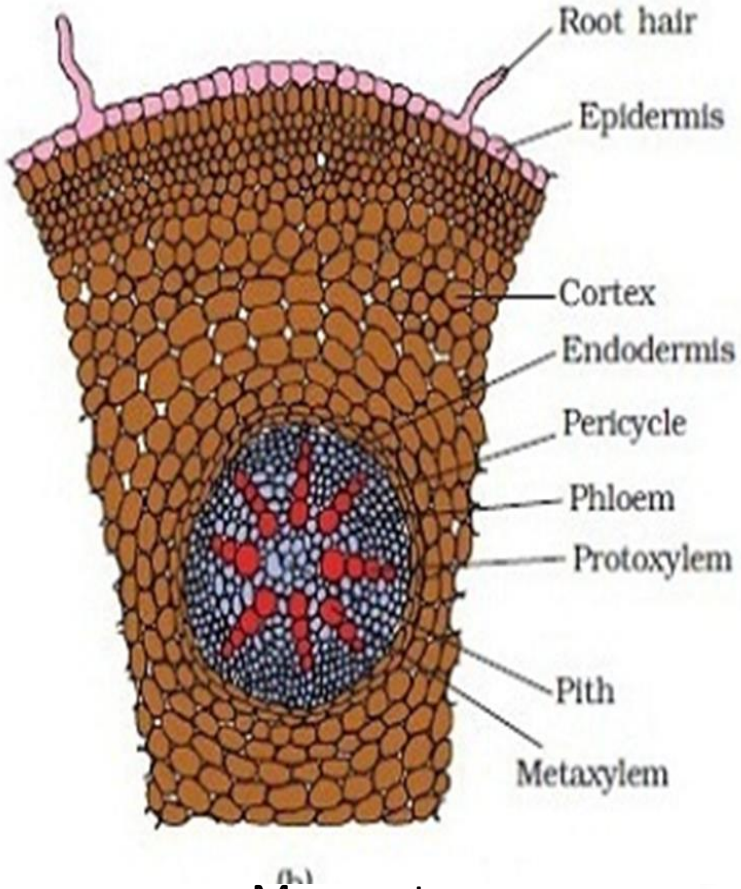


Plant organ: Root

Dicot and Monocot Root

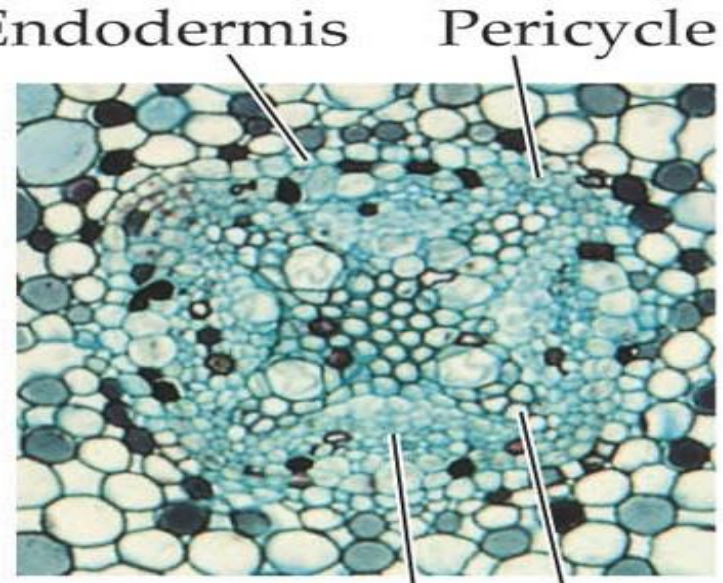


Dicot

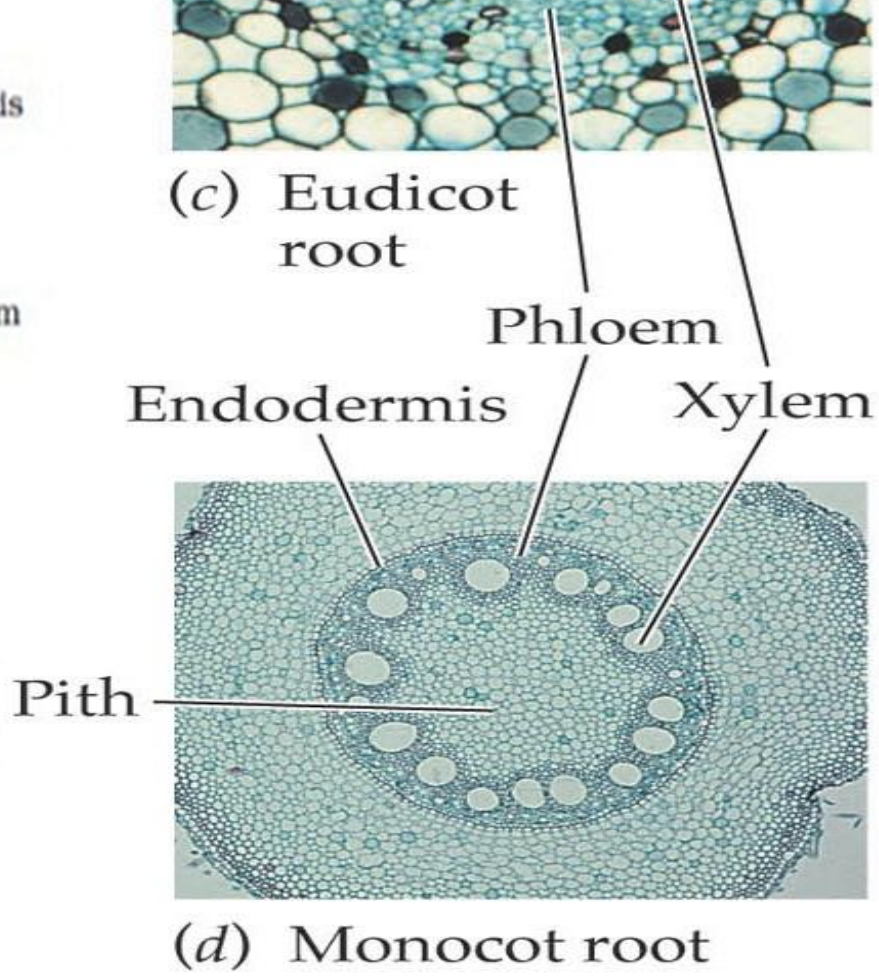


Monocot

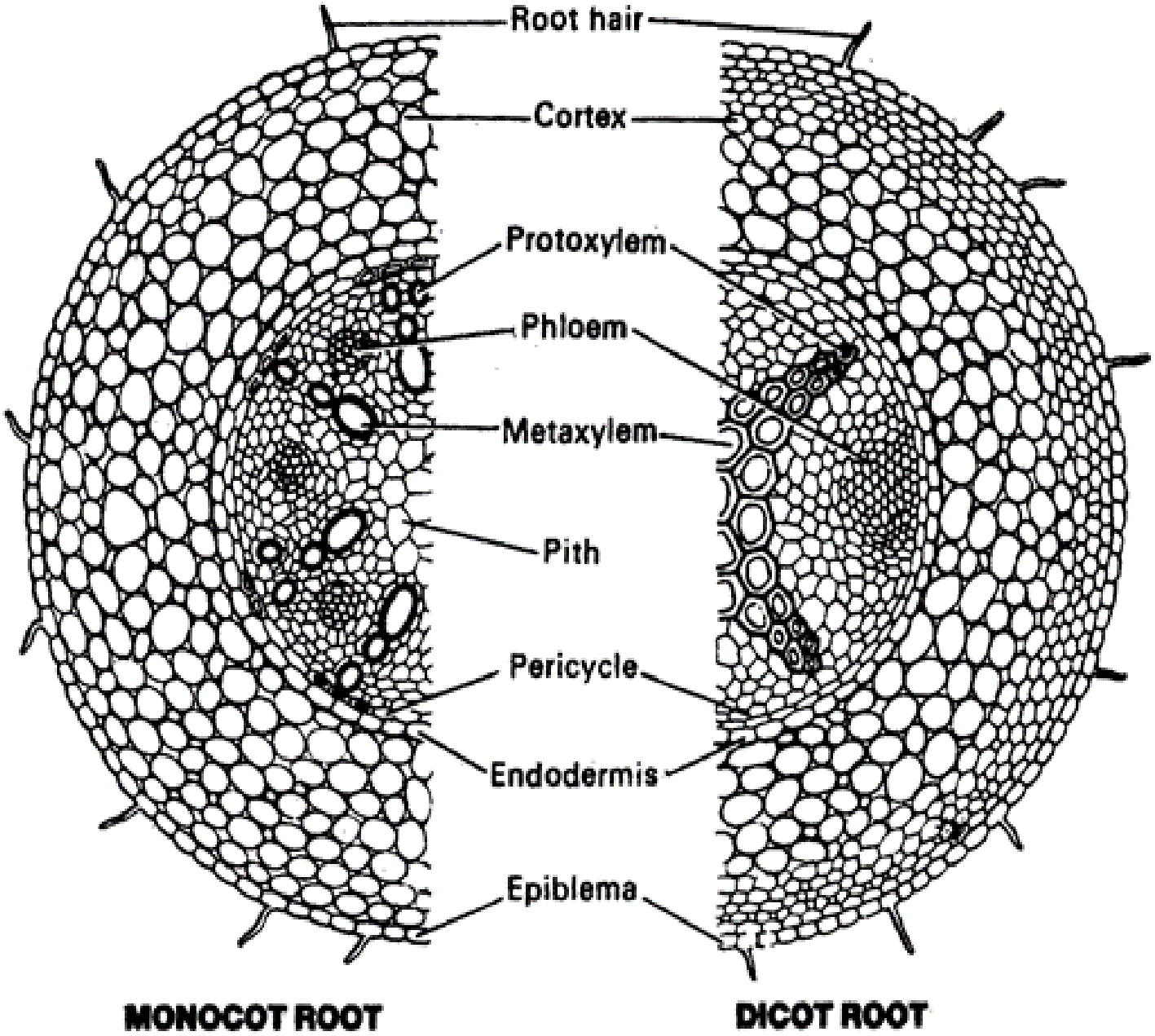
Vascular bundles الحزم الوعائية	2-6 alternate bundles of xylem and phloem.	8 or more alternate bundles of xylem and phloem.



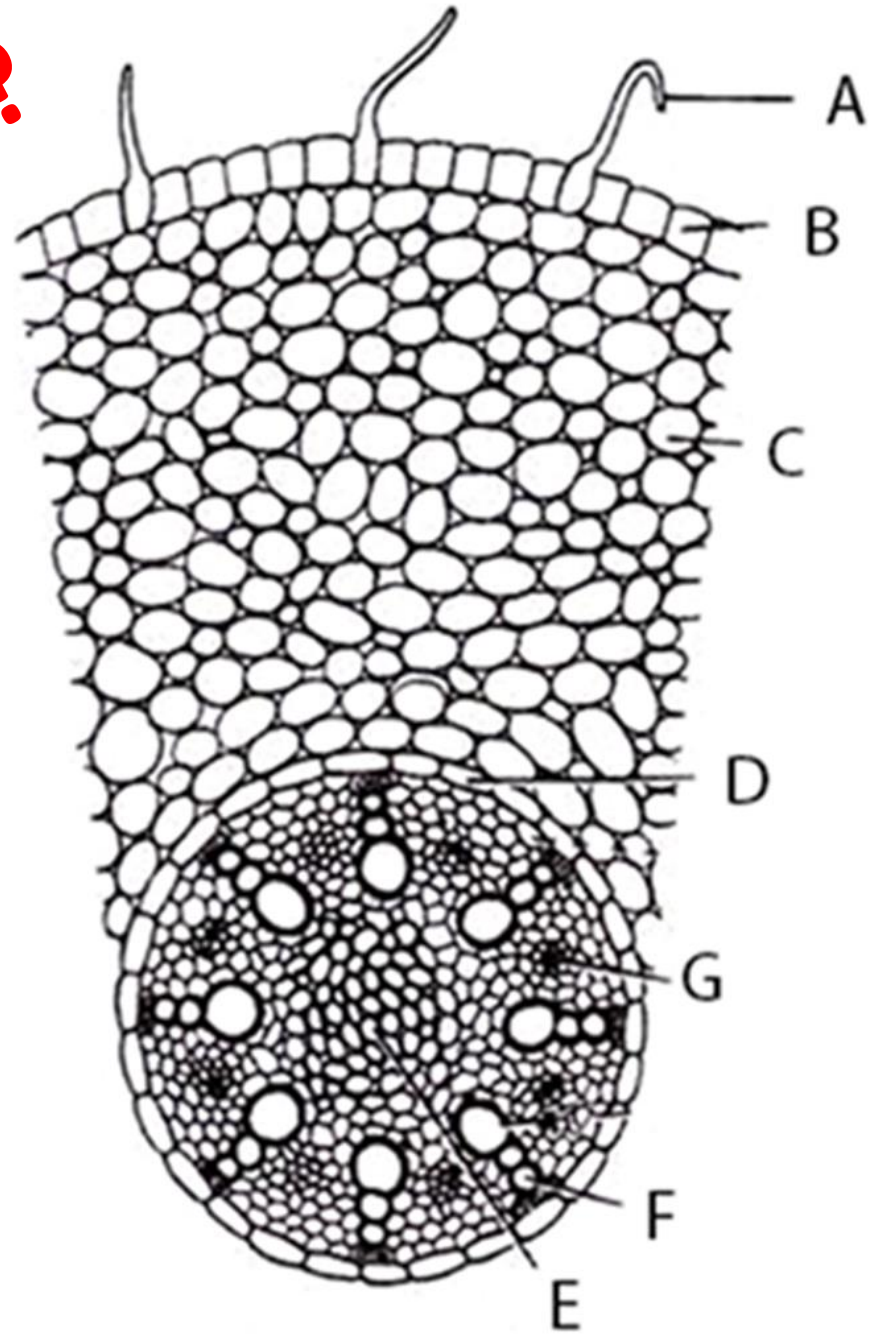
(c) Eudicot root



(d) Monocot root


Root hair
Cortex
Protoxylem
Phloem
Metaxylem
Pith
Pericycle
Endodermis
Epiblema
MONOCOT ROOT
DICOT ROOT

?


A
B
C
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G
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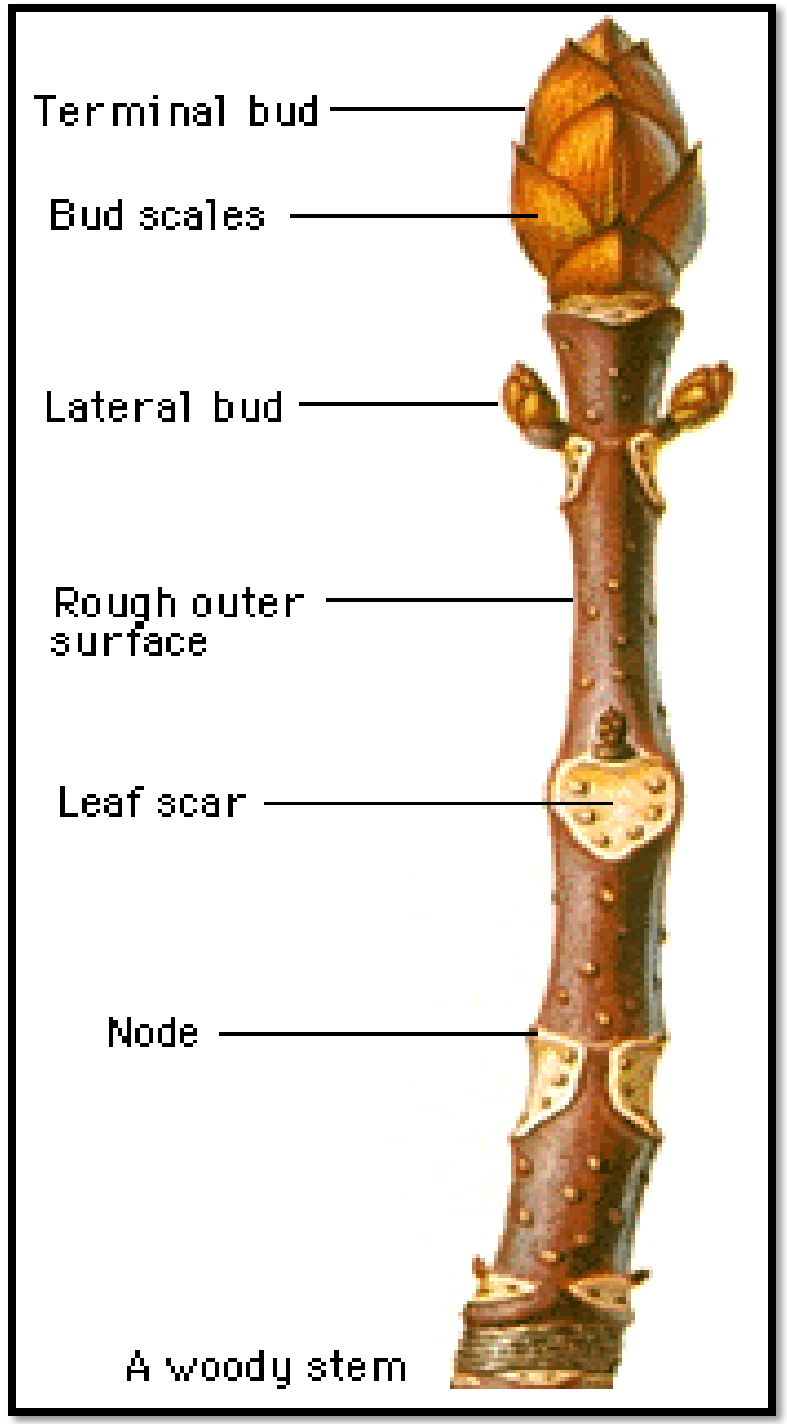
E

Stem Structure

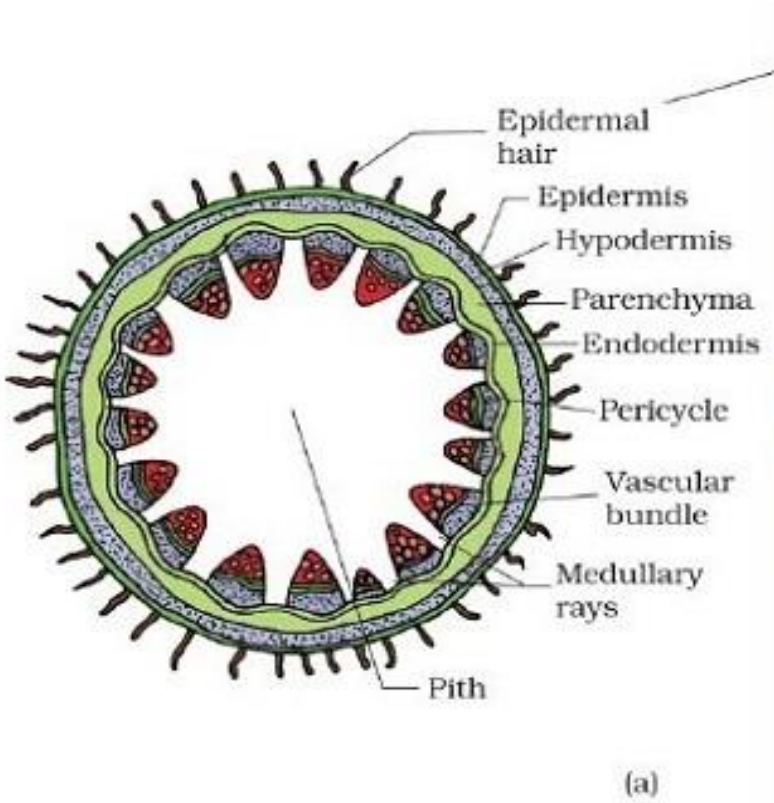
Structure and Function of Stem

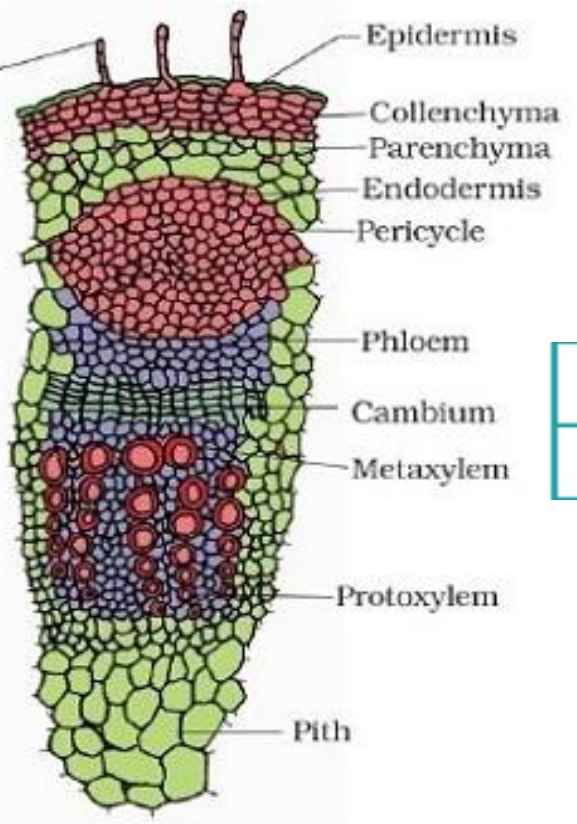
- The tip of each stem usually has a برعم طرفي **Terminal Bud** enclosed by specialized leaves called **Bud Scales** حراشف البرعم
- Adapted **to support leaves**
- **Transport water and minerals** from root to leaves
- **Transport sugars** from leaves to roots
- Stems grow from the النسيج الإنشائي القمي **tip or apical meristem**
- **Internode** المسافات بين العقد (السلاميات) is space between nodes on a stem
- Stems increase in circumference by محيط الساق **lateral meristems** الخلايا الإنشائية الجانبية
- Leaves are attached to stems at العقد **nodes**



Stem Structure
Dicot and Monocot

- **Vascular Tissue** is arranged in bundles with **xylem** toward the **inside** & **phloem** toward the **outside**
- Vascular bundles are scattered throughout **monocot** stems
- Vascular bundles are arranged in rings in **dicot** stems





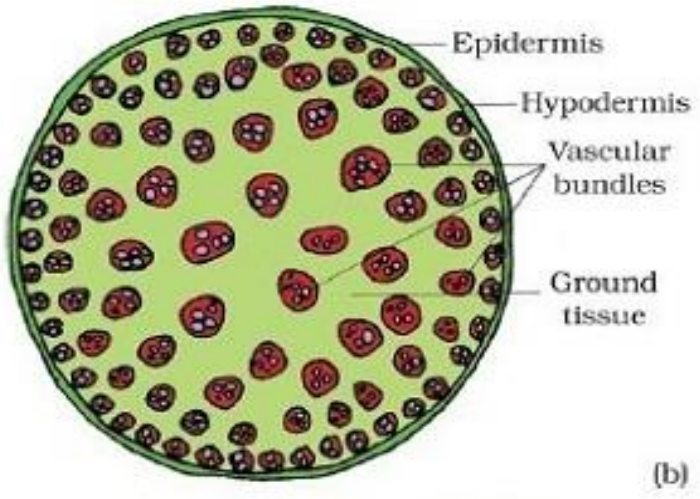
الحزم الوعائية

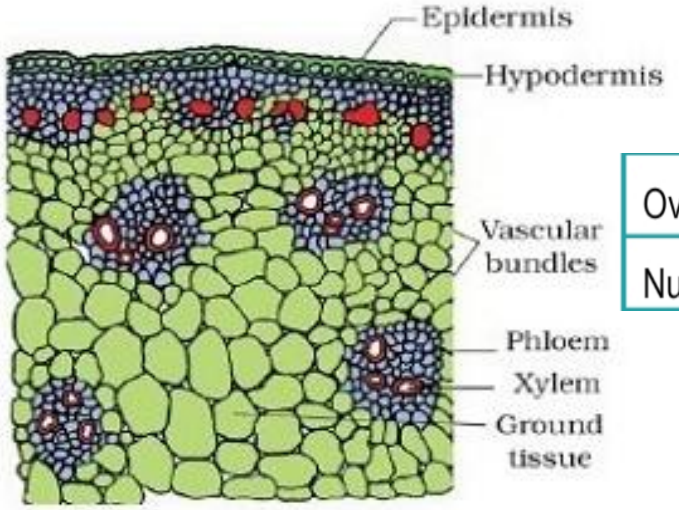
Vascular bundles

dicot

Wedge shaped.
Arranged in a ring.

وتدية الشكل
وموزعة على شكل حلقة



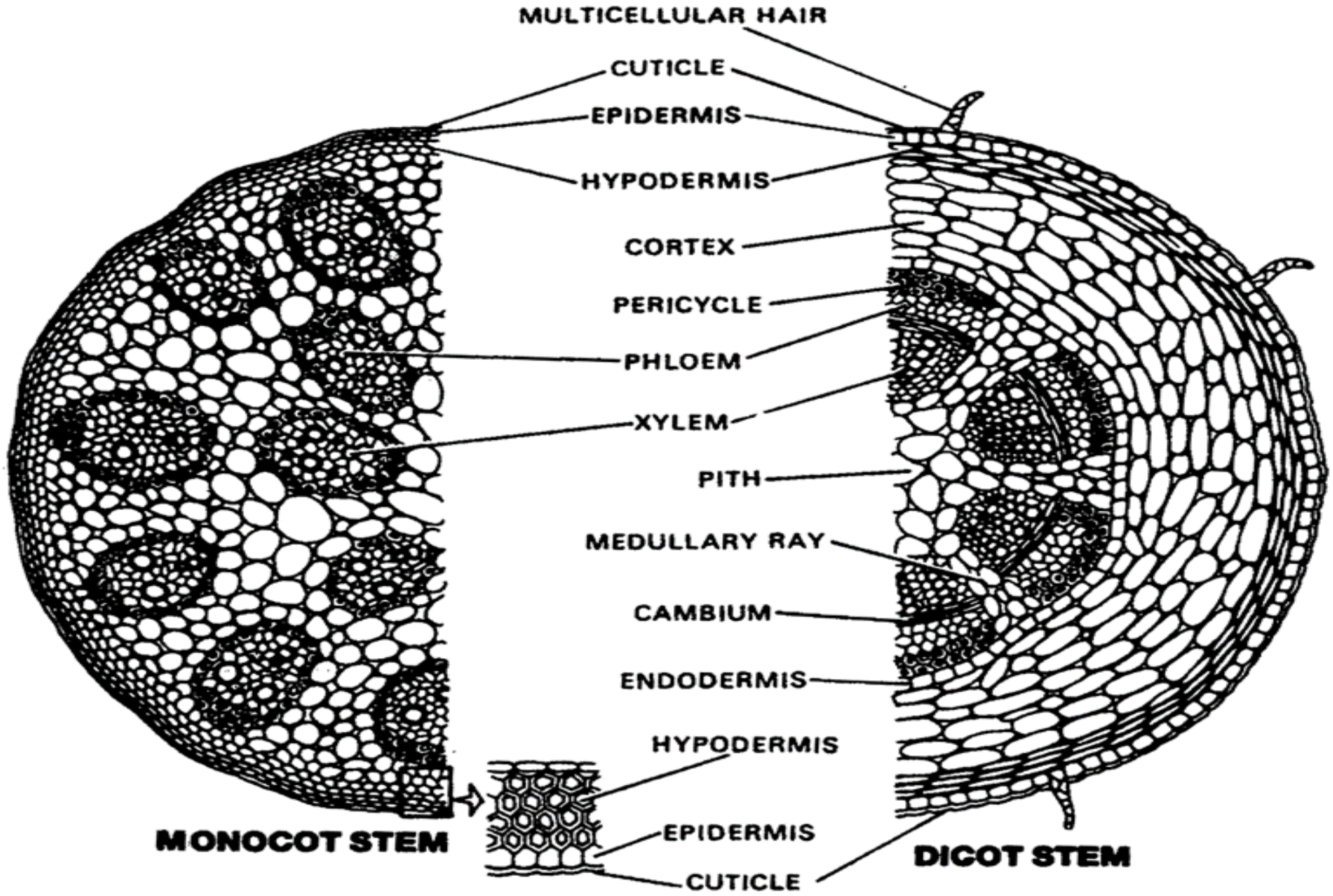


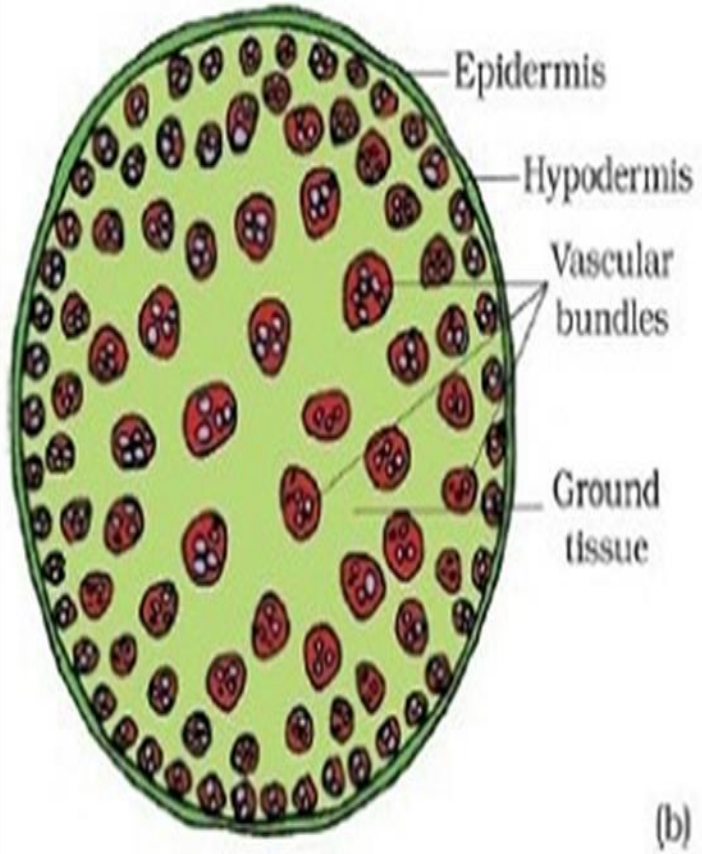
monocot

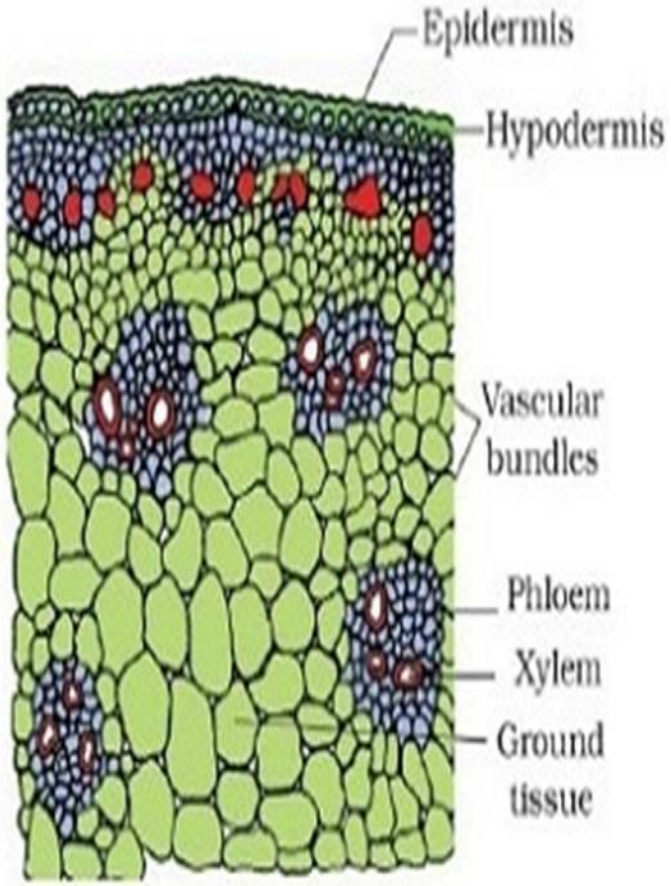
Oval in shape.
Numerous and scattered.

بيضاوية الشكل
عديدة و مبعثرة

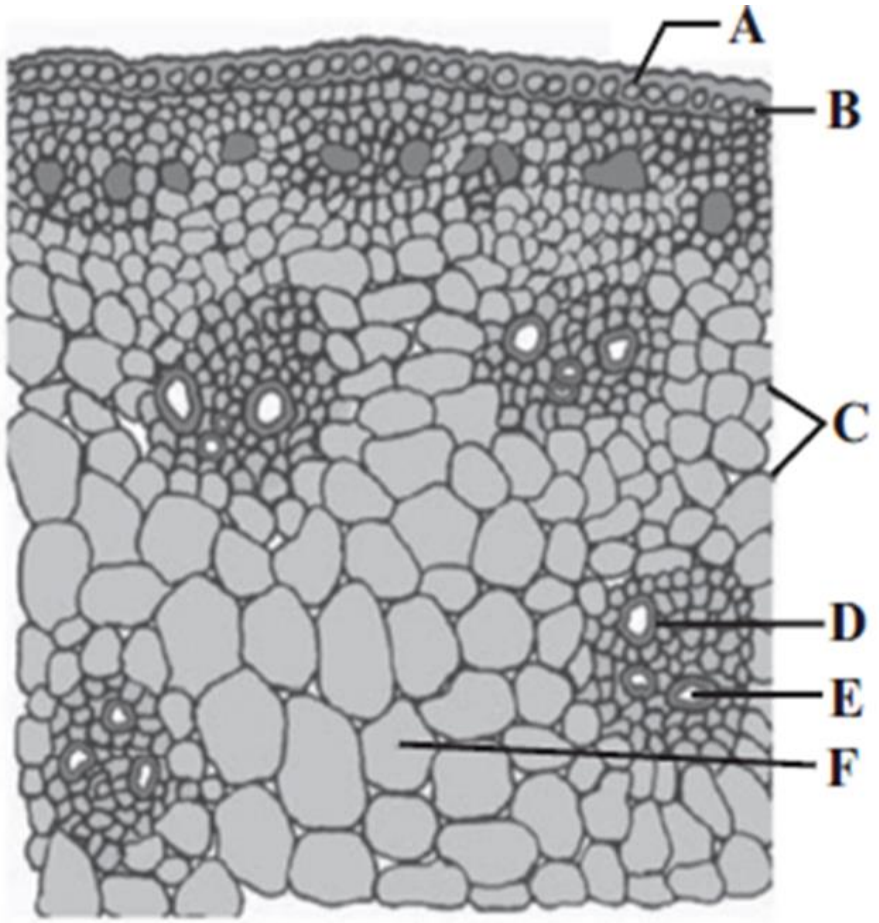
تترتيب الأنسجة الوعائية في الحزم ويكون الخشب باتجاه الداخل واللحاء نحو الخارج
الحزم الوعائية في سيقان نباتات ذات الفلقة تنتشر في جميع أنحاء الساق
الحزم الوعائية في سيقان نباتات ذات الفلقتين تترتيب في حلقات


MULTICELLULAR HAIR
CUTICLE
EPIDERMIS
HYPODERMIS
CORTEX
PERICYCLE
PHLOEM
XYLEM
PITH
MEDULLARY RAY
CAMBIUM
ENDODERMIS
HYPODERMIS
EPIDERMIS
CUTICLE
MONOCOT STEM
DICOT STEM


Epidermis
Hypodermis
Vascular bundles
Ground tissue
(b)


Epidermis
Hypodermis
Vascular bundles
Phloem
Xylem
Ground tissue

?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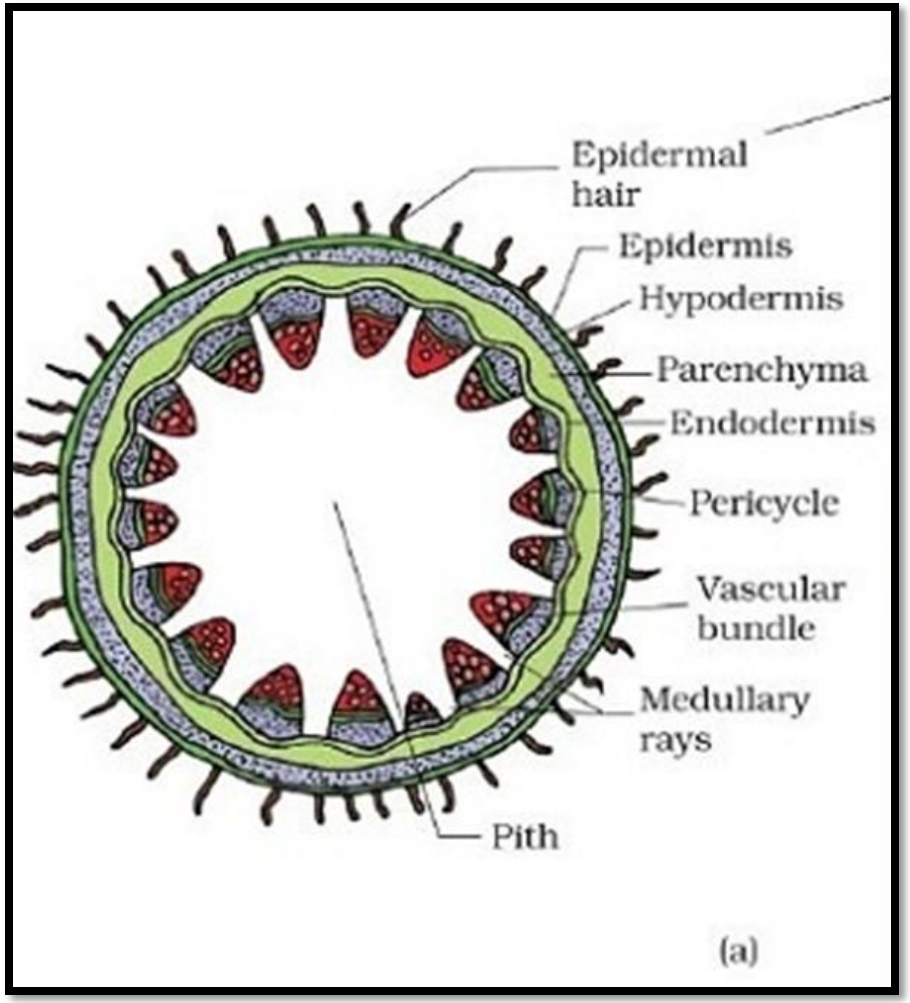
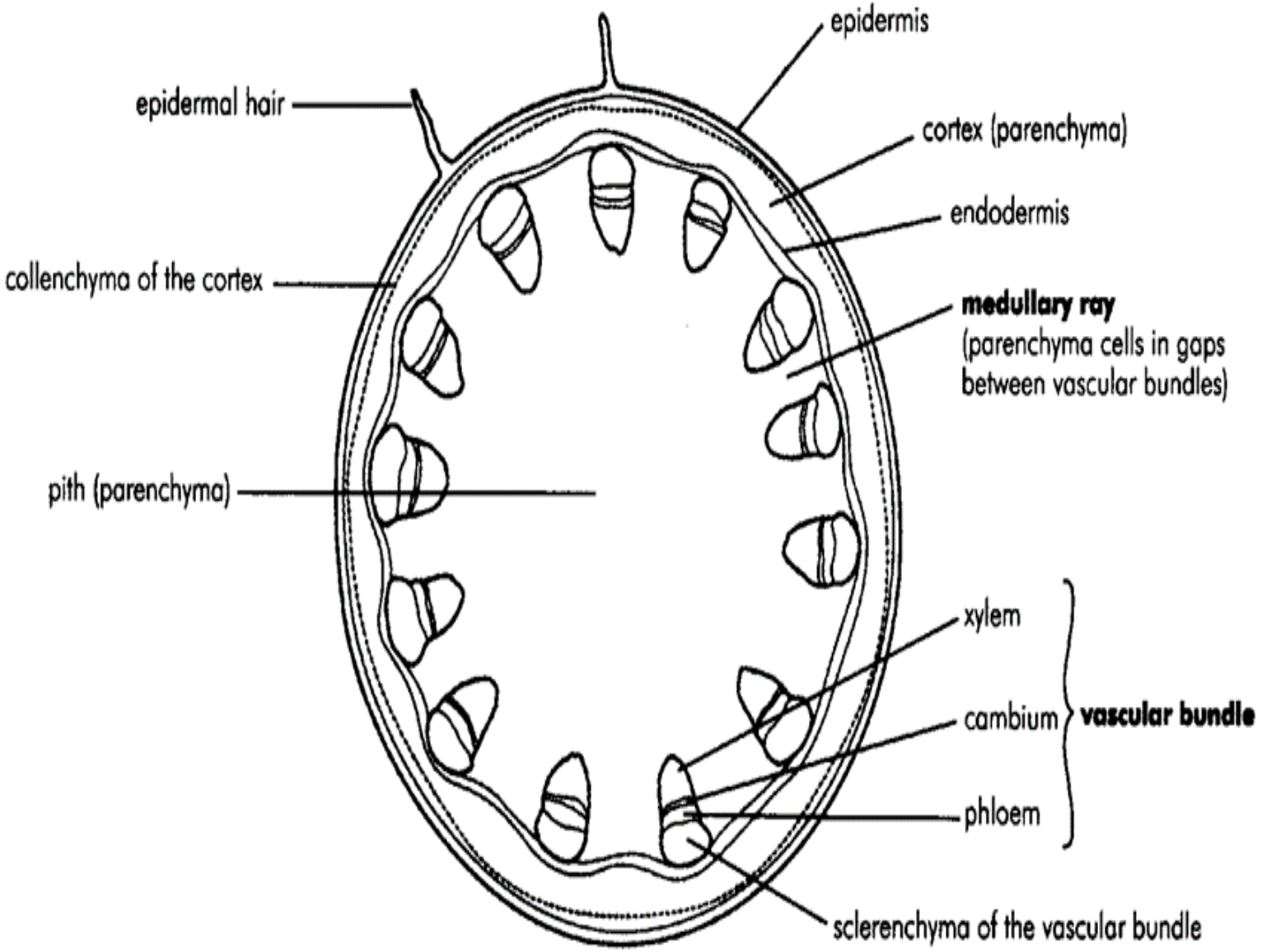

Epidermal hair
Epidermis
Hypodermis
Parenchyma
Endodermis
Pericycle
Vascular bundle
Medullary rays
Pith
(a)


epidermis
epidermal hair
cortex (parenchyma)
endodermis
collenchyma of the cortex
medullary ray
(parenchyma cells in gaps between vascular bundles)
pith (parenchyma)
xylem
cambium
vascular bundle
phloem
sclerenchyma of the vascular bundle

leaf Structure

Leaf Structure

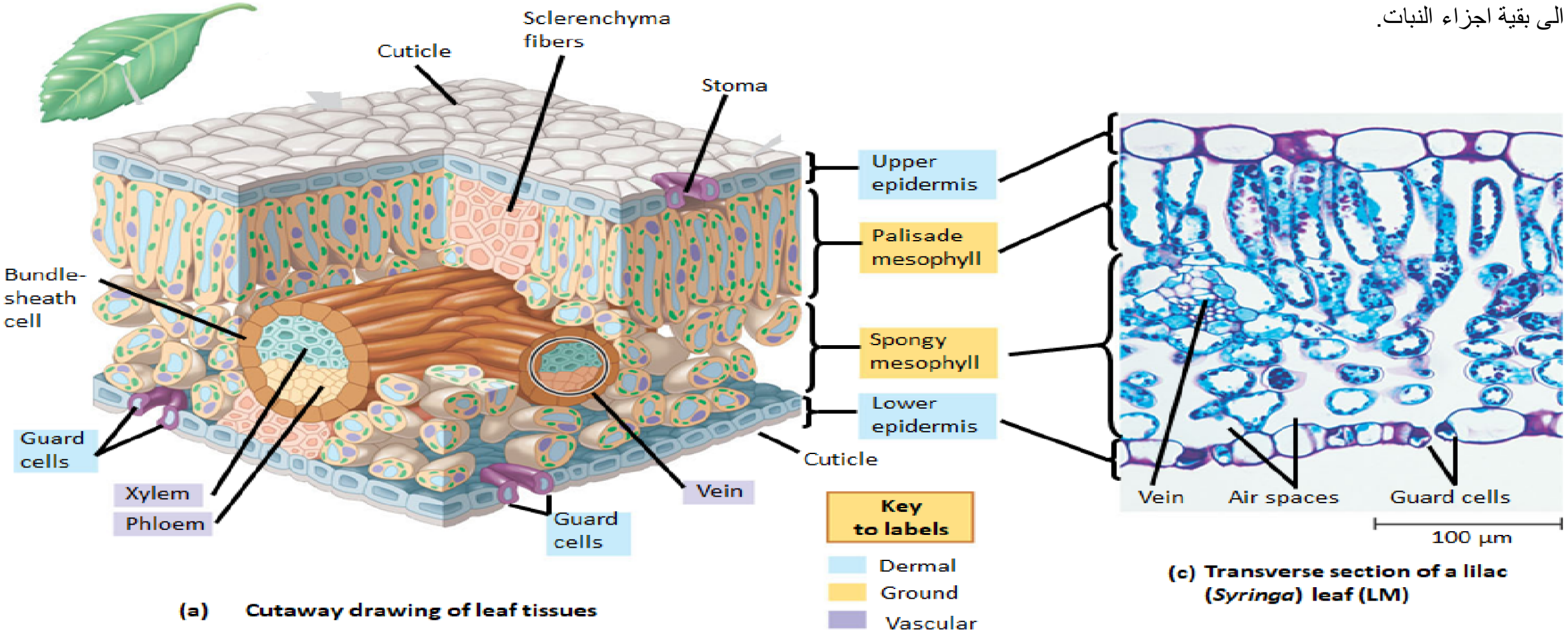
- **Leaf anatomy is adapted to carry out :**
  - **photosynthesis**
  - **limit evaporative water loss (transpiration)**
  - **transport the products of photosynthesis to the rest of the plant.**

تكيف تشريح الورقة للقيام بعملية التركيب الضوئي، والحد من فقدان المياه المتبخرة، ونقل نواتج التمثيل الضوئي الى بقية اجزاء النبات.

Leaf Structure

- The **mesophyll** contains **air space** through which CO_2 can diffuse to the photosynthesizing cells.
- **Veins** (**vascular bundles**) supply mesophyll cells with water and minerals, and they **transport** the products of photosynthesis to the rest of the plant.

يمر الهواء الجوي خلال النسيج الوسطي للورقة وينتشر ويصل إلى الخلايا التي تقوم بعملية البناء الضوئي
العروق(الحزم الوعائية) تزود خلايا العرض النسيج الوسطي بالماء والمعادن، وتنقل نواتج البناء الضوئي
الى بقية اجزاء النبات.



(a) Cutaway drawing of leaf tissues

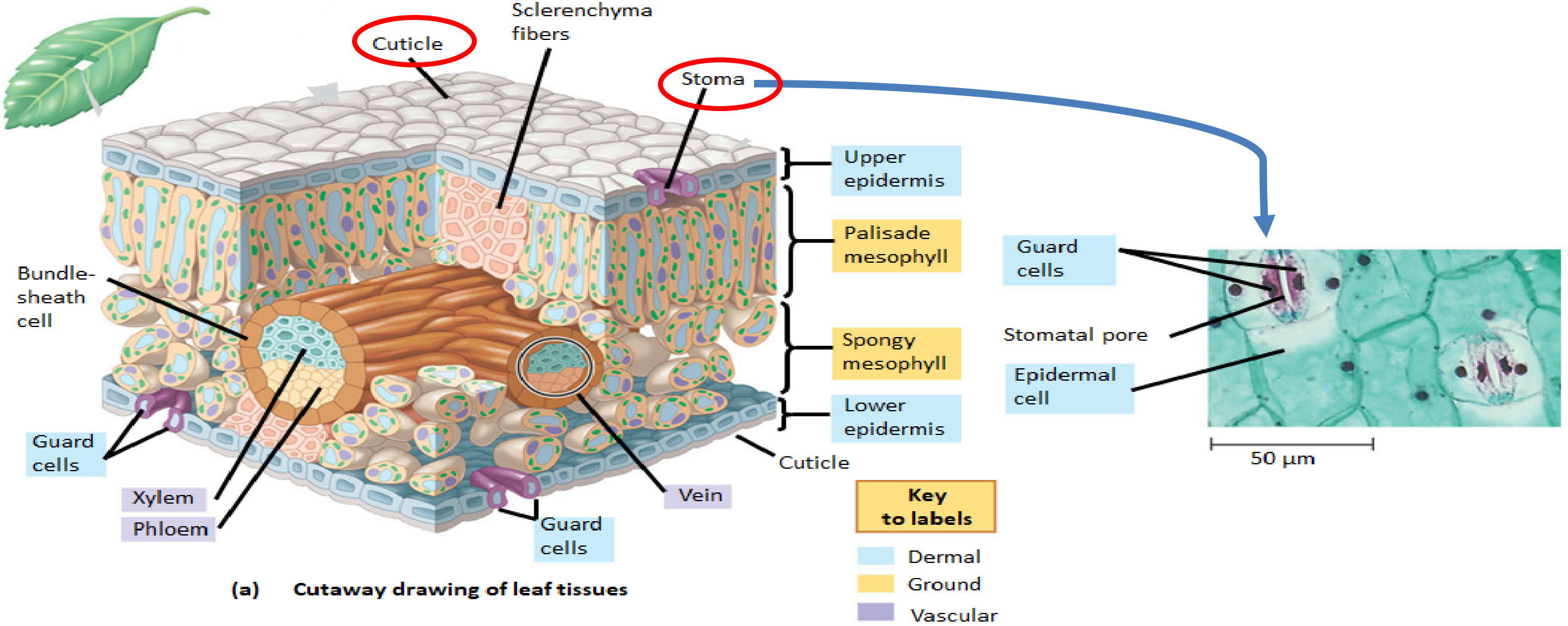
(c) Transverse section of a lilac (*Syringa*) leaf (LM)

Leaf Structure

- **The epidermis of the leaf is the outermost cell layer, which is covered by a waxy cuticle.**

- **Guard cells allow controlled gas exchange through pores in the leaf (the stomata).**

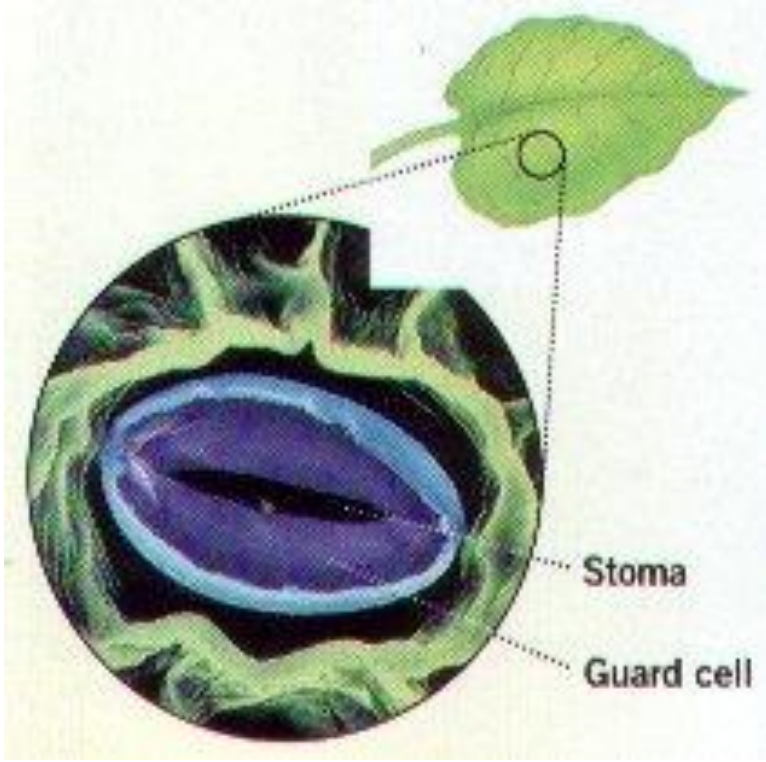
بشرة الورقة هي طبقة الخلايا الخارجية وتغطيها ادمة شمعية. من وظائف البشرة الحفاظ على الماء نواتج البناء الضوئي في ورقة.
الخلايا الحارسة تتحكم في تبادل الغازات من خلال المسام في ورقة (فتحات الثغور).

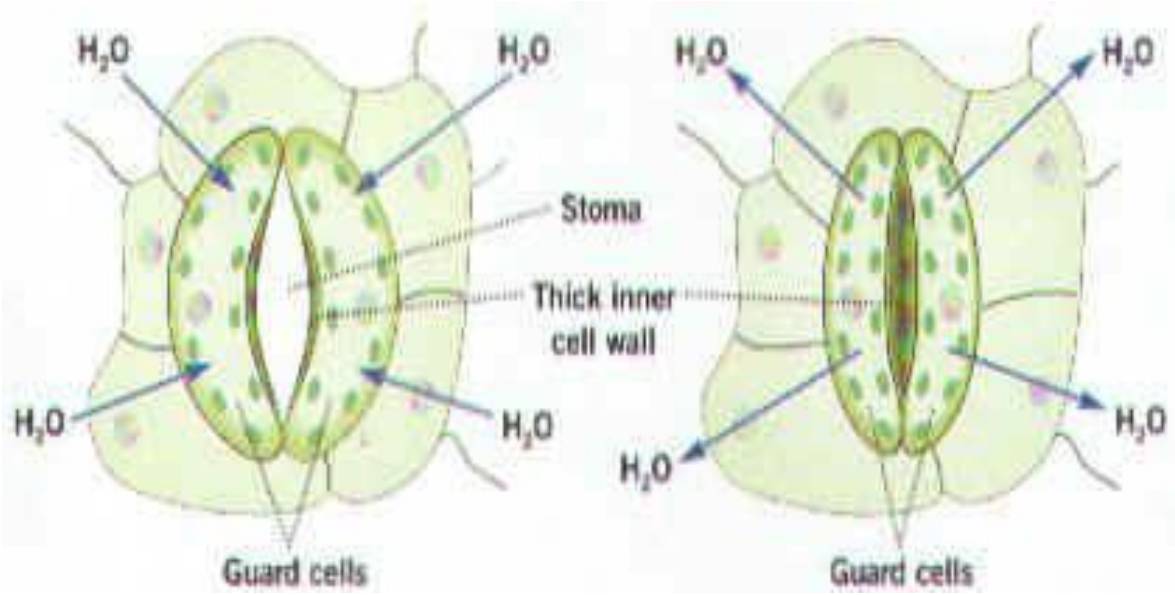


(a) Cutaway drawing of leaf tissues

Stomata:

- **Openings called stomata on the underside of leaves for gas exchange (CO2 & O2)**
- **Two guard cells on either side of the stomata open & close the openings**
- **When guard cells LOSE water, the stoma CLOSE, while the stoma OPEN when guard cells gain water & swell**

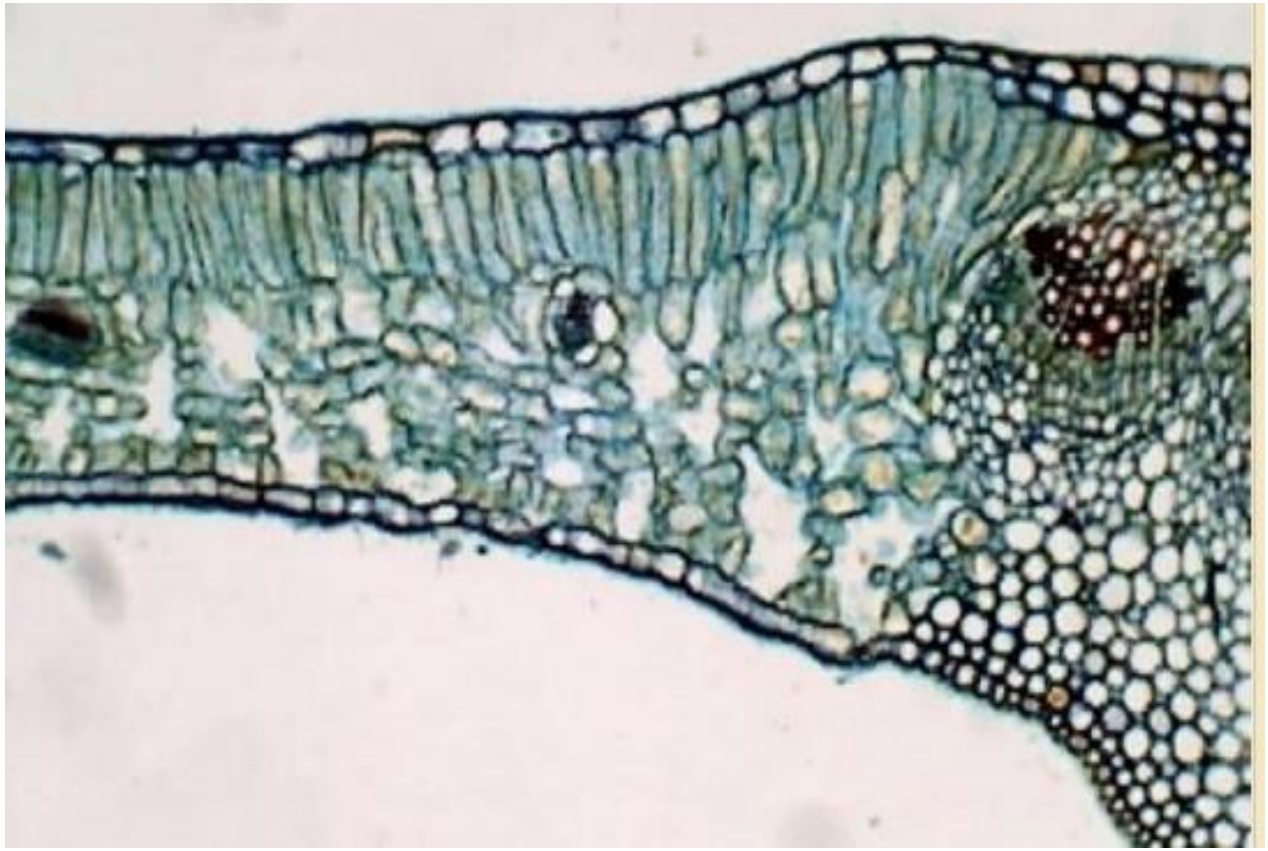


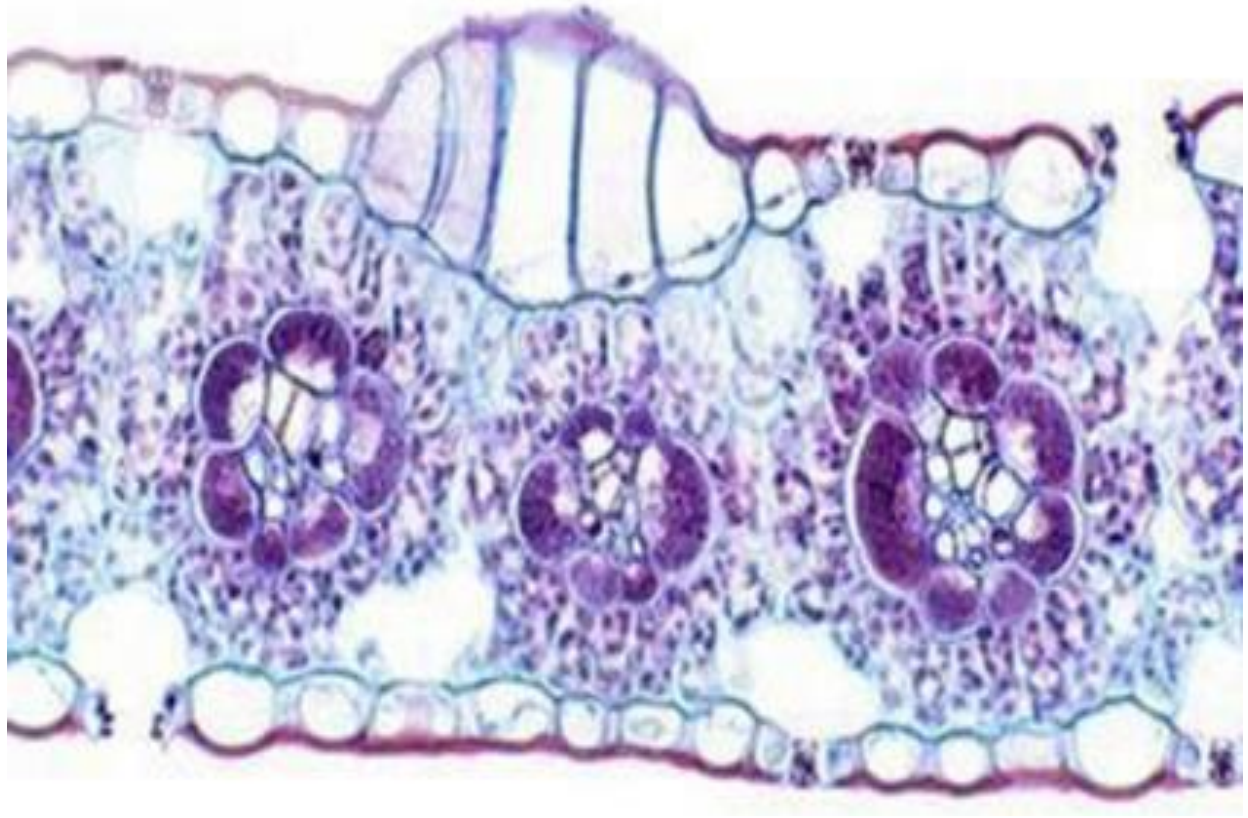


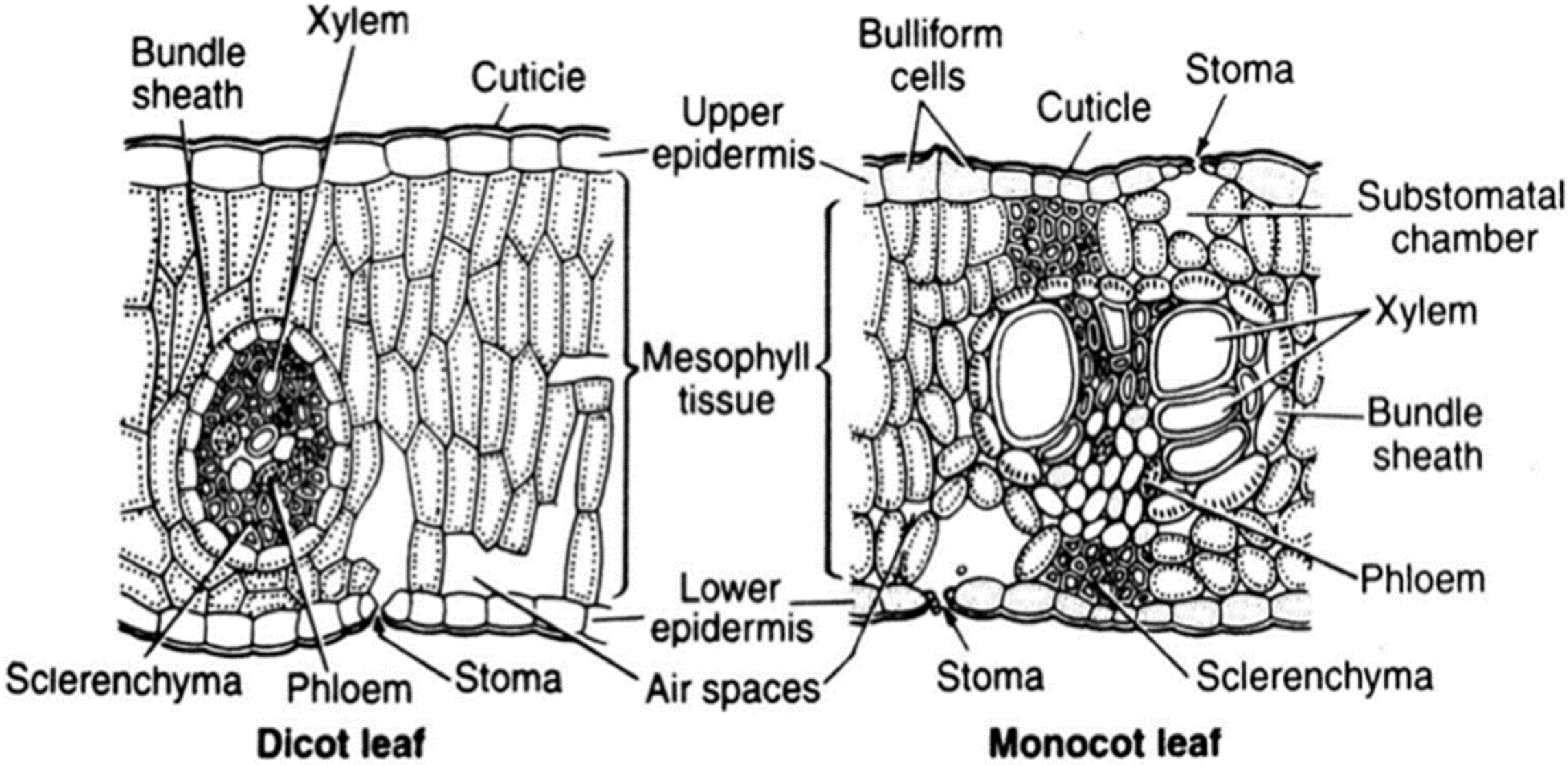
الثغور :
فتحات على الجانب السفلي من الأوراق لتبادل الغازات CO_2 وO_2 تسمى الثغور
الخليتين الحارستين على جانبي الثغور تفتح وتغلق فتحات التغر
عندما تفقد الخلايا الحارسة الماء ينغلق الثغر، بينما ينفتح الثغر عندما تمتلئ الخلايا الحارسة بالماء وتنتفخ

Internal structure of Dicot and Monocot leaves

Dicot leaf	Monocot leaf
1. Cuticle thick at upper epidermis and thin at lower epidermis	Uniform cuticle on both the surface
2. Stomata are more on lower surface	Equal number of stomata on either side
3. Mesophyll is differentiated into palisade parenchyma and spongy parenchyma	Mesophyll is not differentiated into palisade and spongy parenchyma







Comparison of T.S. of a dicot and a monocot leaf

Upper epidermis

Palisade mesophyll

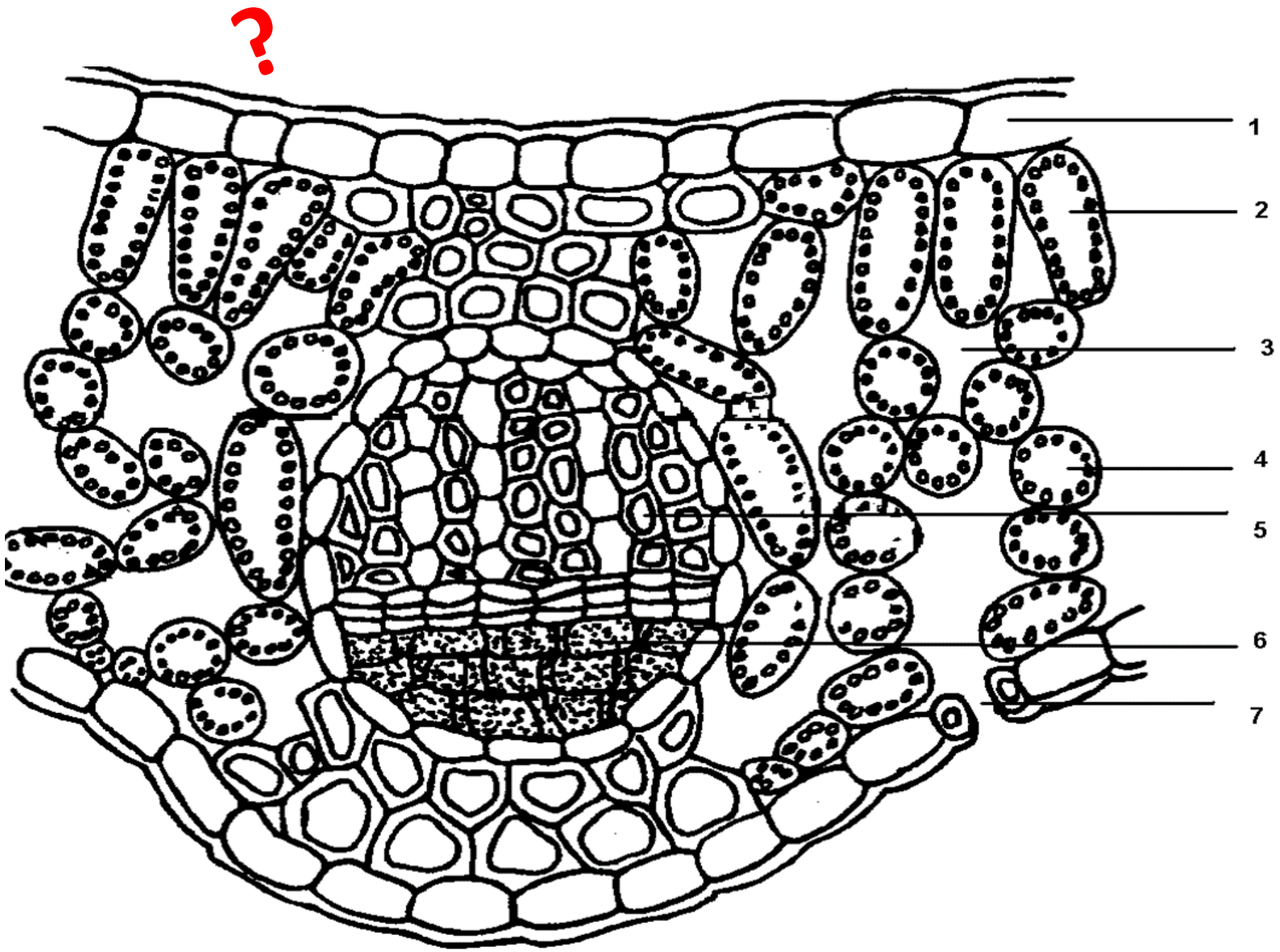
air space

Spongy mesophyll

Xylem

Phloem

stomata



Upper epidermis

mesophyll

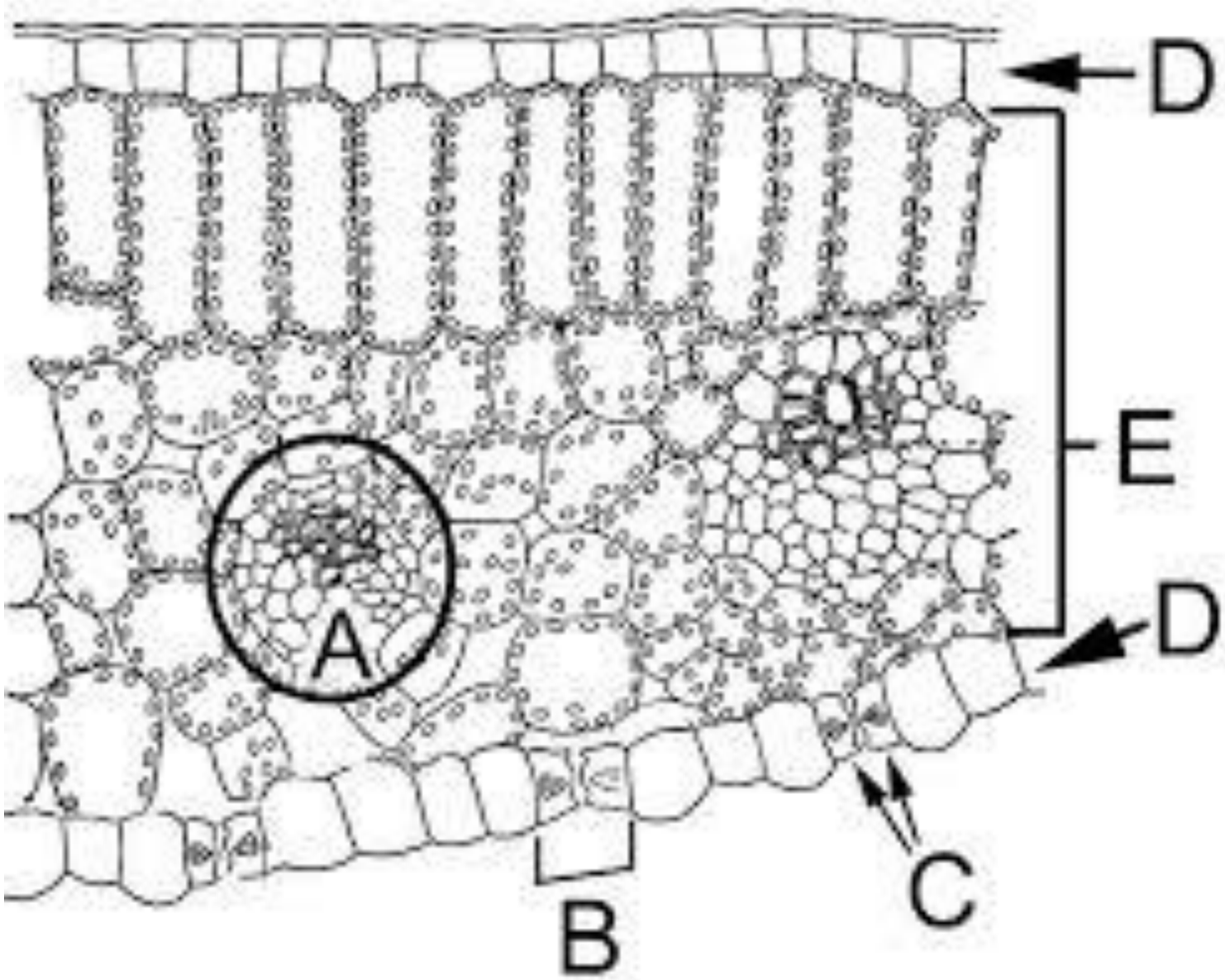
Lower epidermis

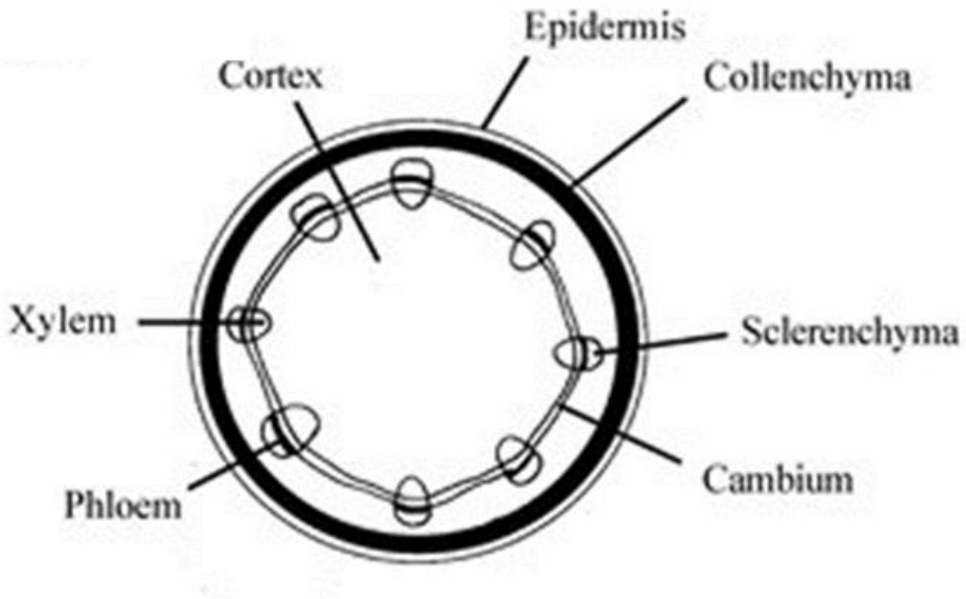
Guard cells

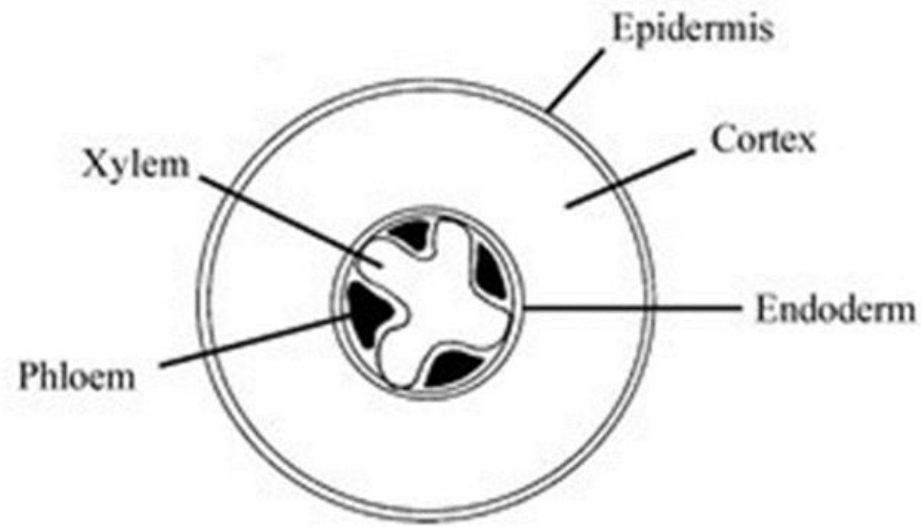
stomata

Veins (vascular bundles)

?







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Dicot Root

Monocot Root

Dicot Stem

Monocot Stem

Dicot leave

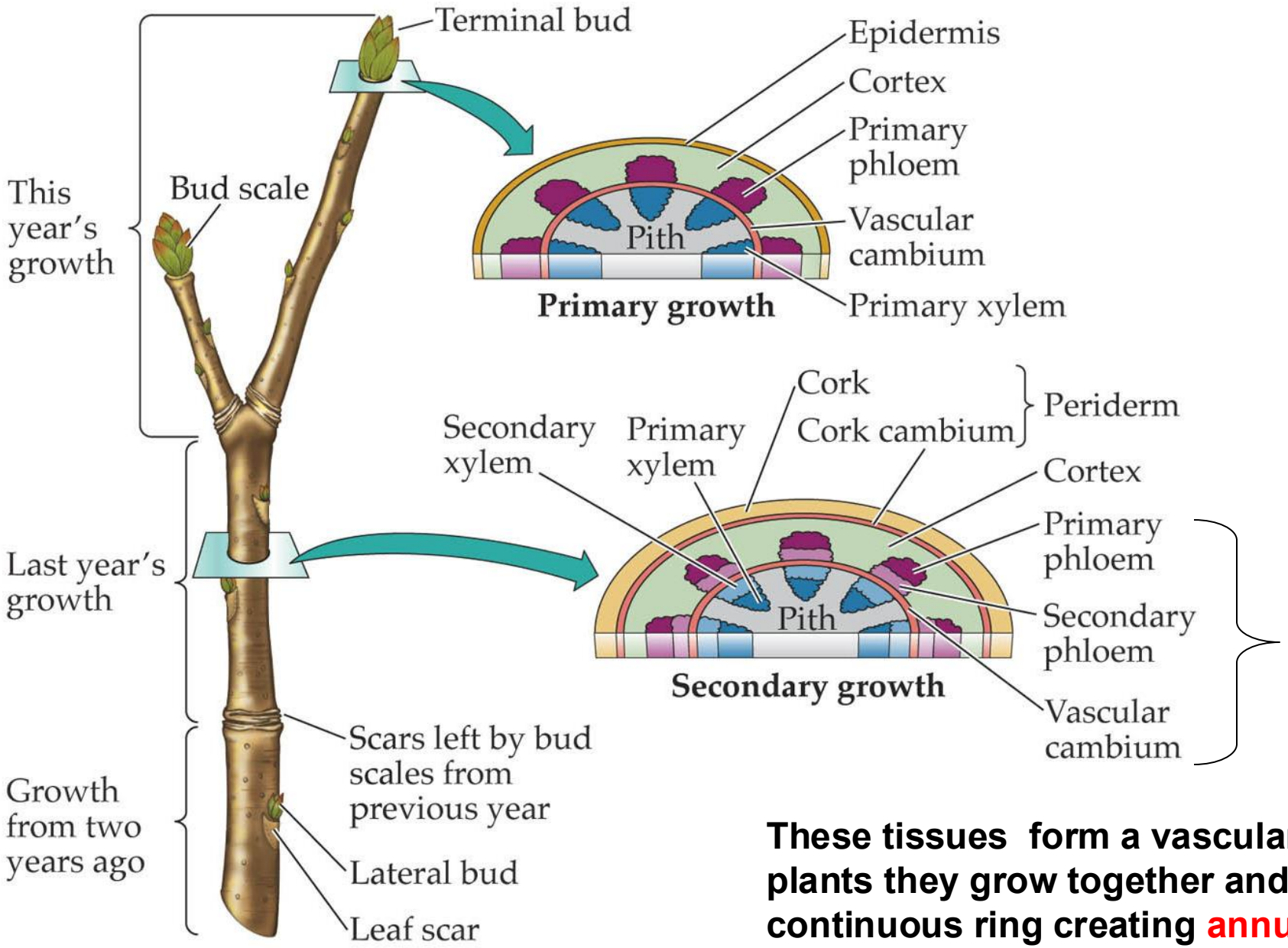
Monocot Leave

Plant Secondary Growth

النمو الثانوي في النبات

Plant Secondary Growth

النمو الثانوي في النبات

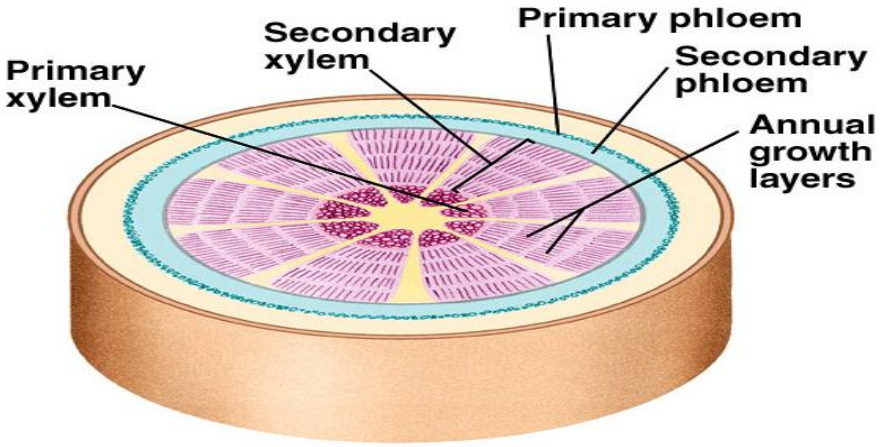


The vascular cambium is a plant tissue located between the xylem and the phloem in the stems and roots of vascular plants.

These tissues form a vascular bundle. In woody plants they grow together and diffuse to form a continuous ring creating annual growth rings.

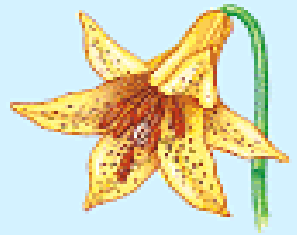
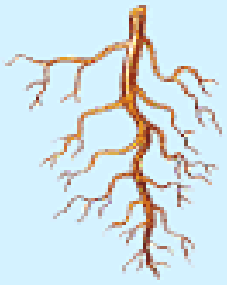
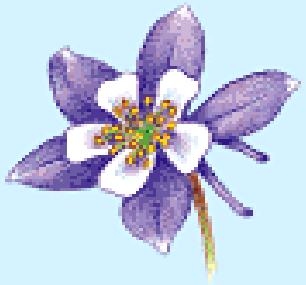
Plant Secondary Growth: Annual Ring

- **Secondary growth increases the diameter of stems and roots.**
- **Secondary growth results from the activity of vascular and cork cambia.**
- **Only eudicots have a vascular cambium and a cork cambium and thus undergo secondary growth.**
- **Annual rings can be seen by the cross sections of most tree trunks**
- **Annual rings form due to differential rates of growth in spring (when water is plentiful) and in summer.**
- **Wood that is no longer conducting water is known as heartwood.**
- **Sapwood is wood that is actively conducting water and minerals in the tree.**



النمو الثانوي يزيد من قطار السيقان والجذور.
ينتج النمو الثانوية من نشاط الأوعية والكامبيوم الفليني.
النباتات ثنائية الفلقة لديها **طبقة الكامبيوم الوعائي والكامبيوم الفليني** وبالتالي يحدث فيها النمو الثانوي.
القاطاعات العرضية لمعظم جذوع اشجار غابات المناطق المعتدلة لديها ما يسمى **بالحلقات سنوية**.
الحلقات السنوية تشكل بسبب اختلاف معدلات النمو في فصل الربيع (عندما تكون الماء وفير)، وفي فصل الصيف(عندما تكون الماء شحيحا).
الخشب الذي لا ينقل الماء يعرف بالخشب الصلب.
الخشب الرخو هو الخشب الذي لايزال نشيطا في نقل الماء والمعادن في الشجرة.

Monocots vs. Dicots

	Embryos	Leaf venation	Stems	Roots	Flowers
Monocots	One cotyledon	Veins usually parallel	Vascular bundles usually complexly arranged	Fibrous root system	 Floral parts usually in multiples of three
Dicots	Two cotyledons	Veins usually netlike	Vascular bundles usually arranged in ring	 Taproot usually present	 Floral parts usually in multiples of four or five