

→ Section Anatomy 1

* Crystals - البلورات

Plant Anatomy Internal structure of the plant.

Plant → system → organs → Tissue → cell

* Plant cell: smallest structure and function unit of the plant.

Plant cell components:-

- Living → Nucleus

- Non living → crystals (البلورات)

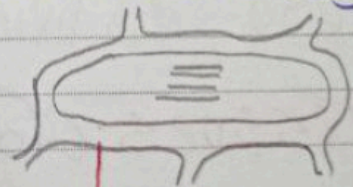
* calcium crystals

بلورات الكسالات الكالسيوم - calcium oxalate

* Raphides بلورات إبرية

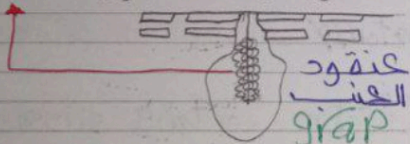
Needle

إبرة ←



2) calcium carbonate كربونات الكالسيوم

* Crystalline حبيبية



* Tissues - الأنسجة

1) meristematic

* living * Non-specific - غير محدد

* continuous division - يتوسع أقسماً

2) Permanent - دائم

* specific - دائم

* living, Non living

* Tissues: Group of cells

DECEMBER 2011						
S	3	10	17	24	31	
S	4	11	18	25		
M	5	12	19	26		
T	6	13	20	27		
W	7	14	21	28		
T	1	8	15	22	29	
F	2	9	16	23	30	

الدائم - Permanent

1) simple one type of cell.

* Parenchyma - بارانشيمي

* Collenchyma - كولانشيمي

* Sclerenchyma - اسكلرنشيمي

* living * thin wall * cellulose

2) complex many type of cell

* Xylem - خشب

* Phloem - لحاء

2

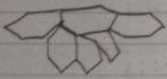
DECEMBER 2011						
S	3	10	17	24	31	
S	4	11	18	25		
M	5	12	19	26		
T	6	13	20	27		
W	7	14	21	28		
T	1	8	15	22	29	
F	2	9	16	23	30	

* Parenchyma - بارنشيمية

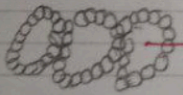
- ① living حية
- ② thin wall جدار رقيق
- ③ of cellulose من السيلولوز
- ← لا تنقسم ولكن يمكن أن تنقسم

→ Parenchyma shapes

1. Polyhedral - عديدة الأوجه



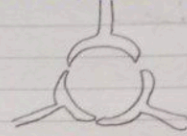
2. Aerenchyma - دائرية



→ Air spaces

DECEMBER	2011
S	3 10 17 24 31
S	4 11 18 25
M	5 12 19 26
T	6 13 20 27
W	7 14 21 28
T	1 8 15 22 29
F	2 9 16 23 30

3) stellate Armed - نجية ذراعية



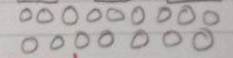
→ Types:

- 1) storage Parenchyma تخزينية
- 2) Aerenchyma → Air space
في النباتات المائية
تبادل الغازات - for gaseous change
- 3) chloroenchyma الكلورونشيمية
→ Parenchyma with chloroplasts
مع البلاستيدات خضراء

Plastid tissue



Spongy tissue



→ نسيج اسفنجي

DECEMBER	2011
S	3 10 17 24 31
S	4 11 18 25
M	5 12 19 26
T	6 13 20 27
W	7 14 21 28
T	1 8 15 22 29
F	2 9 16 23 30

← أشكال الشراخج الخيلروسكوبية

1) Polynedral مضلعة

2) stellate armed نجمية

3) cystolith عنقود العنب

4) Rophides نقط سوداء (بورات)

5) Aerenchyma دائرية

DECEMBER	2011
S	3 10 17 24 31
S	4 11 18 25
M	5 12 19 26
T	6 13 20 27
W	7 14 21 28
T	1 8 15 22 29
F	2 9 16 23 30

sec 2

Practical Plant Anatomy

1) collenchyma

→ characters

* living tissue

* Cell wall { Thick
Primary → non lignified

→ Types

o Angular →

o Lamellar →

o Lacunar → فراغ

o Annular →

DECEMBER	2011
S	3 10 17 24 31
S	4 11 18 25
M	5 12 19 26
T	6 13 20 27
W	7 14 21 28
T	1 8 15 22 29
F	2 9 16 23 30

2) sclerenchyma

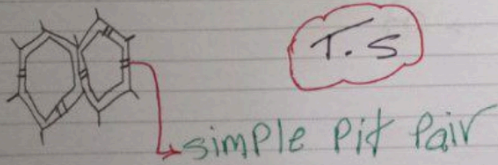
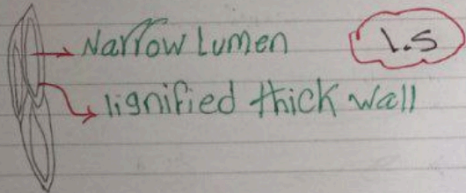
→ character

★ Dead tissue

★ cell wall { Thick
secondary → lignified

Types:

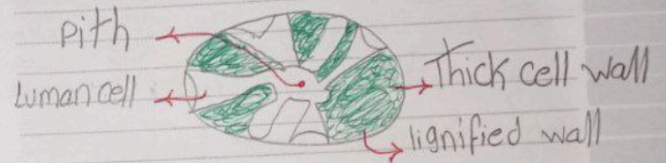
1) fibers



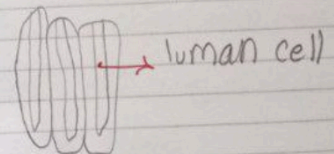
	3	10	17	24	31
S	3	10	17	24	31
S	4	11	18	25	
M	5	12	19	26	
T	6	13	20	27	
W	7	14	21	28	
T	1	8	15	22	29
F	2	9	16	23	30

2) sclereids

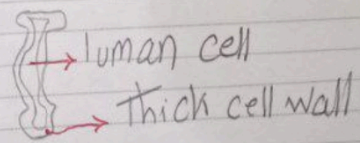
1. Brachysclereids ("stone cells")



2. macrosclereids ("Rod cells")

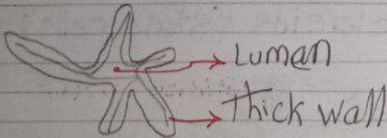


3. osteo sclerides ("Bone cell")



	3	10	17	24	31
S	3	10	17	24	31
S	4	11	18	25	
M	5	12	19	26	
T	6	13	20	27	
W	7	14	21	28	
T	1	8	15	22	29
F	2	9	16	23	30

4) Astrosclereids (star-shaped)



DECEMBER	2011
S	3 10 17 24 31
S	4 11 18 25
M	5 12 19 26
T	6 13 20 27
W	7 14 21 28
T	1 8 15 22 29
F	2 9 16 23 30

→ complex Tissue more than one type

1) Xylem - خشب

* Tracheids and Vessels أوعية وقضبان هوائية

* Transport water and minerals نقل الماء والمعادن

* All cells dead except parenchymal cells

2) Phloem - لحاء

* Sieve elements → Fiber
→ Parenchyma cells

* Transport nutrients تنقل العناصر الغذائية

* All cells living except fibers

→ Xylem and Phloem = Vascular bundles

* Types of Vascular bundles حزم وعائية

1) Collateral V.B (conjoint)

* in which Xylem and Phloem in the same radius

DECEMBER	2011
S	3 10 17 24 31
S	4 11 18 25
M	5 12 19 26
T	6 13 20 27
W	7 14 21 28
T	1 8 15 22 29
F	2 9 16 23 30

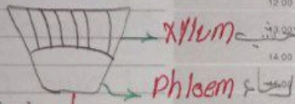
7

→ there are 2 types.

1) closed collateral V.B :

* there isn't cambium between xylum and Phloem

* In monocot stem

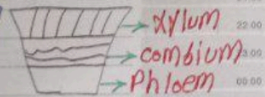


في نفس المستوى ولا يوجد كالمسيح

2) open collateral V.B :

* there is cambium between xylum and Phloem

* In dicot stem and dicot leaf

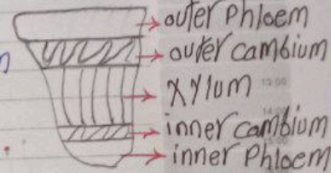


DECEMBER	2011
S	3 10 17 24 31
S	4 11 18 25
M	5 12 19 26
T	6 13 20 27
W	7 14 21 28
T	1 8 15 22 29
F	2 9 16 23 30

2) Bio collateral V.B :

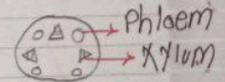
* In which Phloem surround xylum outside and inside.

* There are 2 strips of cambium



3) Radial V.B :

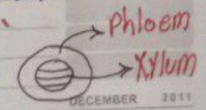
* In which Phloem and xylum alternate with each other



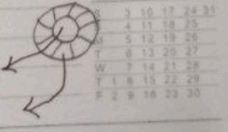
4) concentric V.B :

* Either Phloem surrounds xylum or xylum surrounds phloem completely.

→ Amphicribal : Phloem surround xylum



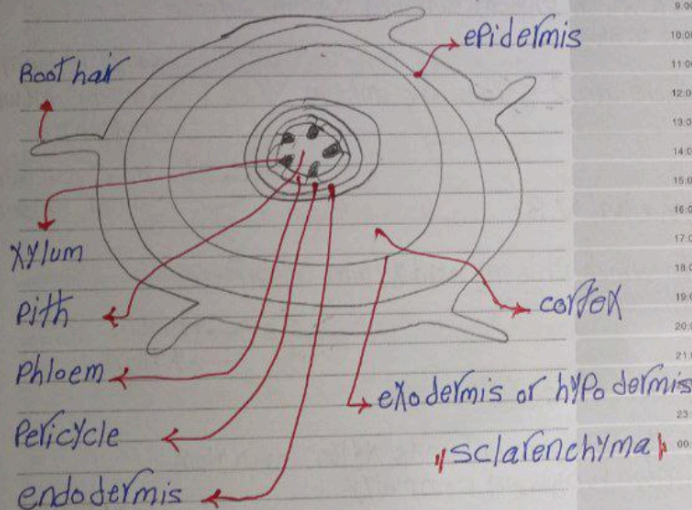
→ Amphivasal : xylum x phloem



DECEMBER	2011
S	3 10 17 24 31
S	4 11 18 25
M	5 12 19 26
T	6 13 20 27
W	7 14 21 28
T	1 8 15 22 29
F	2 9 16 23 30

Diagram of monocot Root

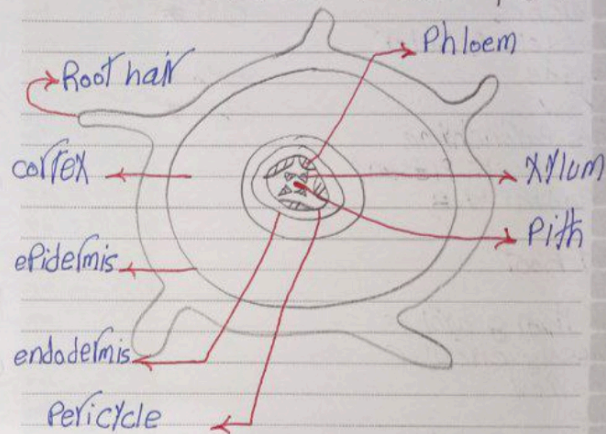
رسم تخطيطي لجذر احادي الفلقة



DECEMBER	2011
S	3 10 17 24 31
S	4 11 18 25
M	5 12 19 26
T	6 13 20 27
W	7 14 21 28
T	1 8 15 22 29
F	2 9 16 23 30

Diagram of Dicot Root

رسم تخطيطي لجذر ثنائي الفلقة



DECEMBER	2011
S	3 10 17
S	4 11 18
M	5 12 19
T	6 13 20
W	7 14 21
T	1 8 15 22
F	2 9 16 23

→ Dicot Root

- ★ Xylem 4 arches
- ★ Xylem Vessels Angular
- ★ cortex wide
- ★ Pith narrow
- ★ hypodermis Parenchyma
- ★ Secondary growth Present
- ★ TYPES: Radial V.B

أذع

واسع

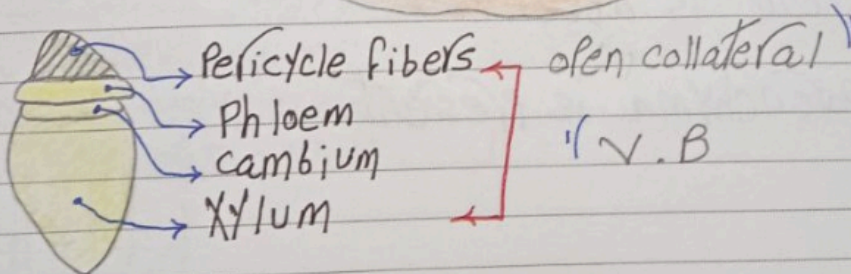
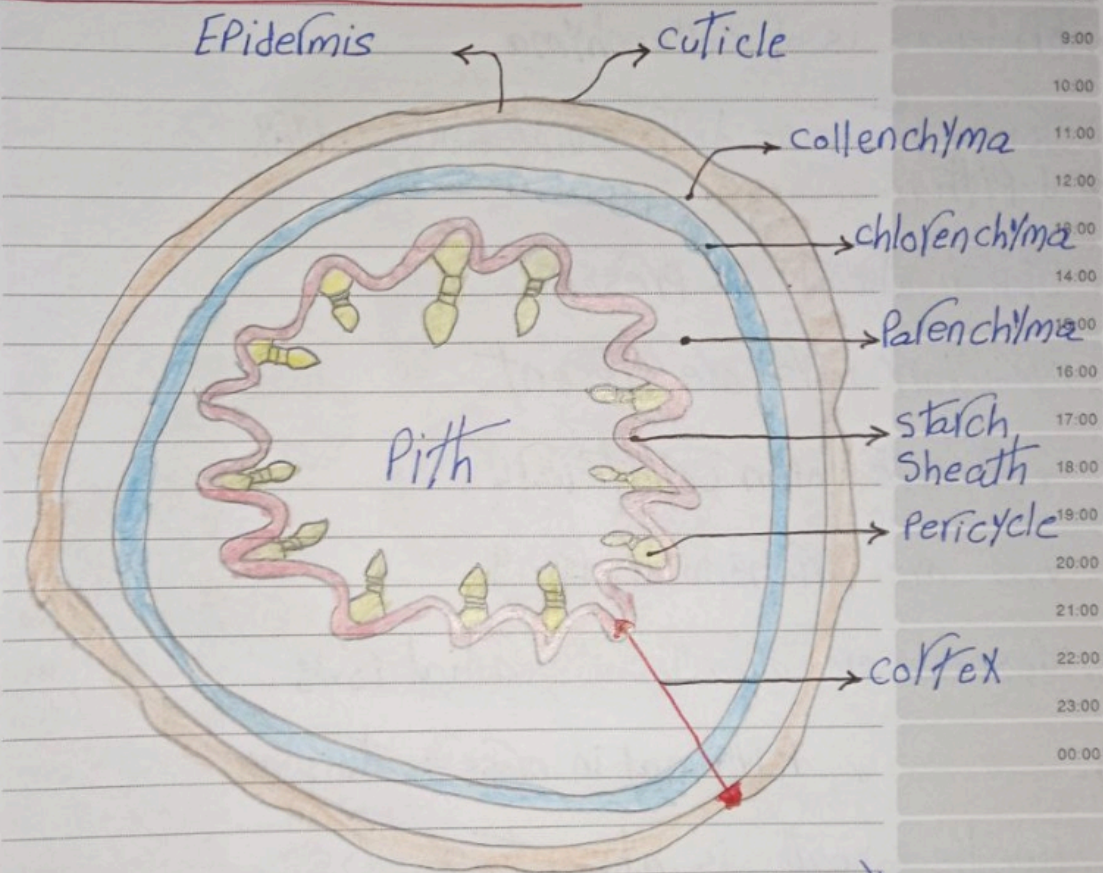
ضيق

→ monocot Root

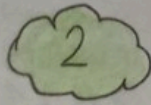
- ★ xylem more than 9 arches
- ★ xylem Vessels circular
- ★ cortex narrow
- ★ pith wide
- ★ hypodermis sclerenchyma
- ★ secondary growth absent
- ★ TYPES: Radial V.B

DECEMBER 2011						
S	3	10	17	24	31	
S	4	11	18	25		
M	5	12	19	26		
T	6	13	20	27		
W	7	14	21	28		
T	1	8	15	22	29	
F	2	9	16	23	30	

Diagram of Dicot stem.



DECEMBER		2011				
S	3	10	17	24	31	
S	4	11	18	25		
M	5	12	19	26		
T	6	13	20	27		
W	7	14	21	28		
T	1	8	15	22	29	
F	2	9	16	23	30	

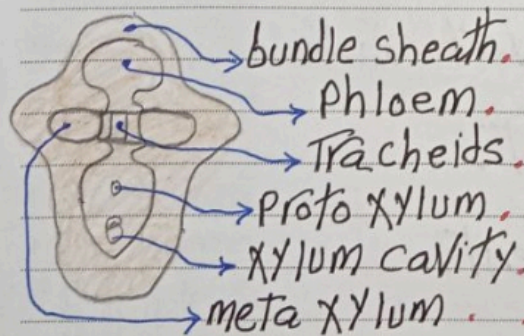
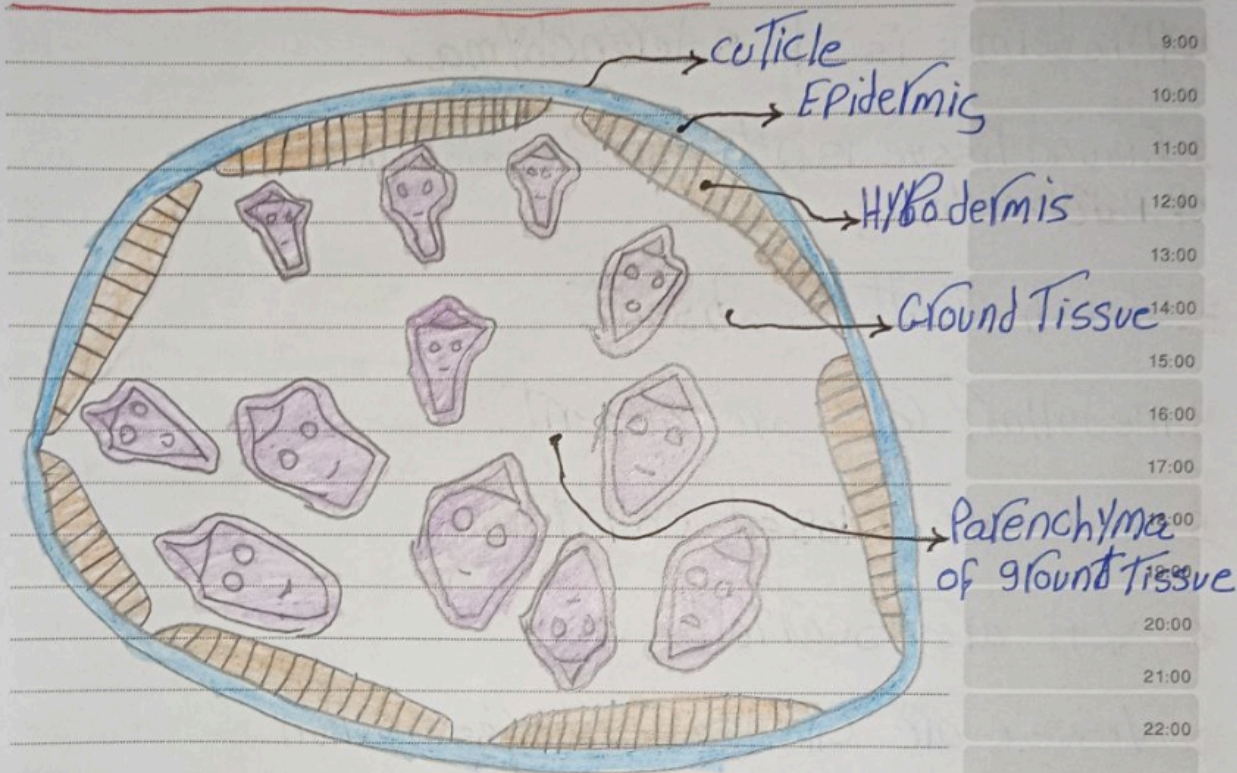


→ Dicot stem

1. Hypodermis is of collenchyma.
2. Ground Tissue is differentiated into cortex and pith.
3. Starch sheath is present.
4. Medullary rays are present.
5. V.B are open collateral.
6. V.B are arranged in Ring.
7. Vessels are arranged in radial rows.
8. " " Polygonal in cross section.
9. Bundle sheath is absent.
10. Phloem Parenchyma is present.

DECEMBER 2011	
S	3 10 17 24 31
S	4 11 18 25
M	5 12 19 26
T	6 13 20 27
W	7 14 21 28
T	1 8 15 22 29
F	2 9 16 23 30

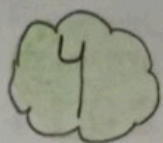
→ Diagram of monocot stem.



close collateral
V.B

DECEMBER 2011

S	3	10	17	24	31
S	4	11	18	25	
M	5	12	19	26	
T	6	13	20	27	
W	7	14	21	28	
T	1	8	15	22	29
F	2	9	16	23	30

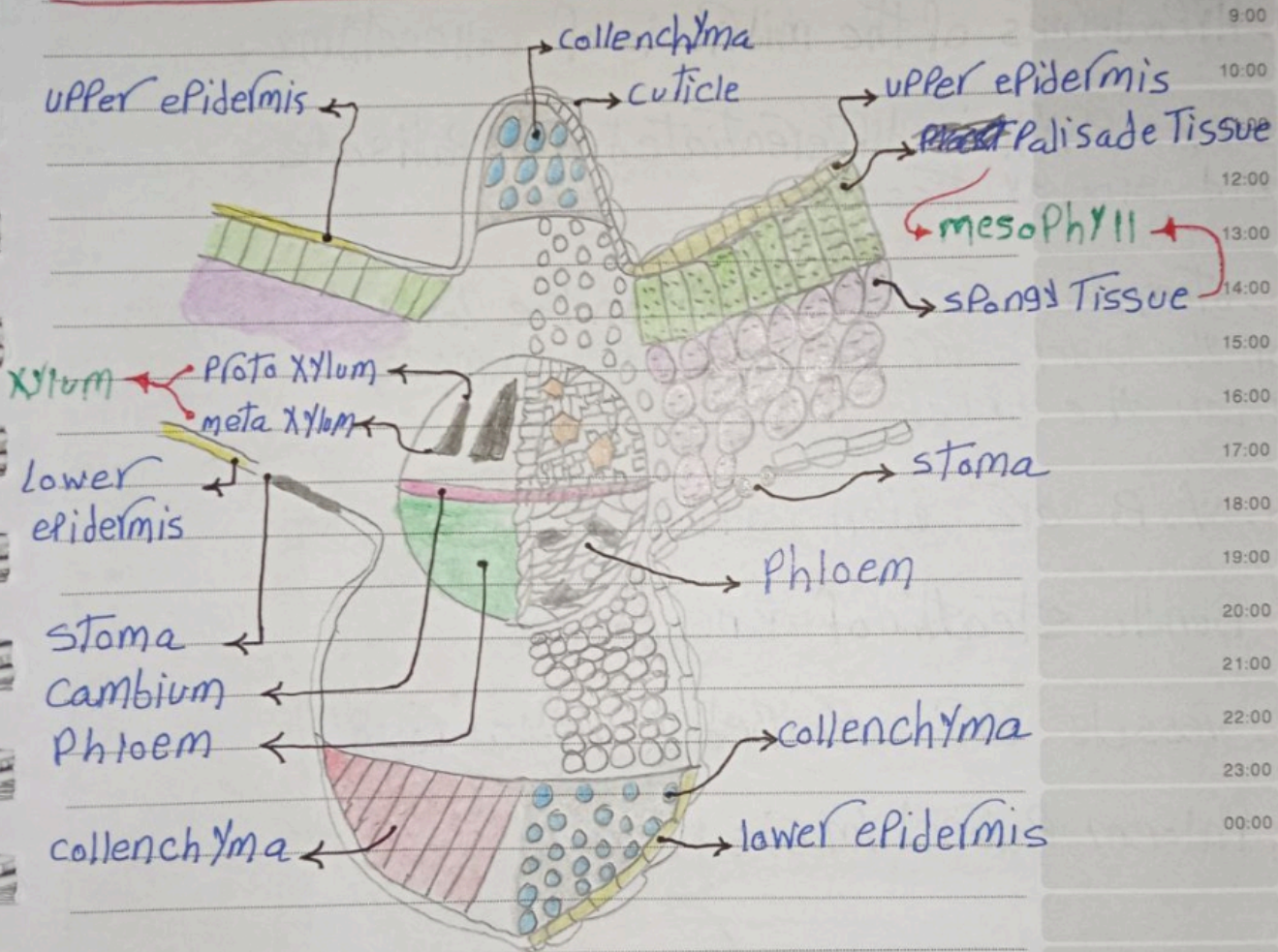


→ Monocot stem

1. Hypodermis is of sclerenchyma.
2. Ground tissue is not differentiated (made of Parenchyma).
3. starch sheath is absent.
4. medullary rays are absent.
5. V.B are closed collateral.
6. V.B are scattered.
7. Vessels are circular in cross section.
8. Vassels are arranged in Vort shape.
9. Bundle Sheath is present.
10. Pholem Perenchyma is absent.

DECEMBER		2011			
S	3	10	17	24	31
S	4	11	18	25	
M	5	12	19	26	
T	6	13	20	27	
W	7	14	21	28	
T	1	8	15	22	29

Diagram of dicot leaf.



DECEMBER 2011

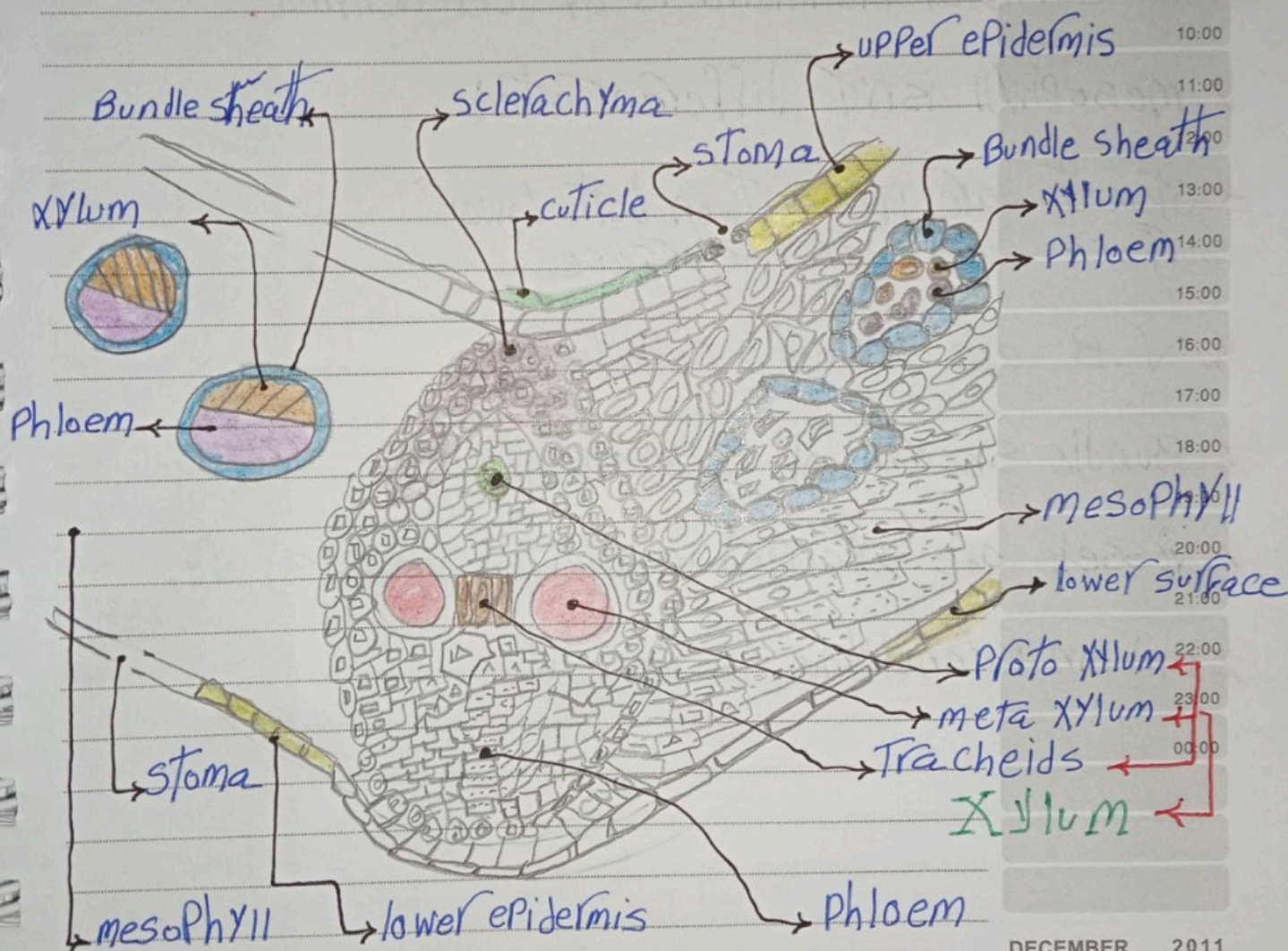
S	3	10	17	24	31
S	4	11	18	25	
M	5	12	19	26	
T	6	13	20	27	



→ Dicot leaf.

1. Hypodermis of the midrib is of collenchyma.
2. mesophyll is differentiated into: Palisade and spongy tissues.
3. stomata are present only on the lower surface or the lower surface has more stomata than the upper one.
4. V.B are open collateral.
5. Bundle sheath of Parenchyma.
6. Vessels are arranged in radial rows.
7. Phloem Parenchyma is present.

→ Diagram of monocot leaf.



DECEMBER 2011

S	3	10	17	24	31
S	4	11	18	25	
M	5	12	19	26	
T	6	13	20	27	



→ monocot leaf.

1. Hypodermis at the midrib is of sclerenchyma.
2. mesophyll isn't differentiated.
3. stomata are present on both lower surface and upper surface.
4. V.B are closed collateral.
5. Bundle sheath of sclerenchyma.
6. vessels are arranged in inverted V or J shape.
7. Phloem Parenchyma is absent.

8:00
9:00
10:00
11:00
12:00
13:00
14:00
15:00
16:00
17:00
18:00
19:00
20:00
21:00
22:00
23:00
00:00

DECEMBER 2011

S	3	10	17	24	31
S	4	11	18	25	
M	5	12	19	26	
T	6	13	20	27	



Spiral shaped chloroplast



Raphides



Solitary Crystals



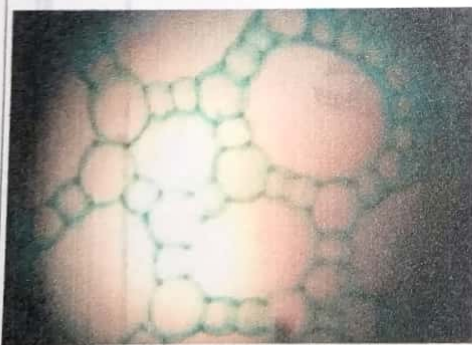
L.S in shoot apex



L.S in root apex



Cystolith



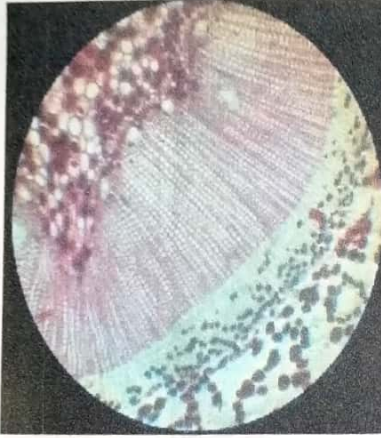
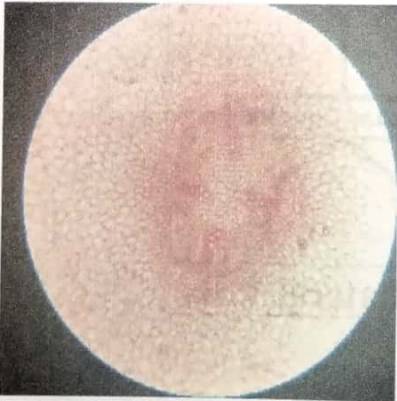
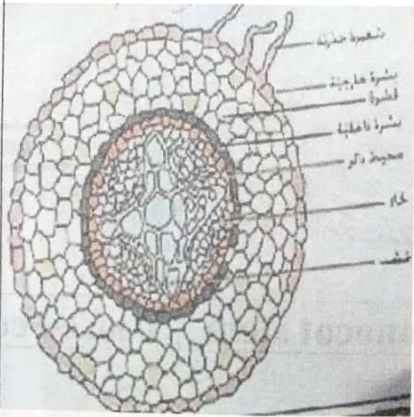
Aerenchyma



Armed Parenchyma

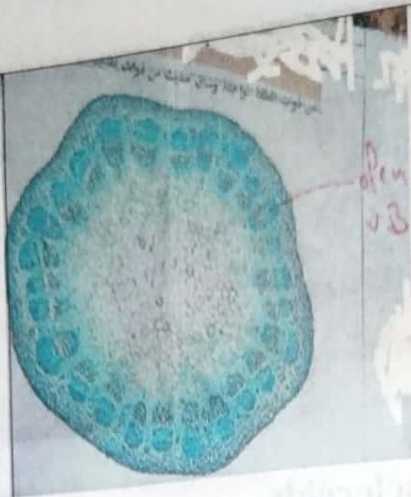


Brachysclereids

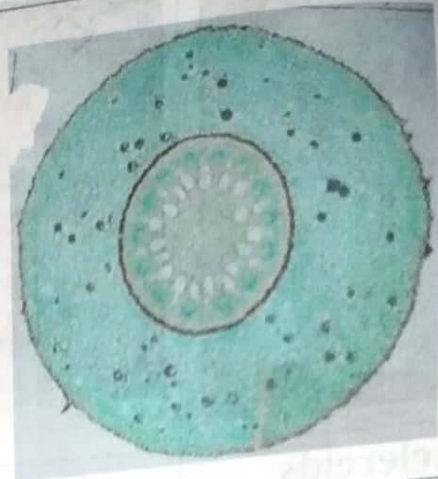
		
Osteosclereids	Osteosclereids	Astrosclereids
		
L.S in Tracheids of Gymnosperms	L.S in Tracheids	L.S in Vessels
		
T.S in young Dicot Root	T.S in young Dicot Root	T.S in young monocot root



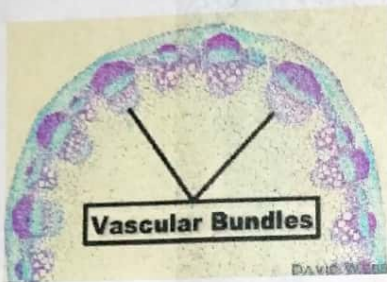
T.S in young Dicot Stem



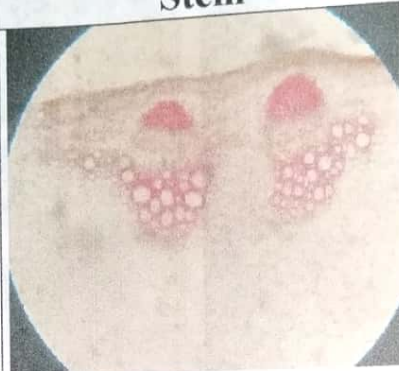
T.S in young Dicot Stem



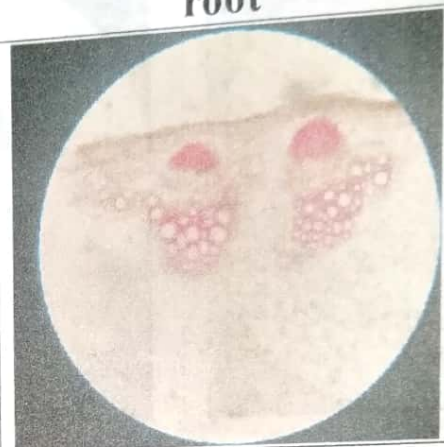
T.S in young monocot root



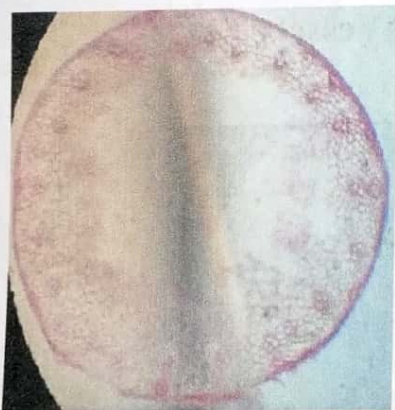
Open Collateral V.Bs



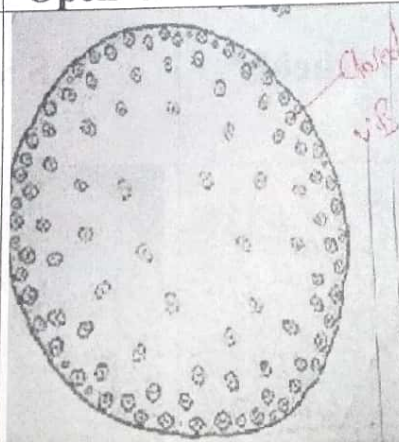
Open Collateral V.Bs



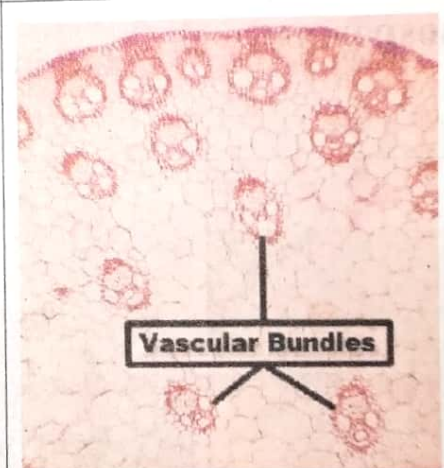
Open Collateral V.Bs



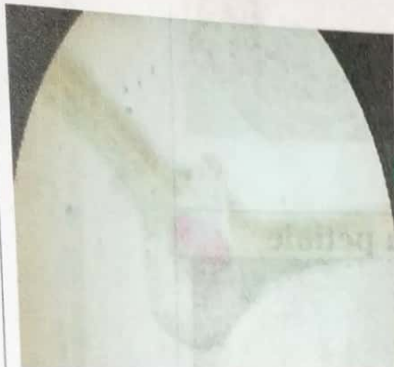
Monocot Hollow Stem



T.S. in monocot stem



Closed collateral V.Bs



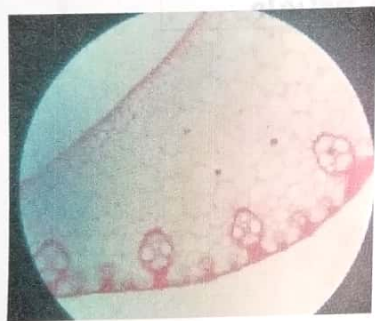
T.S in Dicot Leaf



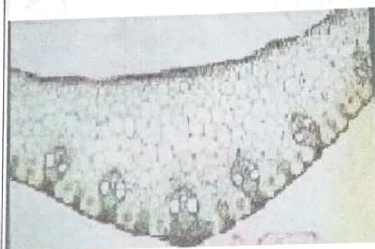
T.S in Dicot Leaf



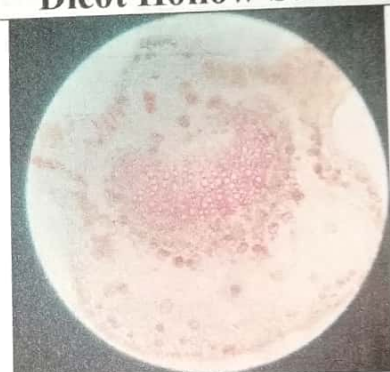
Dicot Hollow Stem



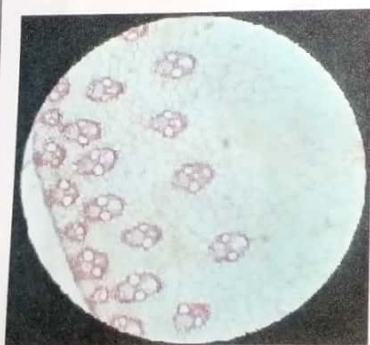
T.S in monocot Leaf



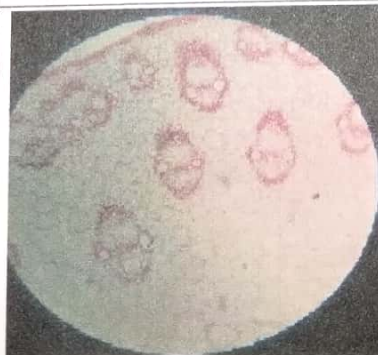
T.S in Monocot Leaf



T.S in Dicot Leaf



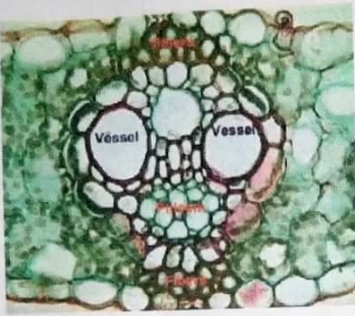
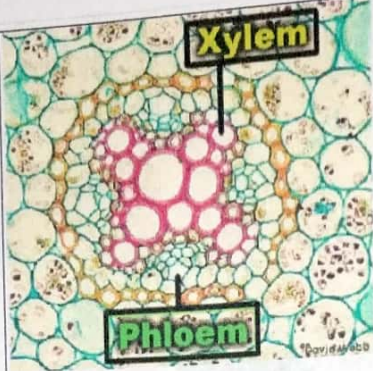
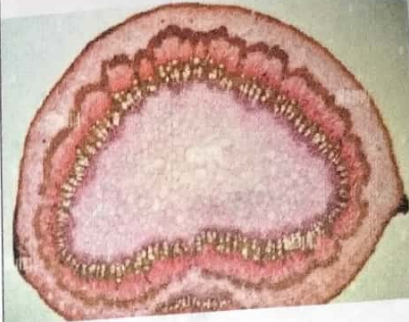
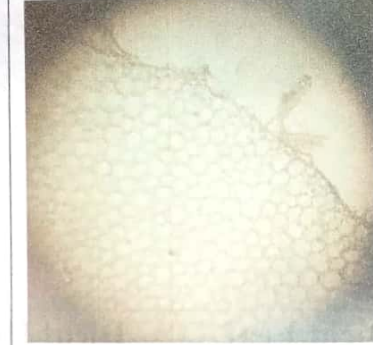
Closed Collateral V.Bs



**Closed Collateral
V.Bs**



T.S in petiole

		
Closed Collateral V.Bs		T.S in petiole
		
	Root hairs	T.S in petiole

Practical Anatomy

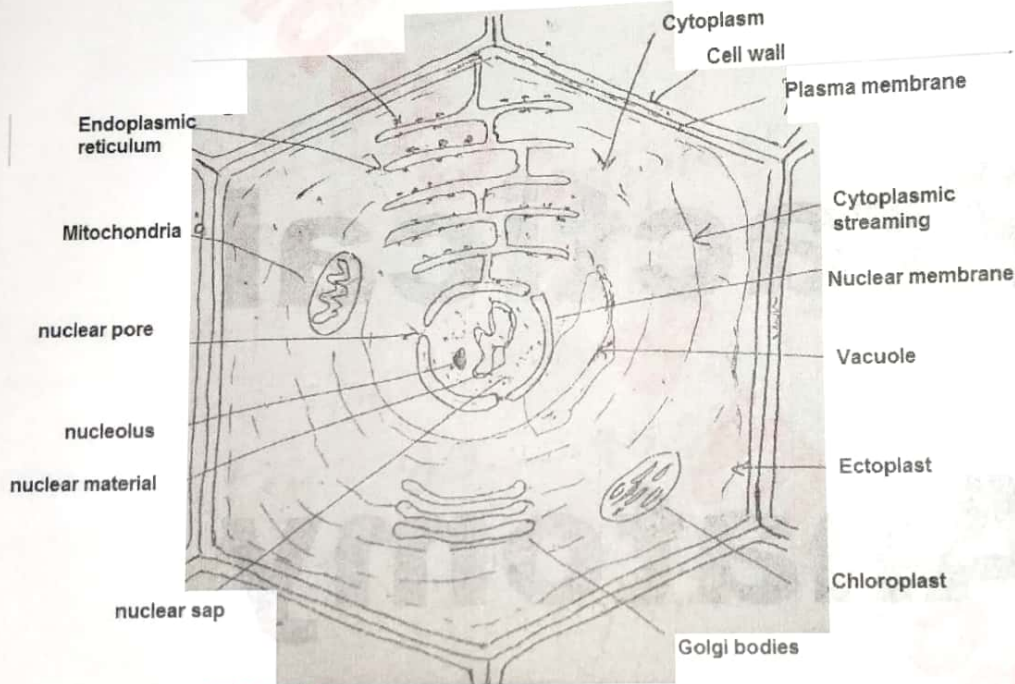
• **Plant cell** الخلية النباتية: is the basic smallest unit of structure and function of a plant.

• It consists of the protoplast surrounded by a cell wall.

• The protoplast is divided into:

protoplasmic or living and non- protoplasmic or non- living components.

• تتكون الخلية النباتية من مكونات بروتوبلازمية (حية) ومكونات لا بروتوبلازمية (غير حية)



• Cell content :

Plant cell consists of

1- Living component or protoplasmic components	2- Non – living component or non-protoplasmic components
It includes cytoplasm, Nucleus, plastids, Ribosomes, ER, mitochondria... المكونات الحية تشمل السيتوبلازم والعضيات	1- Vacuoles. الفجوات 2- Cell wall. جدار الخلية 3- Ergastic materials المواد الايضية

1- Plastids

البلاستيدات

according to pigmentation اللون there are 3 types

Chloroplasts الخضراء
(green plastids)

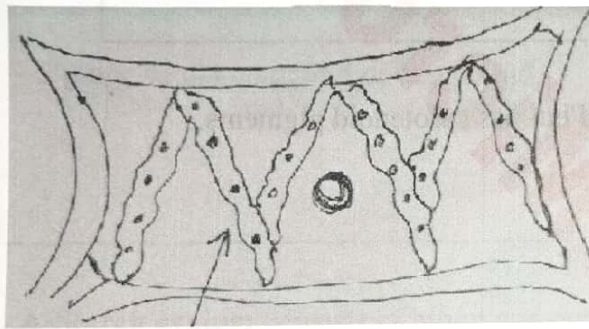
Chromoplasts الملونة
(colored plastids)

Leucoplasts عديمة اللون
(colorless plastids)

A- Chloroplasts:

• Types of chloroplast according to its shape. تقسم البلاستيدات الخضراء على حسب الشكل

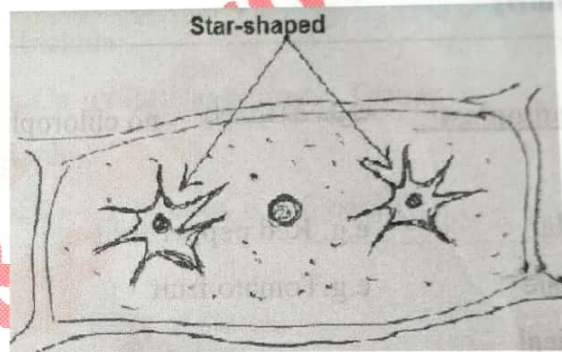
1. Spiral -shaped chloroplast حلزونية



Spiral-shaped

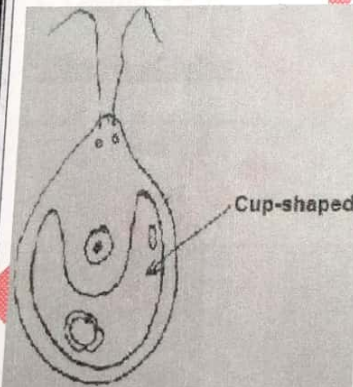
e.g. Spirogyra

2. Star- shaped chloroplast نجمية



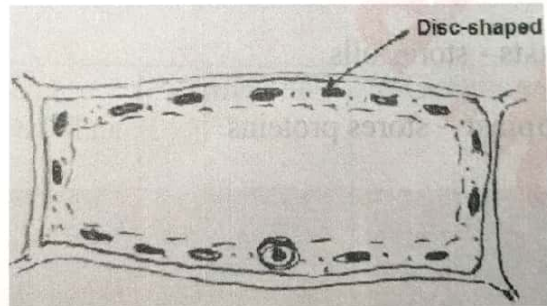
e.g. Zygnema

3. Cup- shaped chloroplast فنجانية



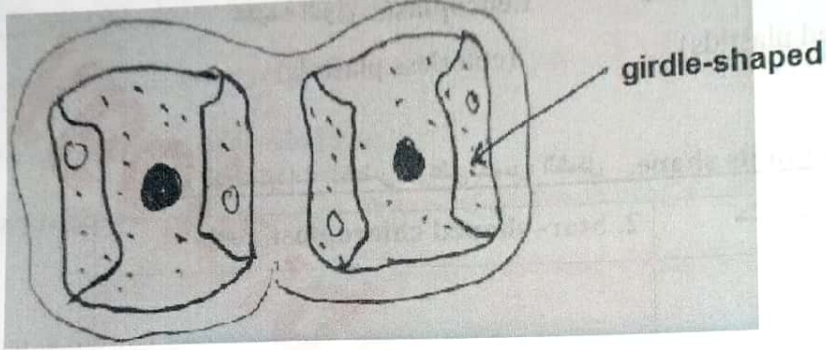
e.g. Chlamydomonas

4. Disc- shaped chloroplast قرصية



e.g. higher plants and Elodea leaf

5. Girdle shape حزامية



e.g. Ulothrix

B- Chromoplast

بلاستيدات ملونة - no chlorophyll but has carotenoid pigments.

1. Angular e.g. Red pepper fruit
2. Elongate e.g. Tomato fruit
3. Spherical
4. Spiral or lobbed.

c. Leucoplasts - بلاستيدات عديمة اللون no pigments; colorless.

- 1) Amyloplasts - stores starch.
- 2) Elaioplasts - stores oils.
- 3) Proteinoplast - stores proteins

2- Non – living component

a. **Vacuoles:** الفجوات are cavity within cytoplasm filled with cell sap.

b. **Ergastic substance:** reserve food materials or product of metabolism.

• Ergastic substances

1- Starch grains حبيبات النشا	2- Crystals بلورات
- Water insoluble polysaccharide formed by condensation of many glucose molecule - Simple, semi compound or compound.	- Solid waste product which deposit in plant tissue as Ca- salts & silica. - Include: a. Ca-oxalate as solitary , Druses or Raphides b. Ca-carbonate. e.g. Cystolith

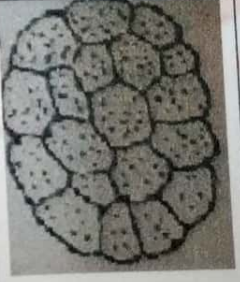
A-Starch grains: consists of hilum and concentric layer of starch.

• **hilum** : is a minute particle & starch layers deposited around it.

• Types of hilum acc. to position

- | | |
|-------------------|-----------------------|
| 1. Centric مركزية | 2. Acentric لا مركزية |
|-------------------|-----------------------|

• Shapes of hilum

1. Pointed	2. Slightly elongated	3. Star shaped=stellate	4- Branched	5- Compound
				
(Potato)	(Phaseolus)	(Pisum)	(Zea)	

• Types of starch grains

1.Simple	2.Semi compound	3.Compound
• has a single hilum. 	• union of two or more grains surrounded by a common envelope. 	• aggregates of individual grains, no common envelope. 

B. Crystals

• Are solid waste products often deposited in plant tissues in the form of calcium salts and silica.

a. Calcium oxalate crystals

i. Druses وردية

rosette- shaped



ii. Raphides إبرية

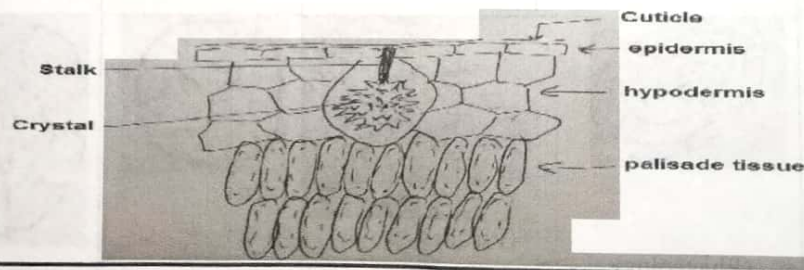
elongated in bundles in vacuoles; tooth pick shaped.



iii. Solitary مفردة



b. Calcium carbonate crystals e.g. Cystolith بللوره حجرية like a bunch of grapes suspended from a stalk, in Ficus leaves.



• Plant tissue

- It is a group of cells have the same shape and derived the same specific function .

• Types of Tissue

1. Merismatic tissue (Meristem)

2. Permanent (Mature)

1. Merismatic tissue (Meristem)

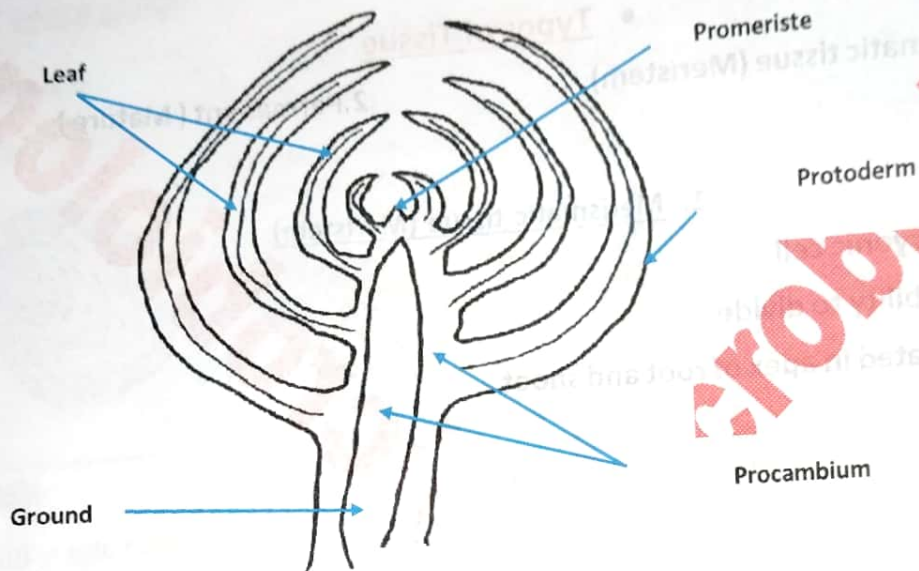
- Is embryonic cell .
- Have ability to divide .
- It is located in apex of root and shoot .

Comment:-

- The shoot apex of meristem
- Present in the apex of main stem and lateral branches
- Most active part in shoot apex is called promeristem
- Promeristem differentiate into :-
 - a. Protoderm meristem - give epidermis
 - b. Procambium --- give xylem and phloem
 - c. Ground meristem --- give cortex and pith

L.s (lateral section) in shoot apex

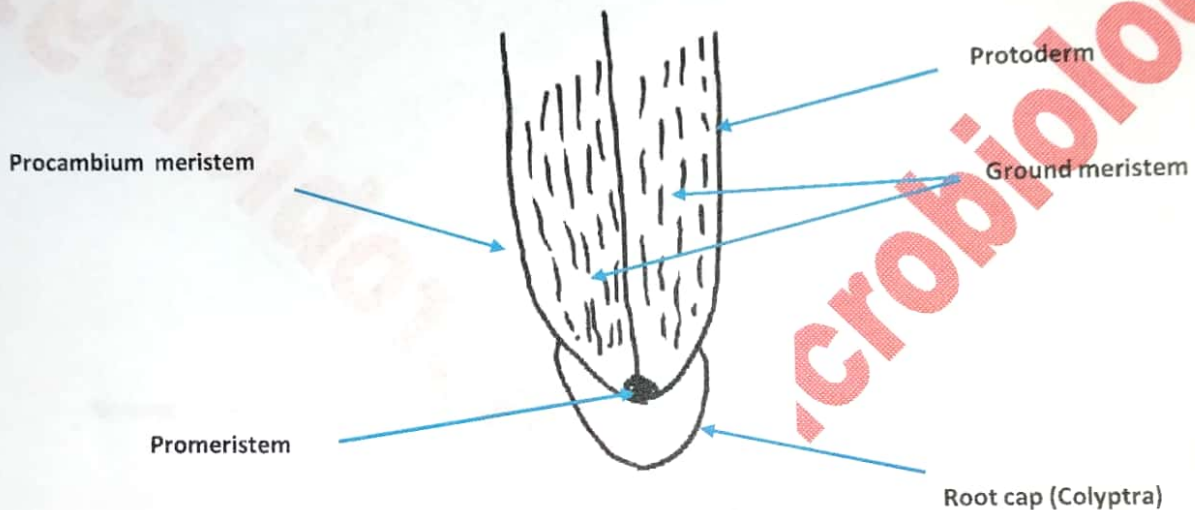
L.s = lateral section



Comment:-

- The shoot apex of meristem
- Present in the apex of main stem and lateral branches
- Most active part in shoot apex is called promeristem
- Promeristem differentiate into :-
 - a. **Protoderm meristem** – give epidermis
 - b. **Procambium** --- give xylem and phloem
 - c. **Ground meristem** --- give cortex and pith

L.s in Root Apex



Comment :-

- The root apex meristem
- Present at the apex of root
- Most active part in root apex called promeristem which differentiated into :-
 - A. Promeristem – give epidermis.
 - b. Procambium --- give xylem and phloem.
 - c. Ground meristem --- give cortex and pith .
 - d. calyptragen – give root cap.

2. Permanent Tissue

* called mature tissue .

Divided into :-

Simple tissue : consists of one type of cell

complex tissue : consists of more than one type of cells .

Parenchyma

Collenchyma

sclerenchyma

Xylem

Phloem

Fibers

scleroids

Astrosclereids

Osteosclereids

macroscleroids

Brachyscleroids

1. Simple tissue

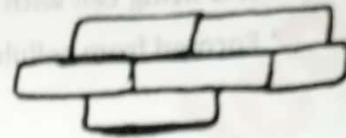
Consists of one type of cell.

a. Parenchyma

- Have different shapes as:-
- It is living cell with thin cell wall.
- Have intercellular spaces.



Rounded



Elongate

Function of Parenchyma

1. storage

2. gas exchange

3. photosynthesis

Types of Parenchyma

<u>Armed</u> 	<u>Lobed</u> 	<u>Aerenchyma</u>
<u>Polyhedral</u> 	<u>Storage</u> 	<u>chlorenchyma</u>
<u>Xylem parenchyma</u> 		<u>Phloem parenchyma</u>

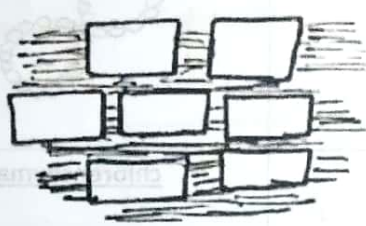
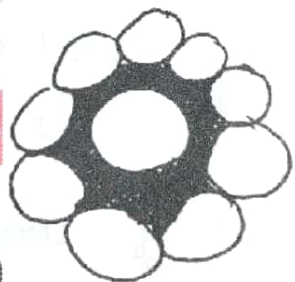
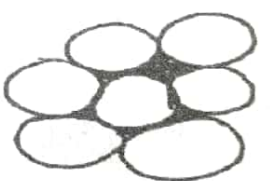
B. Collenchyma

- * it is living cell with thick cell wall
- * Formed from cellulose , hemi cellulose , pectin and non lignified walls .

Function of Collenchyma

- Provide and support plant .

Types of Collenchyma

lamellar	Angular	Lacunar
Thickening at tangential wall.	Thickening at angel.	Thickening with intercellular spaces .
		

C. Sclerenchyma

- * non living cells(become dead cell)
- * with lignified cell wall .

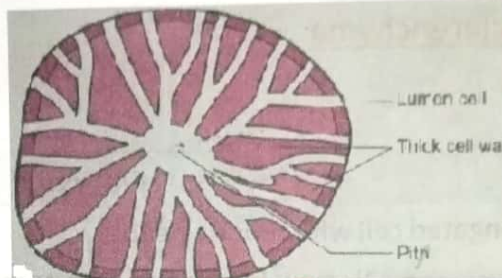
Types of Sclerenchyma

Fibers	
• Is elongated cell with tapering ends. • Narrow lumen and with secondary lignified wall.	
L.s in fibers	T.s in fibers
	
Sclereids	
• Shorter than fibers • Present either single or in group	

ii. Sclereids: 1- thick strongly lignified
2ry walls. & with narrow lumen
classified into:

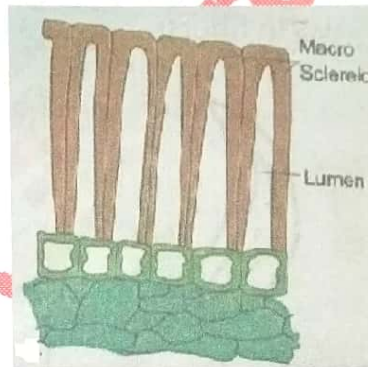
1- Brachysclereids (stone-cells):

- short, roughly isodiametric sclereids, pitted wall with branched canal pits.
- in cortex, phloem, pith and in flesh fruits.



2- Macrosclereids:

- elongated rod - like
- in epidermal layer of leguminous seeds.



3- Osteosclereides:

- bone-shaped, columnar cells, enlarged



4- Astrosclereids:

- star-shaped, ramified to varying degrees (Nymphaea petiole).

Astrosclereide



Vascular bundles are divided into:

a. **Collateral bundles:** phloem occurs on one side of xylem strand (stems, leaves).

- **Open:** cambium between xylem & phloem.

- **Closed:** no cambium between xylem & phloem.

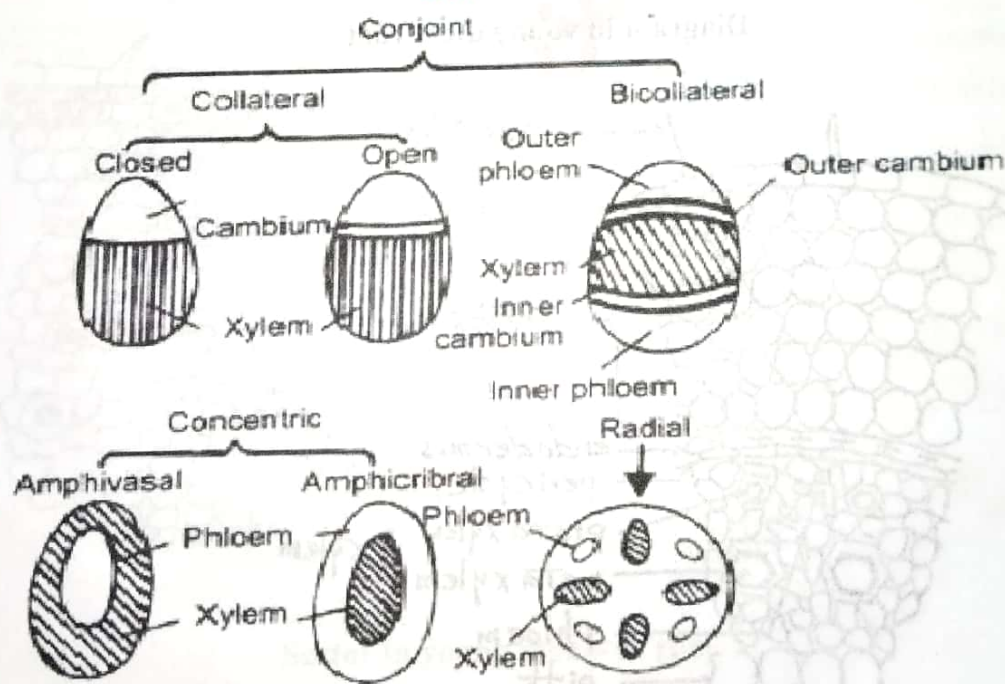
b. **Bicollateral bundles:** phloem occurs on both sides of xylem (Cucurbita stem).

c. **Concentric bundles:** One type of vascular tissue (xylem or phloem) completely surrounds the other, two types:

□ **Amphicribal bundles:** Xylem is surrounded by phloem (ferns, flowers).

□ **Amphivasal bundles:** Phloem is surrounded by xylem (Dracaena stem)

d. **Radial arrangement:** phloem and xylem are separated from each other and lie on different radius of axis alternating with each other (roots).



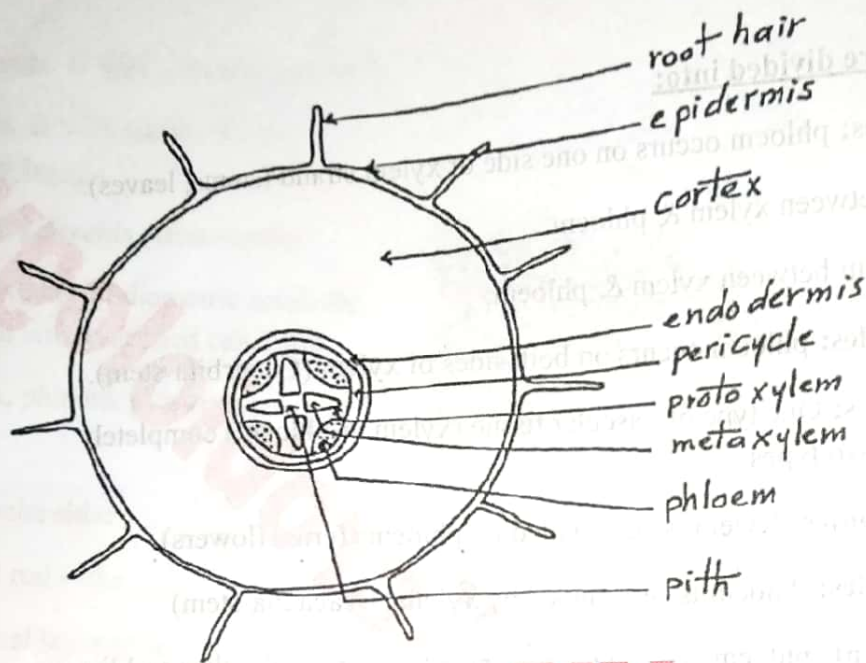
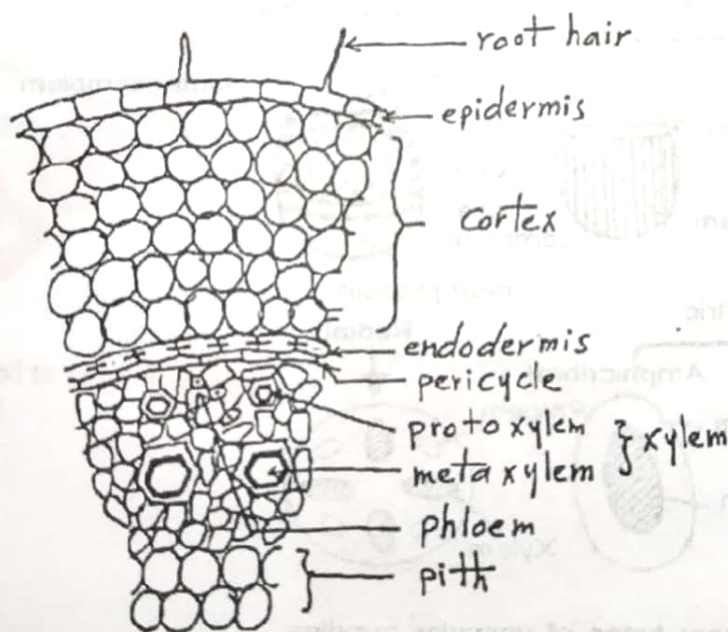


Diagram in young dicot root



Sector in young dicot root

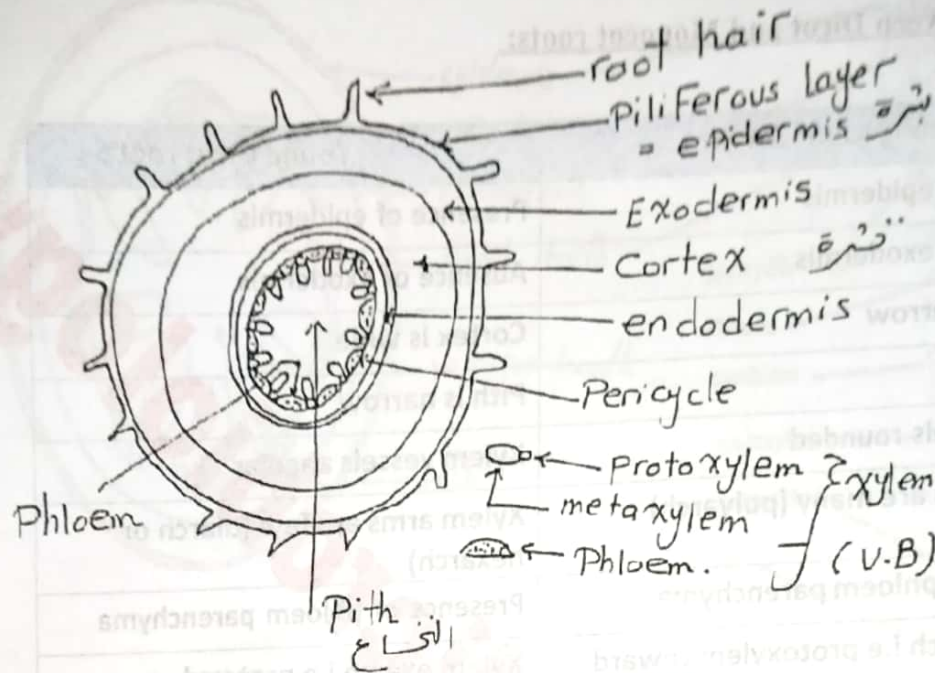
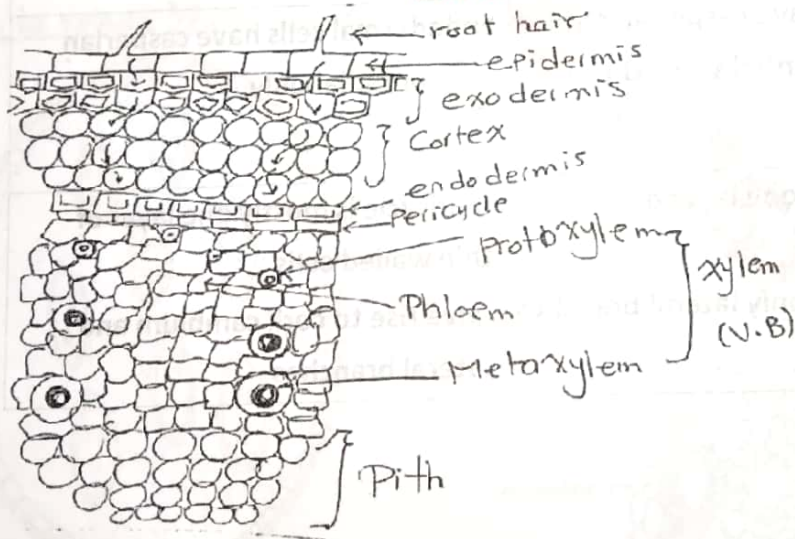


Diagram in young monocot root

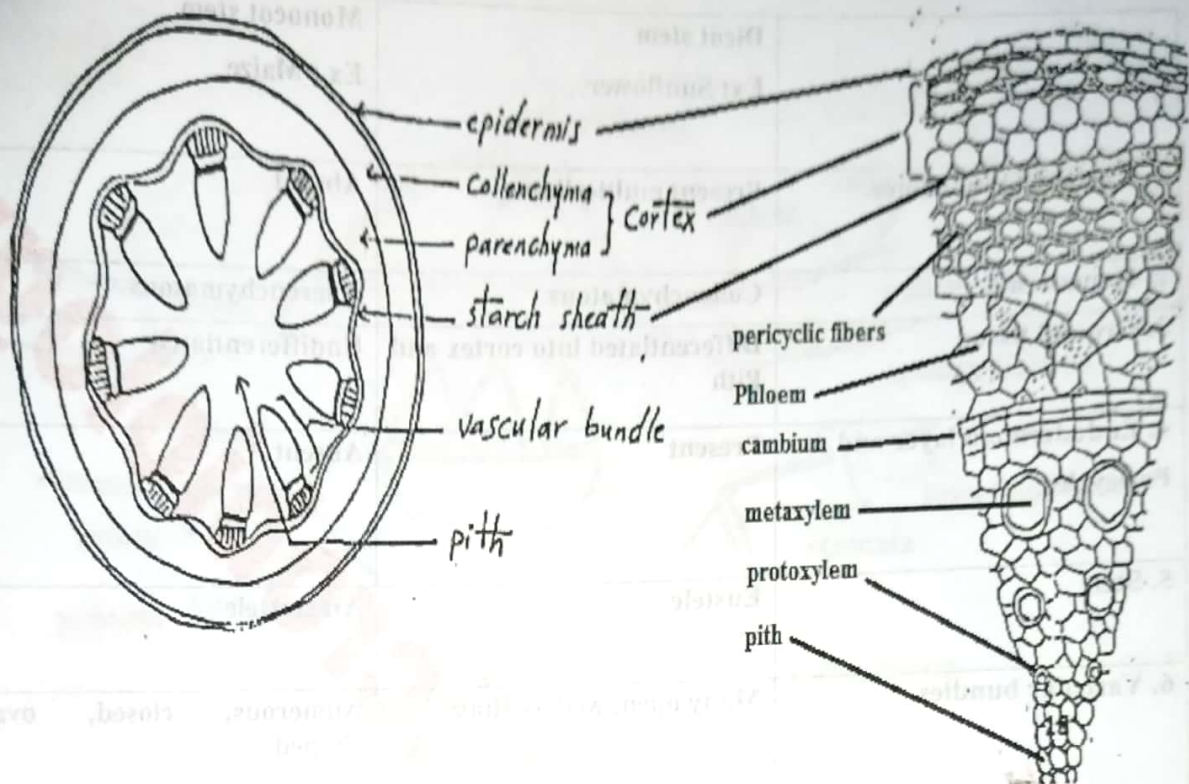


Sector in young monocot root

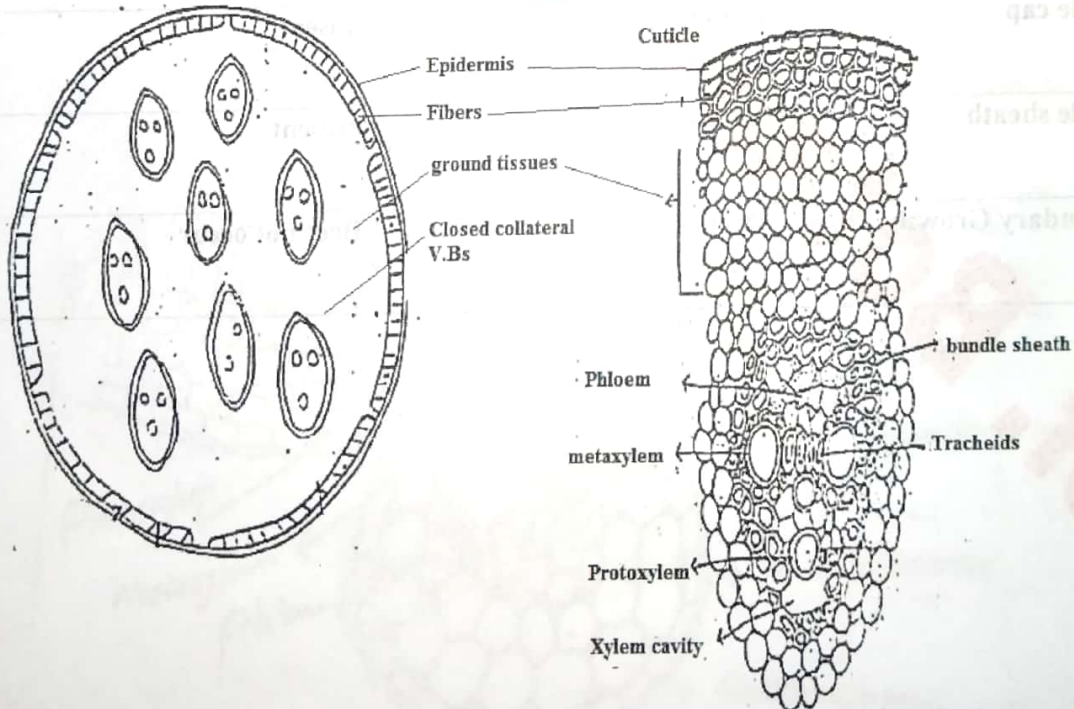
Comparison between Dicot and Monocot roots:

Young Monocot root	Young Dicot root
Presence of epidermis	Presence of epidermis
Presence of exodermis	Absence of exodermis
Cortex is narrow	Cortex is wide
Pith is wide	Pith is narrow
Xylem vessels rounded	Xylem vessels angular
Xylem arms are many (polyarch)	Xylem arms are few (diarch or hexarch)
Absence of phloem parenchyma	Presence of phloem parenchyma
Xylem exarch i.e protoxylem toward outside and metaxylem toward inside	Xylem exarch i.e protoxylem toward outside and metaxylem toward inside
Endodermal cells have casperian strip on radial and tangential walls U or V-shaped	Endodermal cells have casperian strip on radial only
-Pericycle is mostly one layer of thinwalled cells - It may give rise to only lateral branches.	-Pericycle is mostly one layer of thin walled cells -give rise to cork cambium and lateral branches

T.S. in young Dicot stem



T.S. in young Monocot stem



Comparison between the stems of Dicot and Monocot:

	Dicot stem Ex: Sunflower	Monocot stem Ex : Maize
1. Epidermal trichomes	Present multicellular	Absent
2. Hypodermis	Collenchymatous	Sclerenchymatous
3. Ground tissue	Differentiated into cortex and Pith	Undifferentiated
4. Endodermoid layer and Pericycle	Present	Absent
5. Stele	Eustele	Atactostele
6. Vascular bundles	Many open, wedge-shaped	Numerous, closed, oval shaped
7. Lysigenous cavity	Absent	Present
8. Bundle cap	Present	Absent
9. Bundle sheath	Absent	Present
10. Secondary Growth	Occurs later	Does not occur

Diagram in young dicot leaf

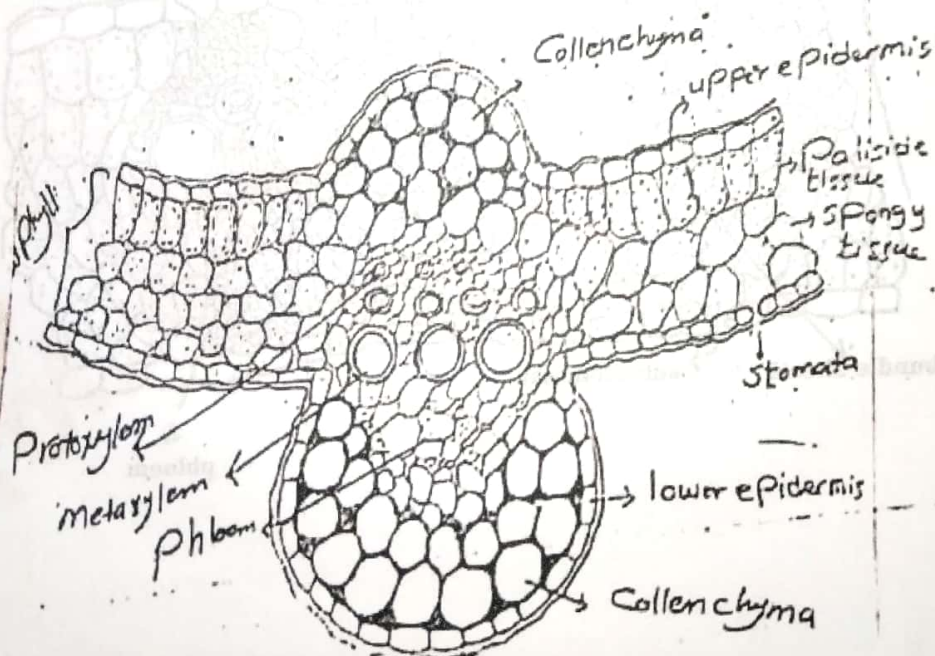
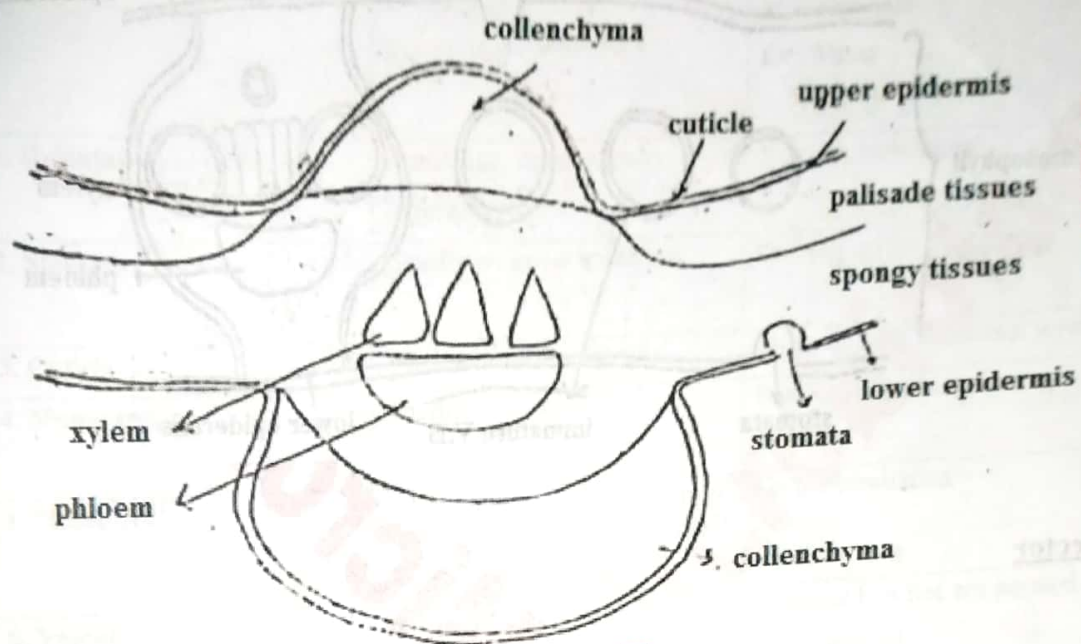
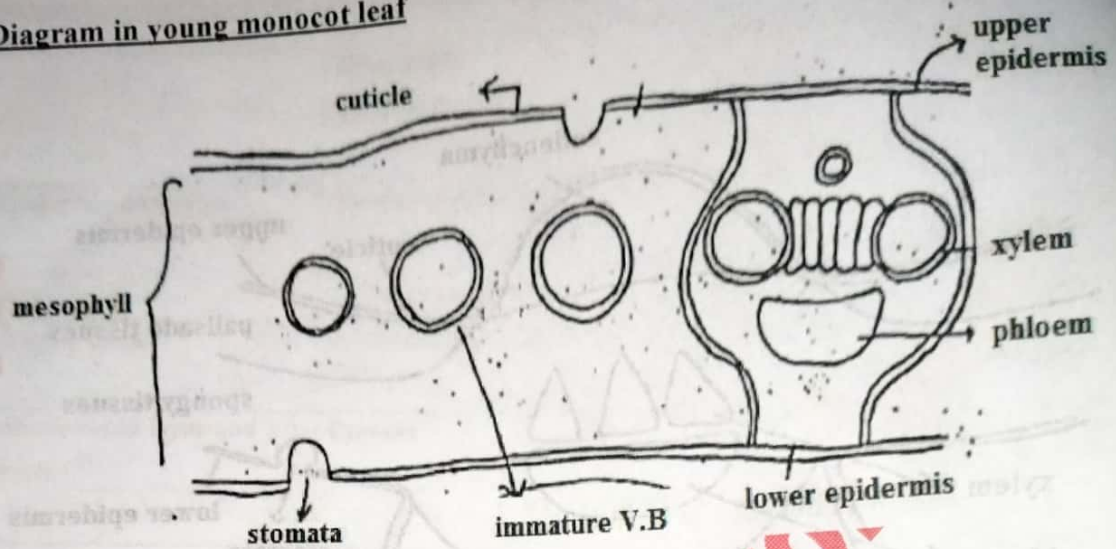
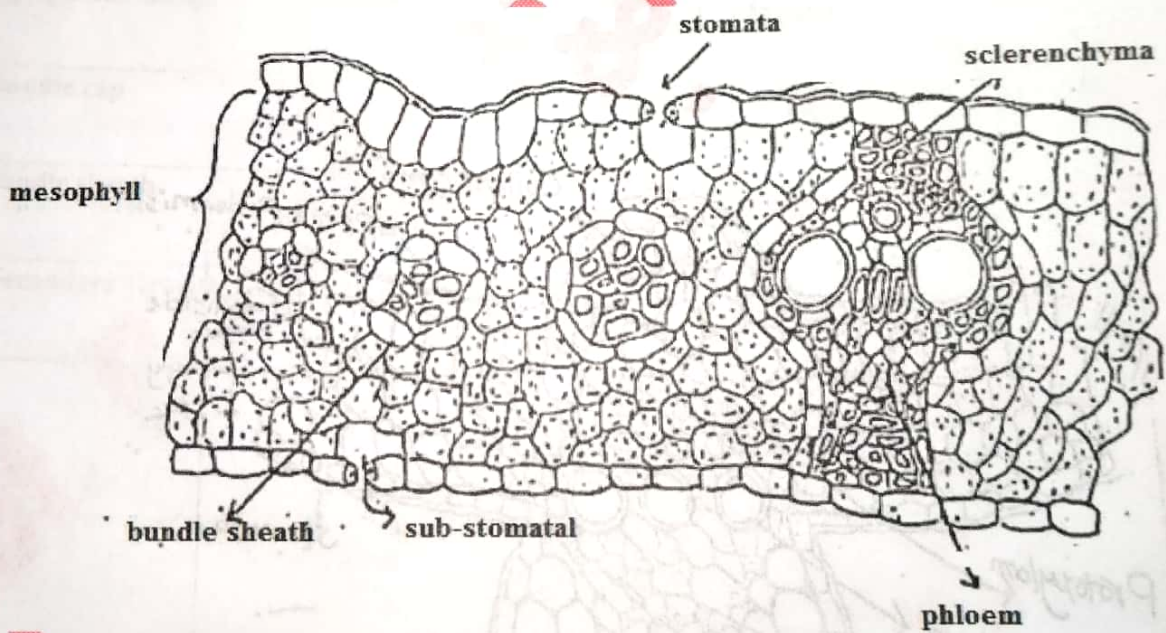


Diagram in young monocot leaf



Sector



Comparison between the of Dicot and Monocot leaf.

	Dicot Leaf Ex: Mango	Monocot Leaf Ex: Maize
1. Orientation of leaf	Horizontal, dorsiventrally differentiated	Vertical, isobilateral
2. Stomata	Usually on lower epidermis	On both epidermal layers
3. Cuticle	Thick on upper epidermis	Thick on both epidermal layers
4. Motor cells	Absent	Present in upper epidermis
5. Mesophyll	Differentiated into upper palisade and lower spongy parenchyma	No differentiation
6. Vascular bundles	not parallel and surrounded by bundle sheath	Vascular bundles are parallel are supported by sclerenchyma patches