

## TISSUE

- \* GROUP OF CELL: COMMON ORIGIN, & FUNCTION.

### TYPES

#### ① MERISTEMATIC TISSUE

- \* Cells: actively dividing
- \* Cell wall: PRIMARY WALL
- \* Immature cell

#### ② PERMANENT TISSUE

- \* Cells usually do not divide
- \* Mature cell

### NOTE : TERMINOLOGY



meristematic  
cell/TISSUE  
(DIVIDING)

UNDIFFERENTIATION.

Cells Stop DIVISION



PERMANENT TISSUE

( DIFFERENTIATION )

Cells Regain  
Capacity of DIVISION



MERISTEMATIC CELLS/  
TISSUE

DEDIFFERENTIATION

NEET 2024

Cell stop division,



PERMANENT TISSUE

REDIFFERENTIATION

PRIMARY MERISTEM



PRIMARY PERM. TISSUE



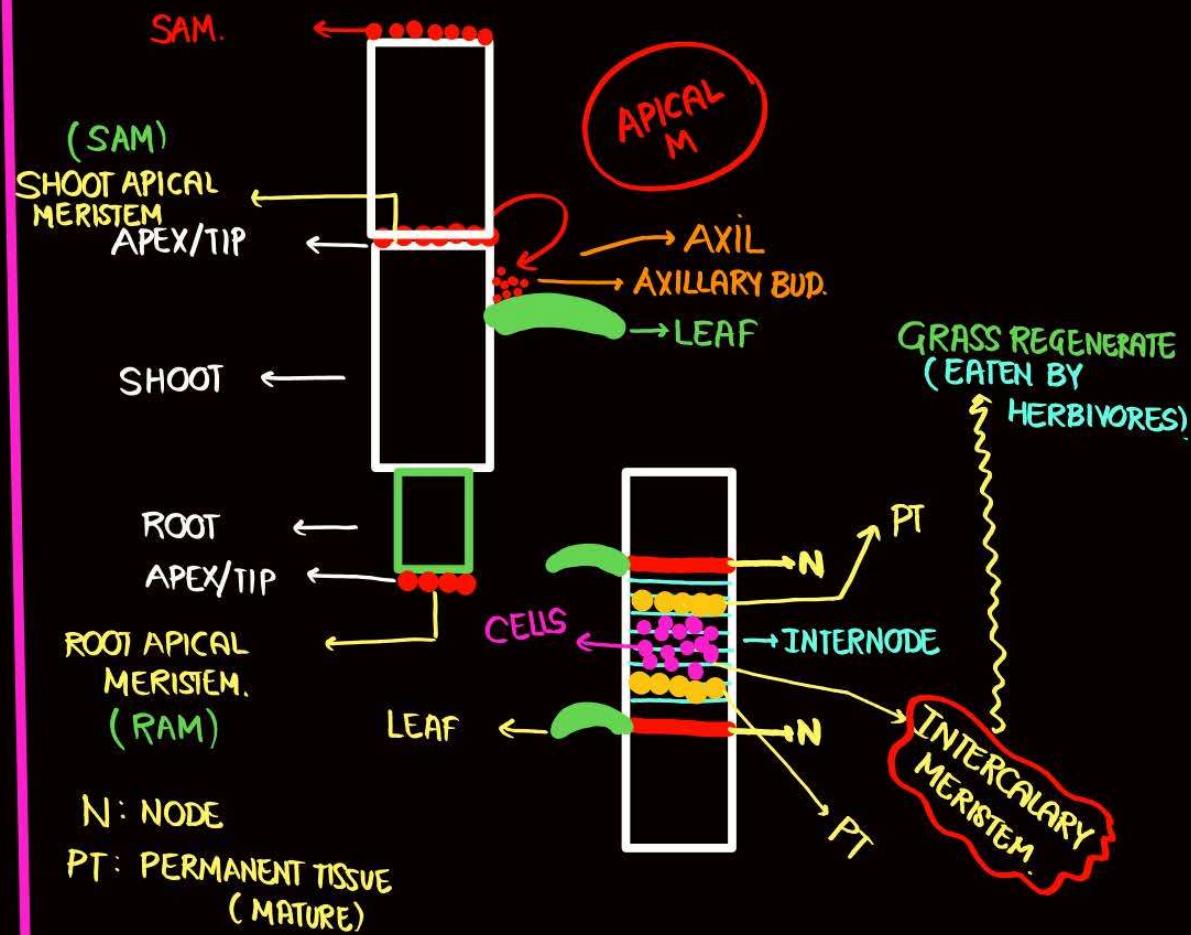
SECONDARY MERISTEM.

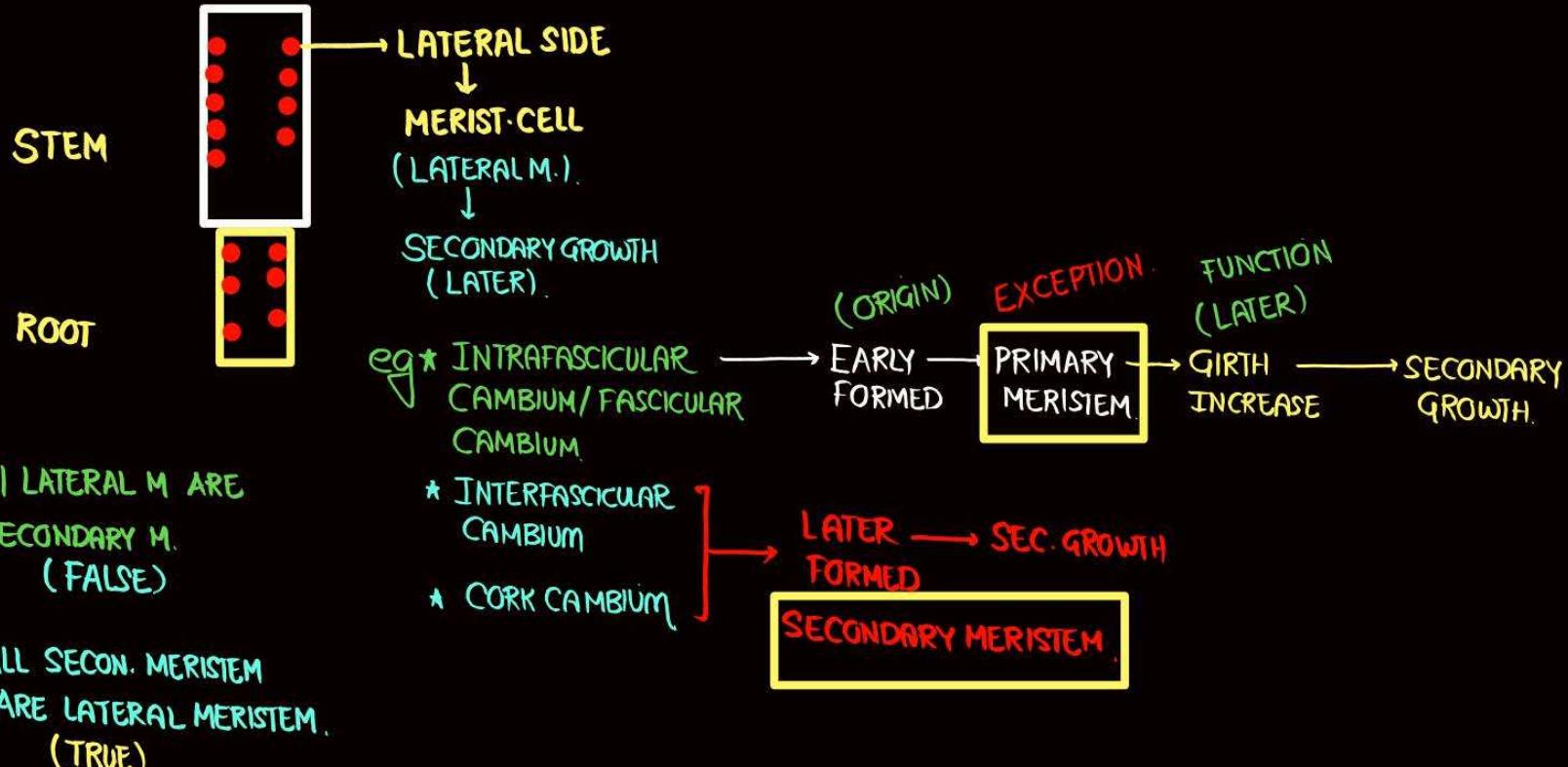


SECONDARY PERMAN. TISSUE

PM	SM
FORMED: EARLY	LATER.
FUNCTION: LENGTH (ROOT, STEM) INCREASE	GIRTH/THICKNESS/ DIAMETER INCREASE
PRIMARY GROWTH (EARLY)	SECONDARY GROWTH (LATER)
PRIMARY XYLEM & PRIMARY PHLOEM FORMED (PRIMARY TISSUE)	SECONDARY XYLEM, SECONDARY PHLOEM (SECONDARY TISSUE)
eg: APICAL M. INTERCALARY M.	eg LATERAL MERISTEM

SOME CELLS SEPERATED FROM SAM AND COLLECTED IN AXIL REGION CALLED AXILLARY BUD → FORM  
 BRANCH FLOWER.





## PERMANENT TISSUE (P.T.)

### SIMPLE P.T.

⇒ ONE TYPE OF CELL:  
PERFORM COMMON  
FUNCTION.

PARENCHYMA ] CELLS DO NOT → **LIVING**  
COLLENCHYMA ] LOSE PROTOPLASM

SCLERENCHYMA → CELLS LOSE → **DEAD**  
PROTOPLASM

### **PARENCHYMA**

\* Cells isodiametric



- EITHER CLOSELY PACKED OR LITTLE INTERCELLULAR SPACE
- CELL WALL: THIN, CELLULOSE
- CHLOROPLAST: PHOTOSYNTHESIS, FOOD STORAGE
- SECRETES OIL, RESIN, TANIN, MUCILAGE, LATEX

NEET 2024.

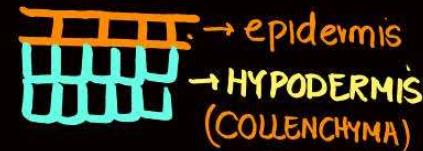
### **COLLENCHYMA**



INTERCELLULAR  
SPACE ABSENT.

CHLOROPLAST  
(PHOTOSYNTHESIS)  
CELL WALL  
(CELLULOSE, HEMICELLULOSE, PECTIN)

deposition  
↑  
more at CORNERS → THICK

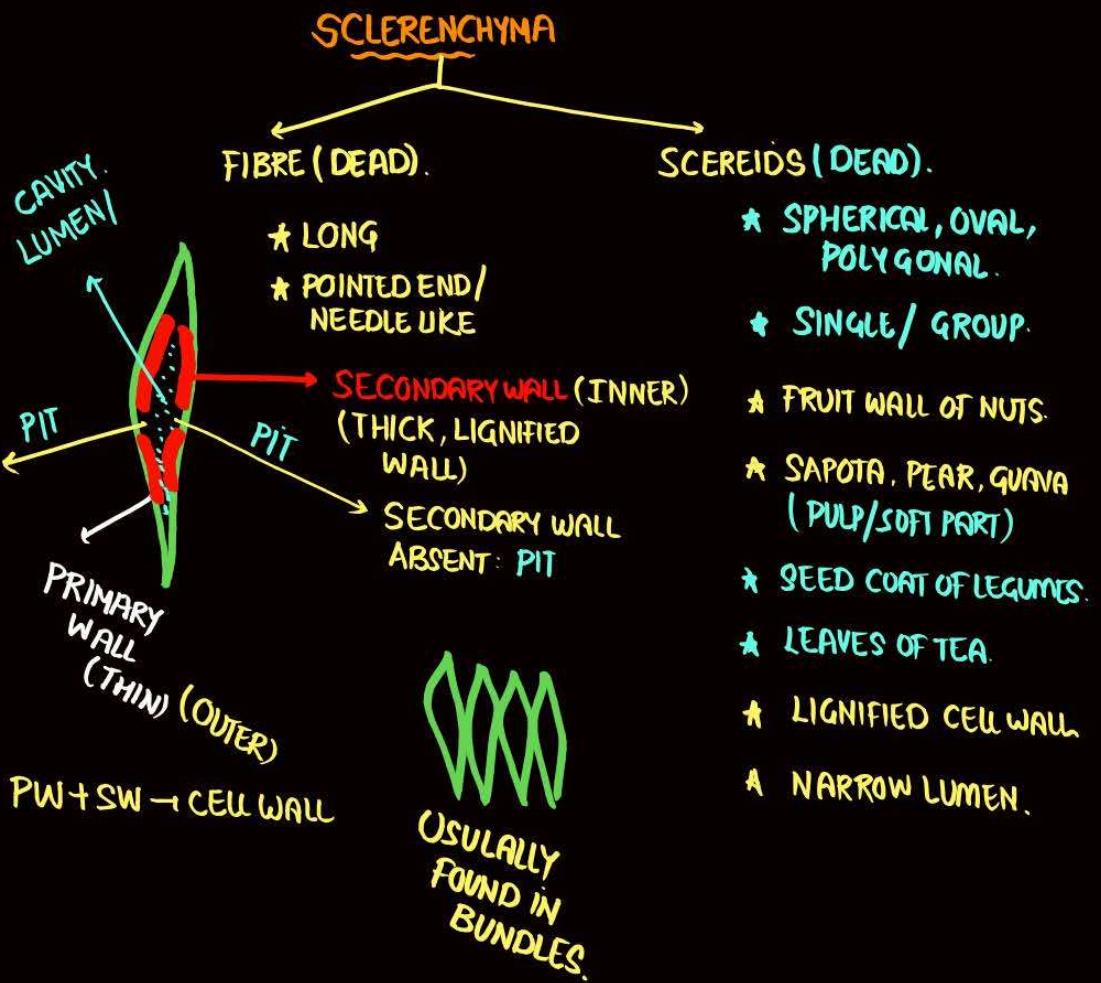


⇒ YOUNG STEM,  
PETIOLE OF LEAF. (MECHANICAL STRENGTH).

⇒ most of dicot stem. (BELOW EPIDERMIS)

MONOCOT STEM:  
HYPODERMIS  
(SCLERENCHYMA).

ROOT: HYPODERMIS  
ABSENT.



## COMPLEX PER.TISSUE (NEET 2024).

\* MORE THAN ONE TYPE OF CELL.

### ① XYLEM:

\* Water & minerals conduction.

\* PROVIDE MECHANICAL STRENGTH.

\* TRACHEID

\* VESSEL

\* XYLEM FIBRE

\* XYLEM PARENCHYMA → LIVING

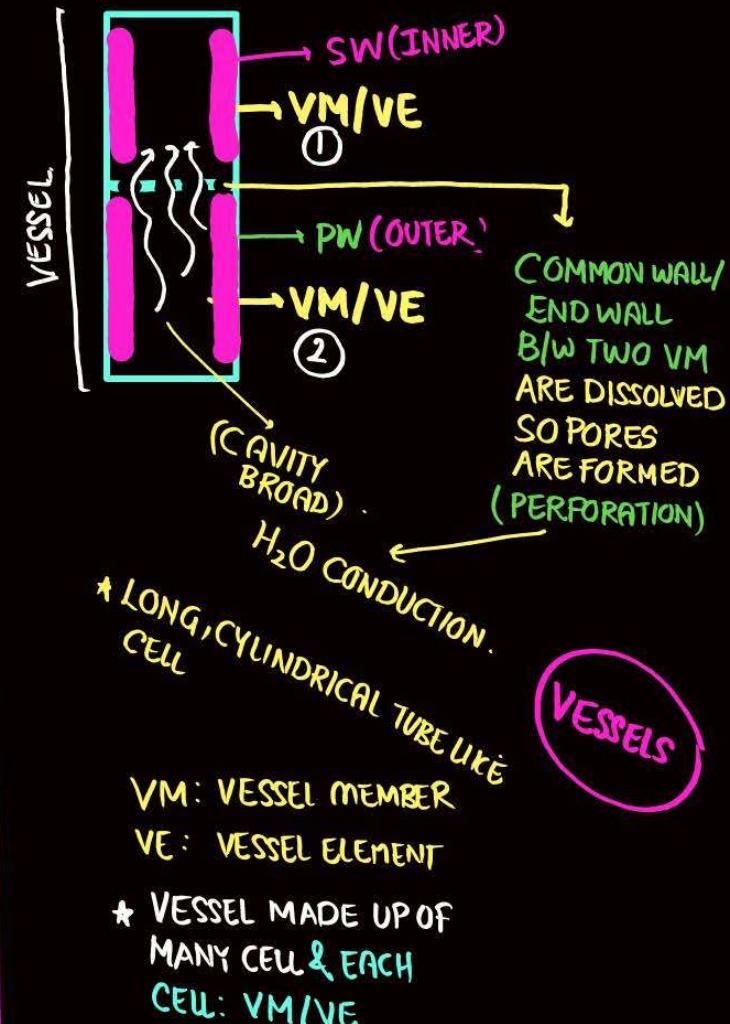
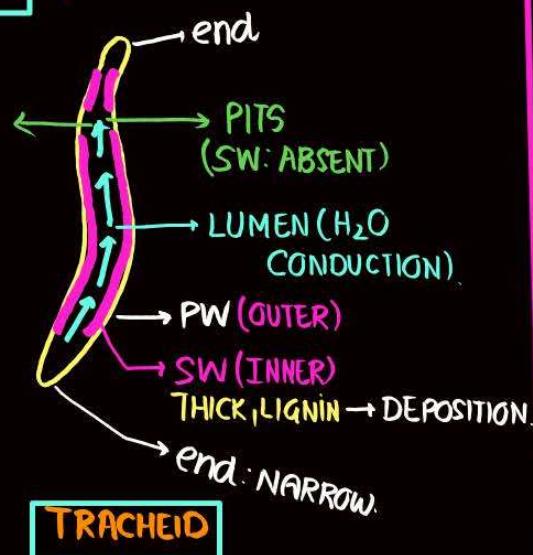
**TRACHEID** → elongated, TUBE LIKE CELL.

PTERIDO, GYMNO, ANGIOSPERM

**VESSEL**

**ANGIOSPERM**

LOOSE PROTOPLASM  
(DEAD)



## XYLEM FIBRE



SEPTATE

THICK, LIGNIFIED CELL WALL,  
DEAD



## XYLEM PARENCHYMA.

- \* LIVING, THIN WALL, CELLULOSE
- \* FOOD: STORE: STARCH/FAT
- \* STORE: TANIN
- \* RADIAL COND<sup>N</sup> OF H<sub>2</sub>O:  
RAY PARENCHYMA.

## TYPES OF XYLEM

### PRIMARY X.

- \* EARLY FORMED  
DURING PRIMARY  
GROWTH

### PROTOXYLEM

- ⇒ FIRST FORMED
- ⇒ NARROW/SMALL  
VESSELS

### SEC. XYLEM

- \* LATER
- \* DURING SEC. GROWTH.

### METAXYLEM

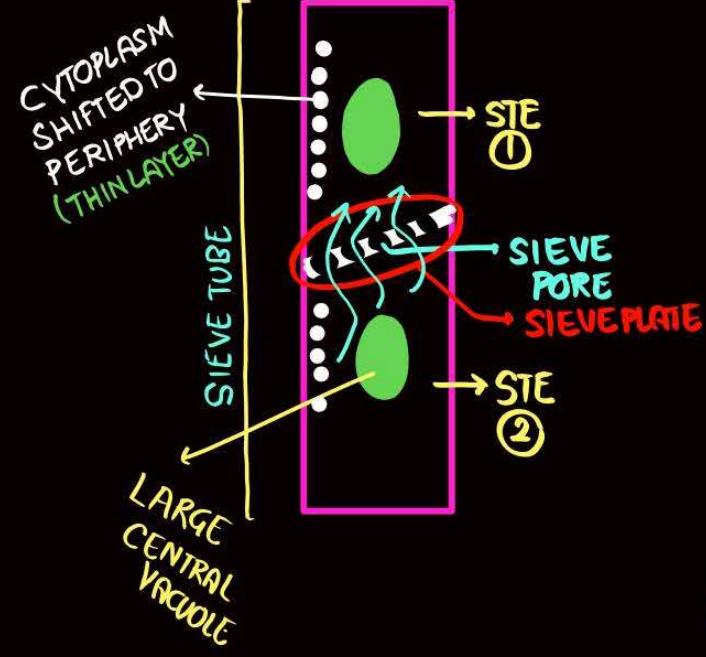
- ⇒ LATER.
- ⇒ BROAD/LARG  
VESSELS.

WAIT?

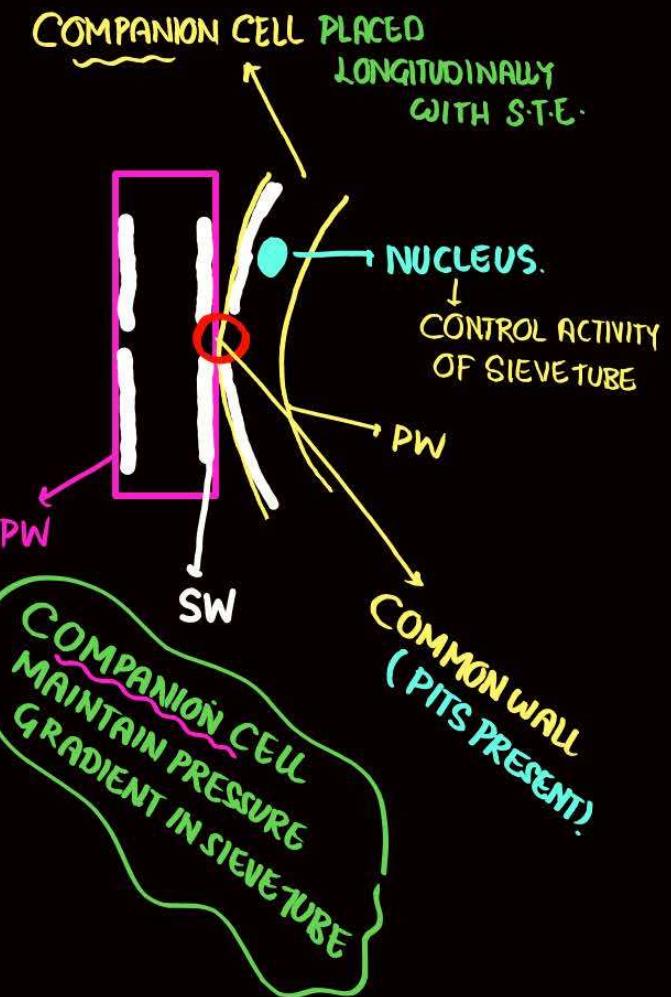
**ENDARCH**  
(STEM)  
**EXARCH.**  
(ROOT)

\* FOOD COND.  
 → SIEVE TUBE  
 → COMPANION CELL.  
 → PHLOEM PARENCHYMA.  
 → PHLOEM FIBRE → DEAD.  
 → SIEVE CELL  
 → ALBUMINOUS CELL.

ANGIOSPERM. PHLOEM  
 LIVING  
 Gymnosperm.



- SIEVE TUBE
- \* MADE UP OF STE (SIEVETUBE ELEMENT).
  - \* CELL WALL: CELLULOSE
  - \* NUCLEUS ABSENT.
  - \* FOOD CON<sup>n</sup> FROM ONE STE TO ANOTHER THROUGH SIEVE PORE

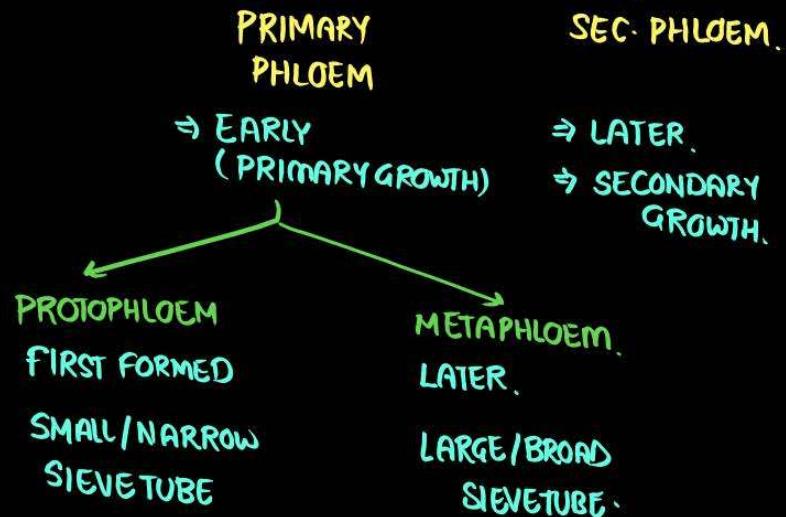


**Phloem fibres** (bast fibres) are made up of sclerenchymatous cells. These are generally absent in the primary phloem but are found in the secondary phloem. These are much elongated, unbranched and have pointed, needle like apices. The cell wall of phloem fibres is quite thick. At maturity, these fibres lose their protoplasm and become dead. Phloem fibres of jute, flax and hemp are used commercially. The first formed primary phloem consists of narrow sieve tubes and is referred to as **protophloem** and the later formed phloem has bigger sieve tubes and is referred to as **metaphloem**.

### Explanation

EARLY  
(PRIMARY  
GROWTH)

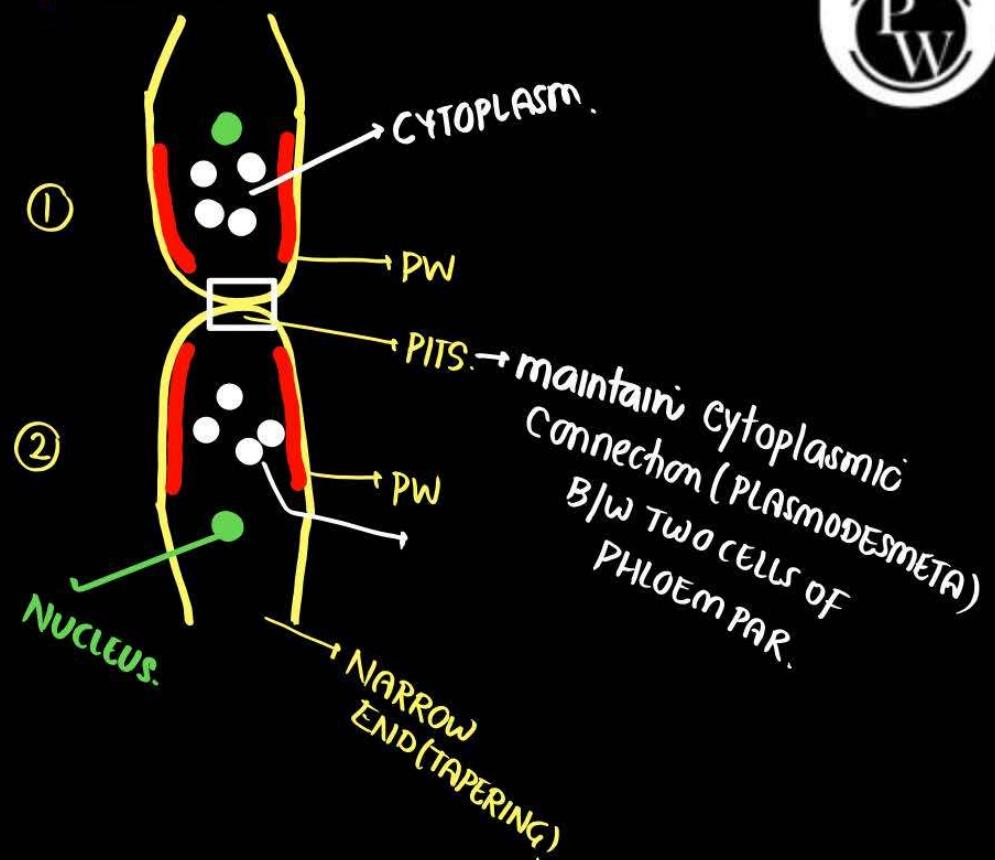
LIGNIN (SEC.WALL).



**Phloem parenchyma** is made up of elongated, tapering cylindrical cells which have dense cytoplasm and nucleus. The cell wall is composed of cellulose and has pits through which plasmodesmatal connections exist between the cells. The phloem parenchyma stores food material and other substances like resins, latex and mucilage. Phloem parenchyma is absent in most of the monocotyledons.

stem.

### Explanation

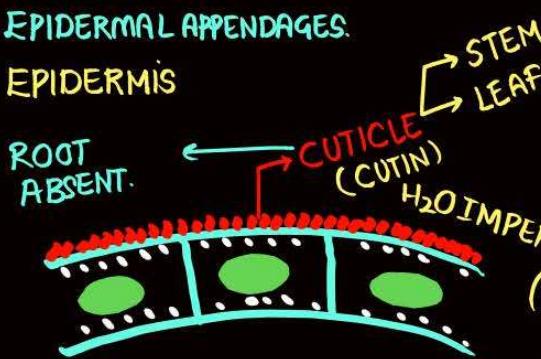


## TISSUE SYSTEM.

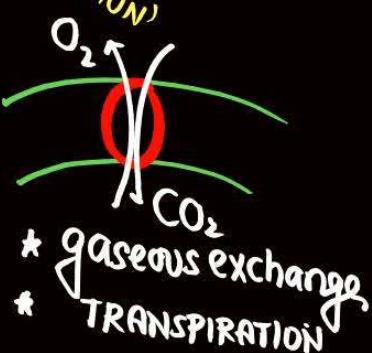
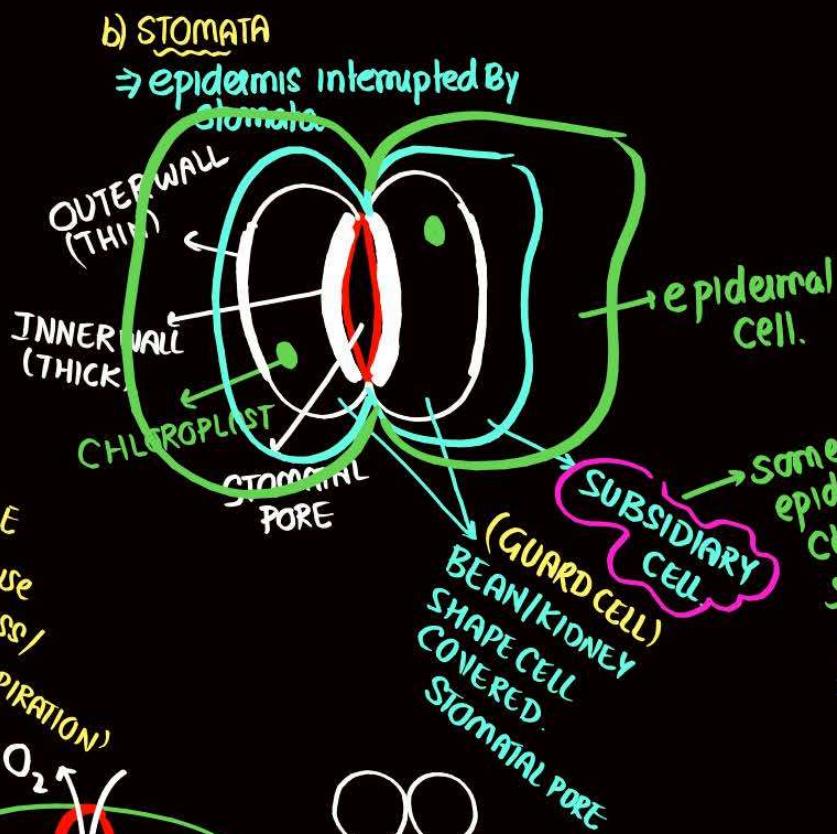
### EPIDERMAL TISSUE SYSTEM.

→ EPIDERMIS ✓  
→ STOMATA ✓  
→ EPIDERMAL APPENDAGES.

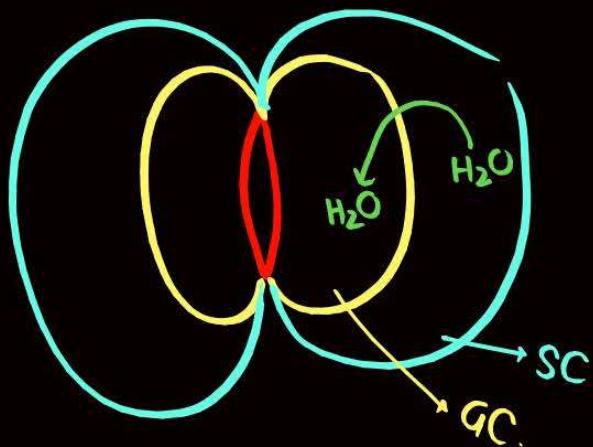
#### a) EPIDERMIS



- ⇒ CELLS: ELONGATED, COMPACTLY ARRANGE
- ⇒ GENERALLY SINGLE LAYER.
- ⇒ CONTINUOUS
- ⇒ CENTRE: LARGE VACUOLE.
- ⇒ cytoplasm: periphery: THIN LAYER.



STOMATAL APPARATUS.



$SC \xrightarrow{H_2O} GC \rightarrow$  SWELL/TURGID  $\rightarrow$  STOMATA PORE OPEN.

$GC \xrightarrow{H_2O} SC$

SHRINK/FLACCID  $\rightarrow$  STOMATA CLOSED.

### EPIDERMAL APPENDAGES

$\Rightarrow$  some outgrowth/structure arise from epidermis



- \* UNICELLULAR.

- \* Absorption of  $H_2O$  / mineral.

- \* MULTICELLULAR (MOSTLY) OR UNICELLULAR.

- \* SOFT / STIFF

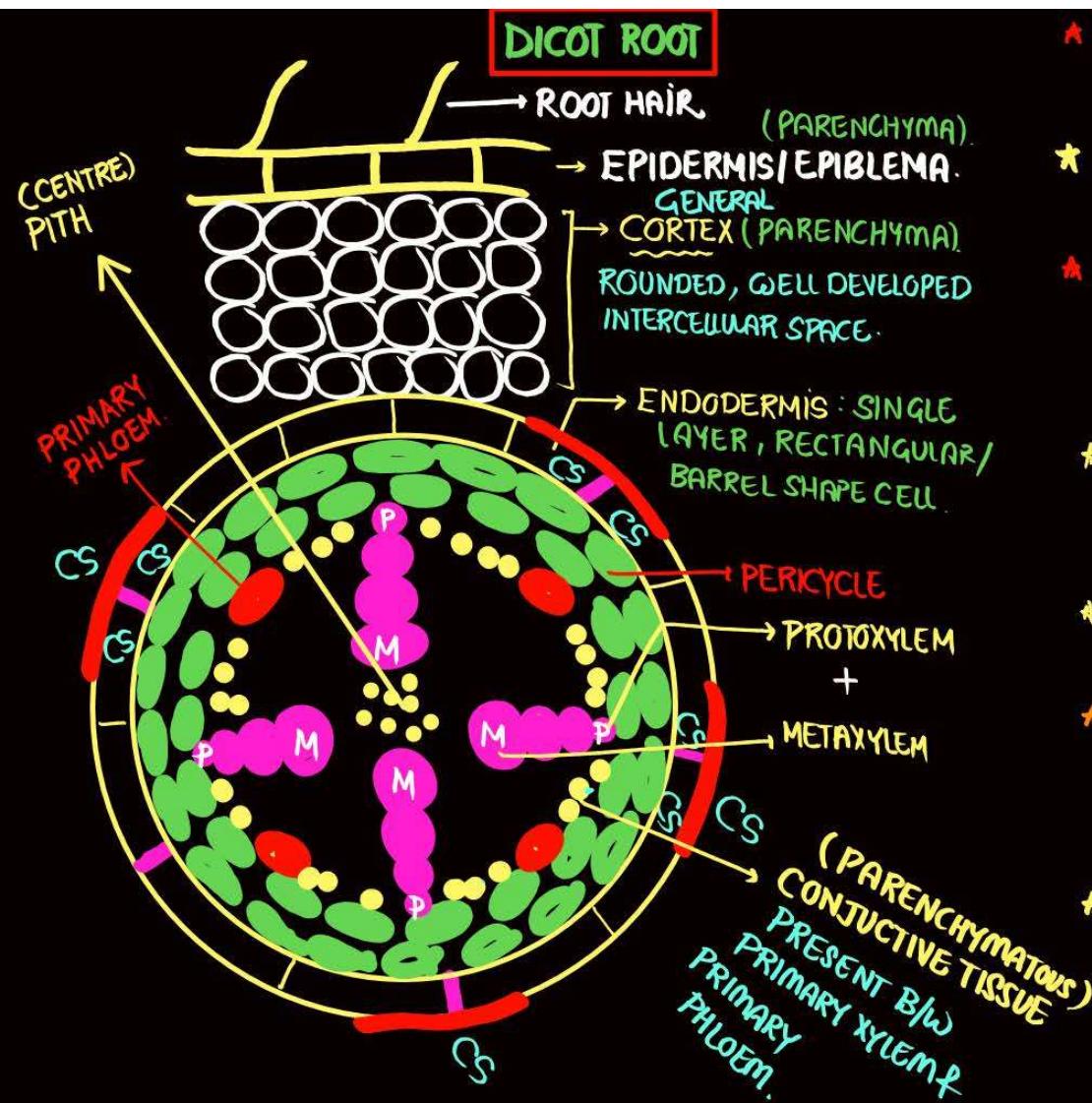
- \* BRANCHED / UNBRANCHED.

- \* SECRETE OIL

- \* TRANSPERSION /  $H_2O$  LOSS PREVENT

## VASCULAR TISSUE SYSTEM.

- RADIAL VASCULAR BUNDLE & EXARCH ( DICOT, MONOCOT ROOT)
- CONJOINT VASCULAR BUNDLE & ENDARCH. ( DICOT, MONOCOT STEM).



- \* RADIAL & TANGENTIAL WALL: WATER IMPERMEABLE SUBSTANCE (SUBERIN) PRESENT: **CASPARIAN STRIPS (CS)**.
- \* **CORTEX**
  - GENERAL CORTEX (OUTER LAYER)
  - ENDODERMIS (INNER LAYER)
- \* **PERICYCLE** (THICK WALLED PARENCHYMA) (PERMANENT TISSUE)
  - meristematic cell OR SECONDARY MERISTEM (VASCULAR CAMBIUM)
  - dedifferentiation
  - INCREASE THICKNESS OF ROOT.
- \* PITH/CENTRE: PARENCHYMA IS NOT WELL DEVELOPED
- \* PITH INCONSPICUOUS, SMALL. EXARCH.
- \* METAXYLEM TOWARDS: PITH/CENTRE  
PROTOXYLEM TOWARDS: PERIPHERY/OUTER
- \* PROTOXYLEM + METAXYLEM → PRIMARY XYLEM
- \* PRIMARY XYLEM & PRIMARY PHLOEM: DIFFERENT LINE/RADIUS, ALTERNATE RADIAL VASCULAR BUNDLE

## STELE

PITH → XYLEM, PHLOEM → PERICYCLE  
(VASCULAR TISSUE)

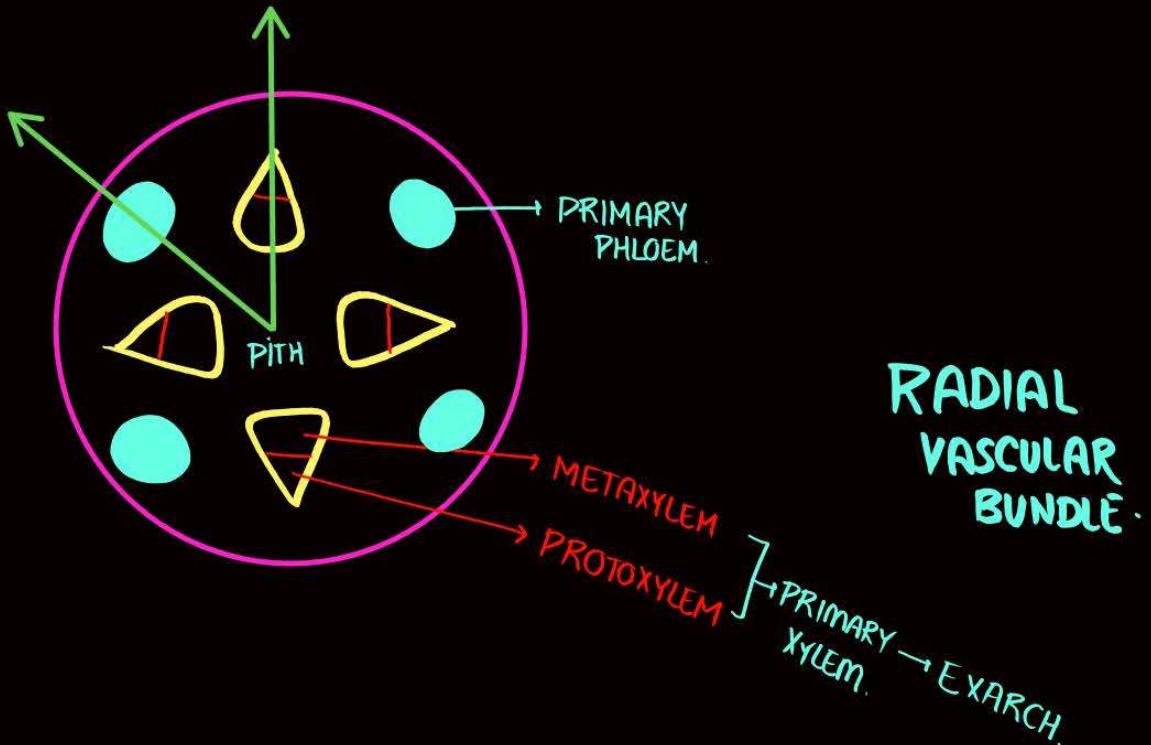
\* 4: XYLEM, 4: PHLOEM  
(TETRARCH ROOT).

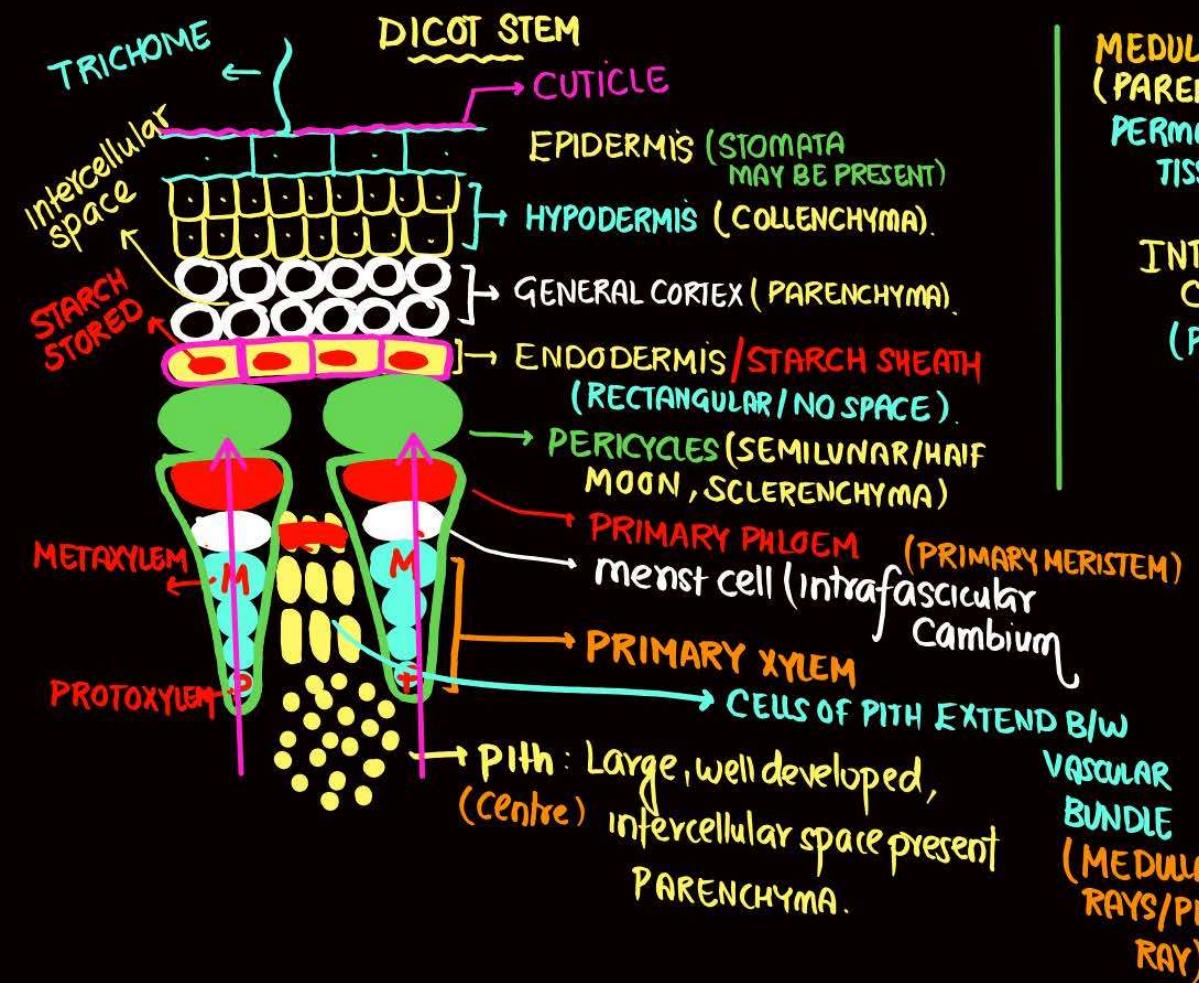
\* 

2 → X, P	→ most common	→ DIARCH
3 → X, P		TO
4 → X, P		TETRARCH.

  
5 → X, P → PENTARCH  
6 → X, P → HEXARCH.

	DICOT ROOT	MONOCOT ROOT
PERICYCLE	VASCULAR CAMBIUM LATERAL ROOT	→ ABSENT → PRESENT
SECONDARY GROWTH (THICKNESS)	✓	✗
SECONDARY XYLEM	✓	✗
PITH	Small, inconspicuous. (NOT WELL DEVELOPED)	LARGE, CONSPICUOUS (WELL DEVELOPED)
VASCULAR BUNDLE	2 TO 4 FEWER EXARCH, RADIAL	MORE THAN SIX (POLYARCH) MORE EXARCH, RADIAL





**MEDULLARY RAYS**  
(PARENCHYMA)  
PERMANENT  
TISSUE.

**dedifferentiation** → **merist cell /  
Secondary meristem /  
Interfascicular cambium**

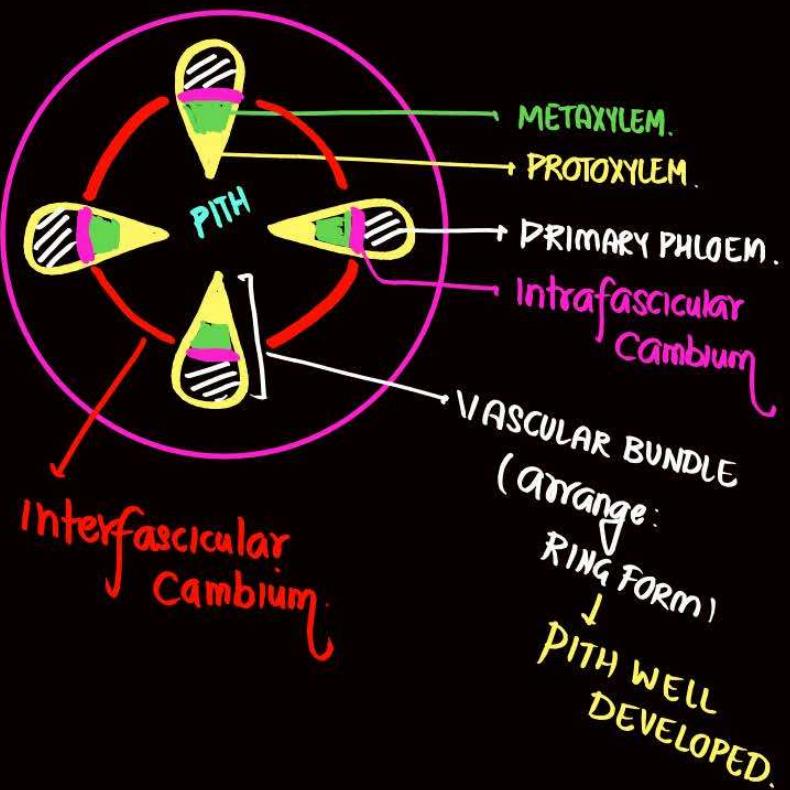
**INTRAFASCICULAR + interfasc. cambium**  
**CAMBIUM**  
(PRIMARY MERISTEM) FORMED EARLY

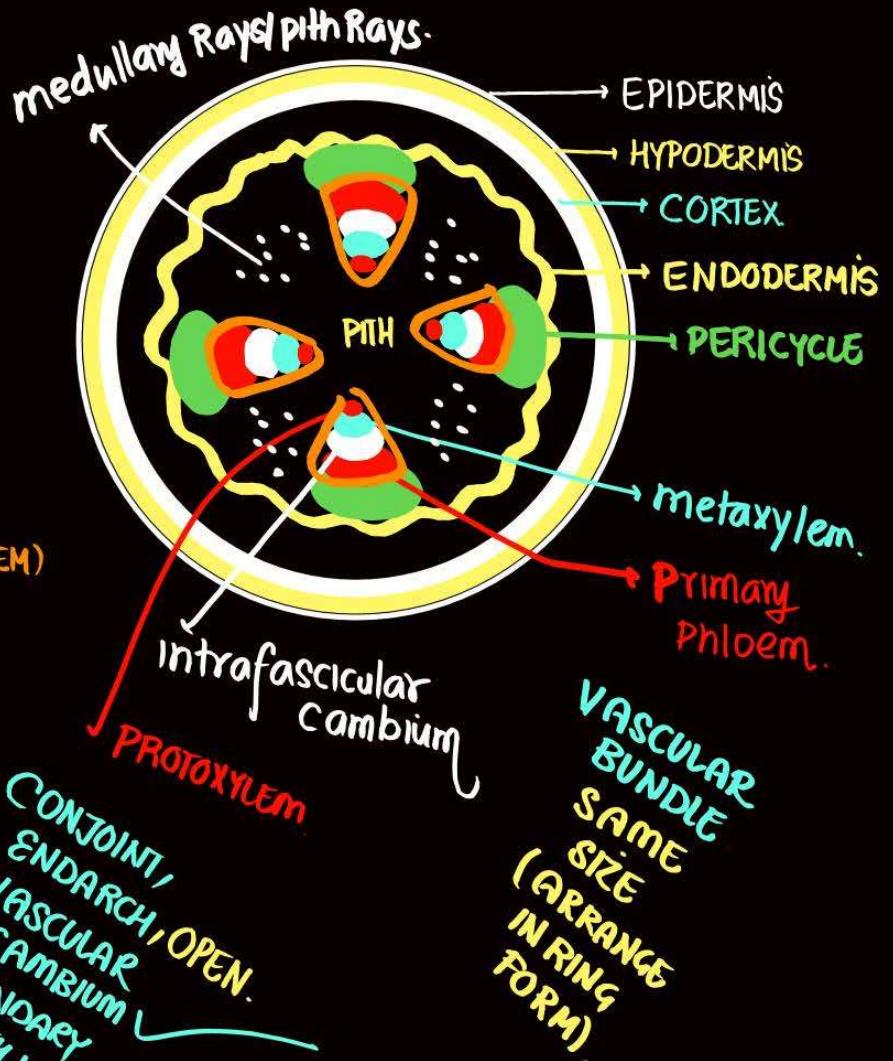
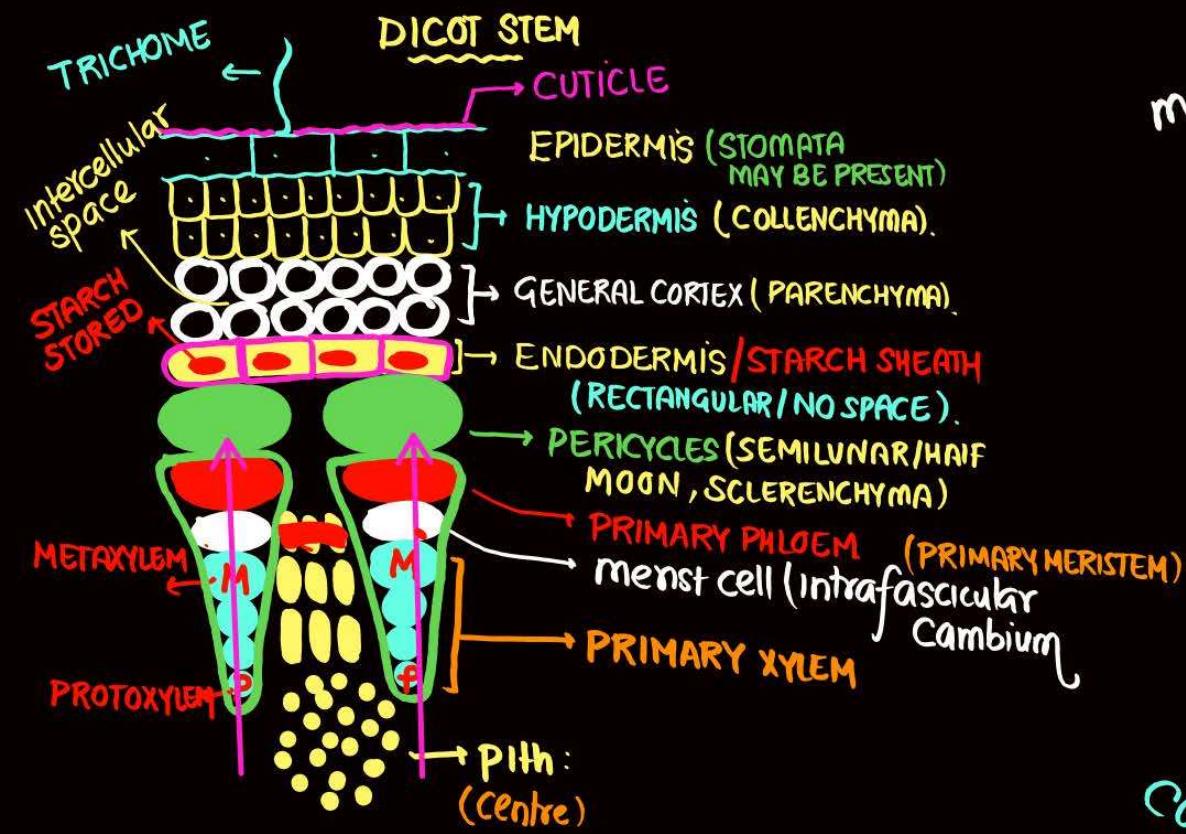
**VASCULAR CAMBIUM**  
(SECON. MERISTEM) LATER FORMED.

**PROTOXYLEM**: TOWARDS PITH  
**METAXYLEM**: PERIPHERY/OUTER.  
**ENDARCH**.

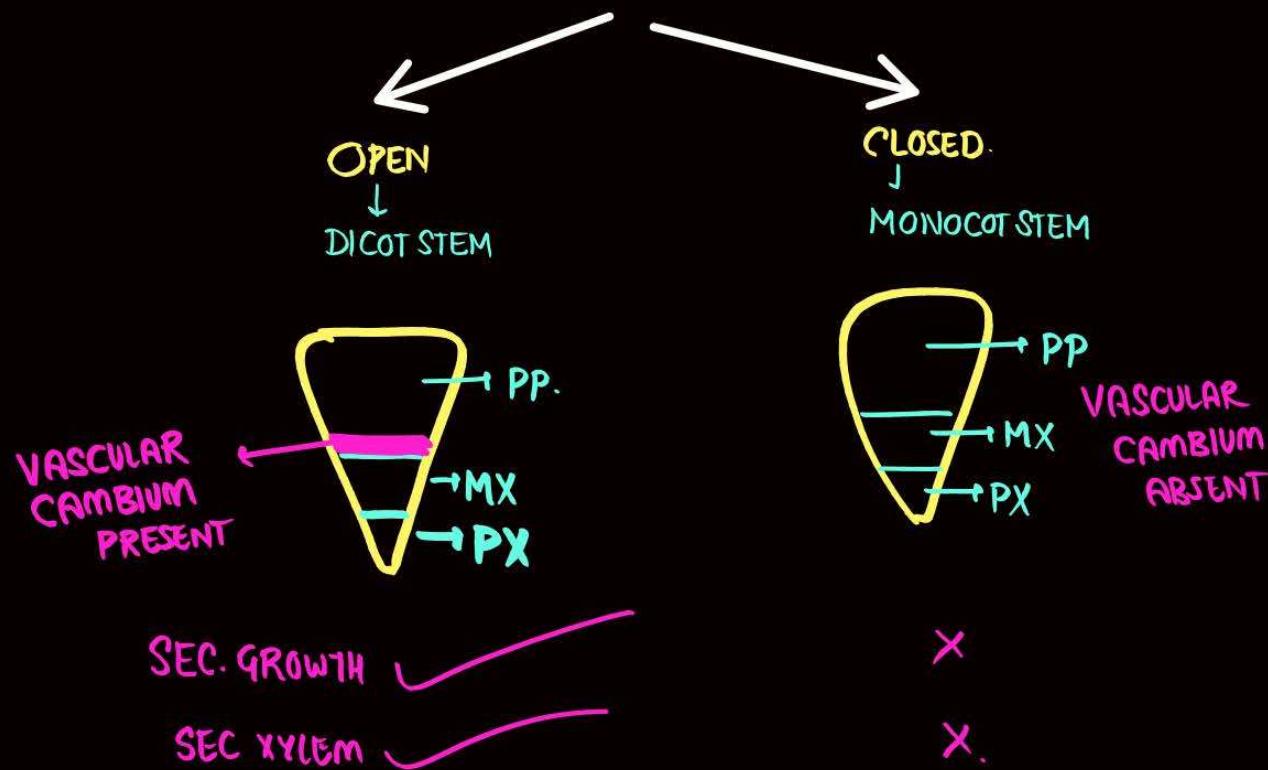
**PRIMARY XYLEM & PRIMARY PHLOEM**: SAME LINE /  
**PRIMARY XYLEM COVERED BY PRIMARY PHLOEM**:  
**CONJOINT VASCULAR BUNDLE**

**SECONDARY GROWTH**.  
(FORMATION OF SECONDARY XYLEM & SECON. PHLOEM)





## CONJOINT (STEM)



## 2. The Ground Tissue System

All tissues except epidermis and vascular bundles constitute the **ground tissue**. It consists of simple tissues such as parenchyma, collenchyma and sclerenchyma. Parenchymatous cells are usually present in cortex, pericycle, pith and medullary rays, in the primary stems and roots. In leaves, the ground tissue consists of thin-walled chloroplast containing cells and is called **mesophyll**.

## Explanation

EPIDERMIS → EPIDERMAL TISSUE SYSTEM.

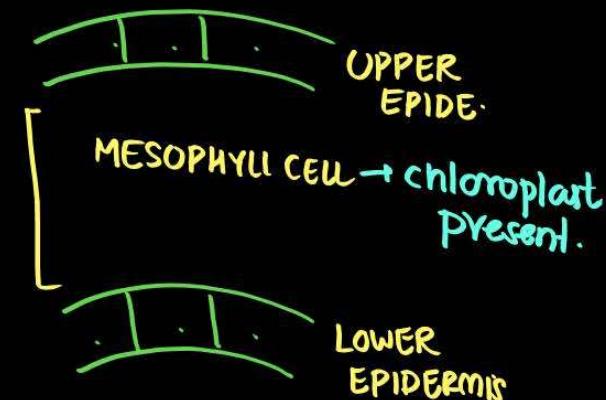
XYLEM, PHLOEM → VASCULAR TISSUE SYSTEM.

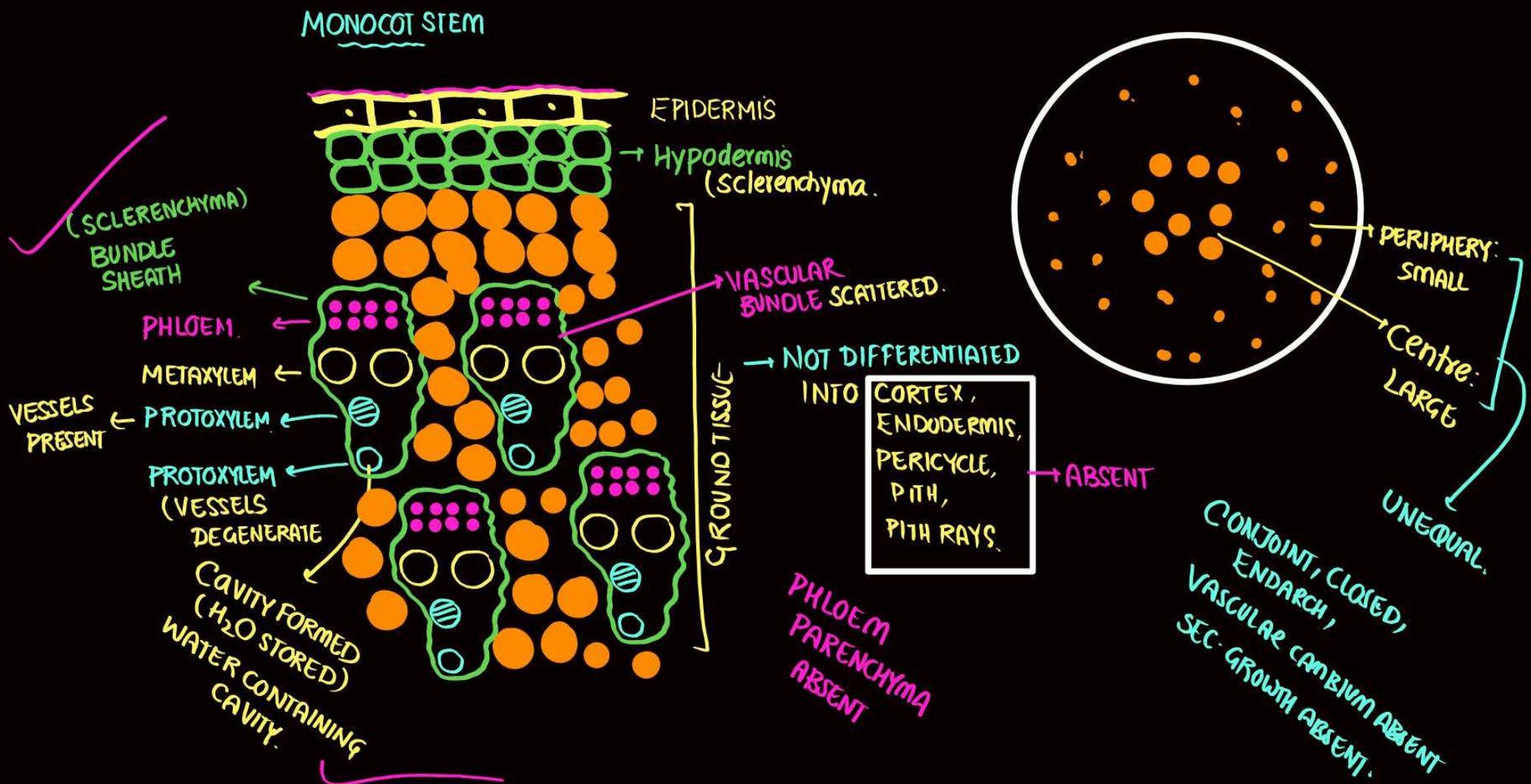
HYPOD, CORTEX, ENDODE, PERICYCLE, PITH, PITH RAYS : GROUND TISSUE SYSTEM.

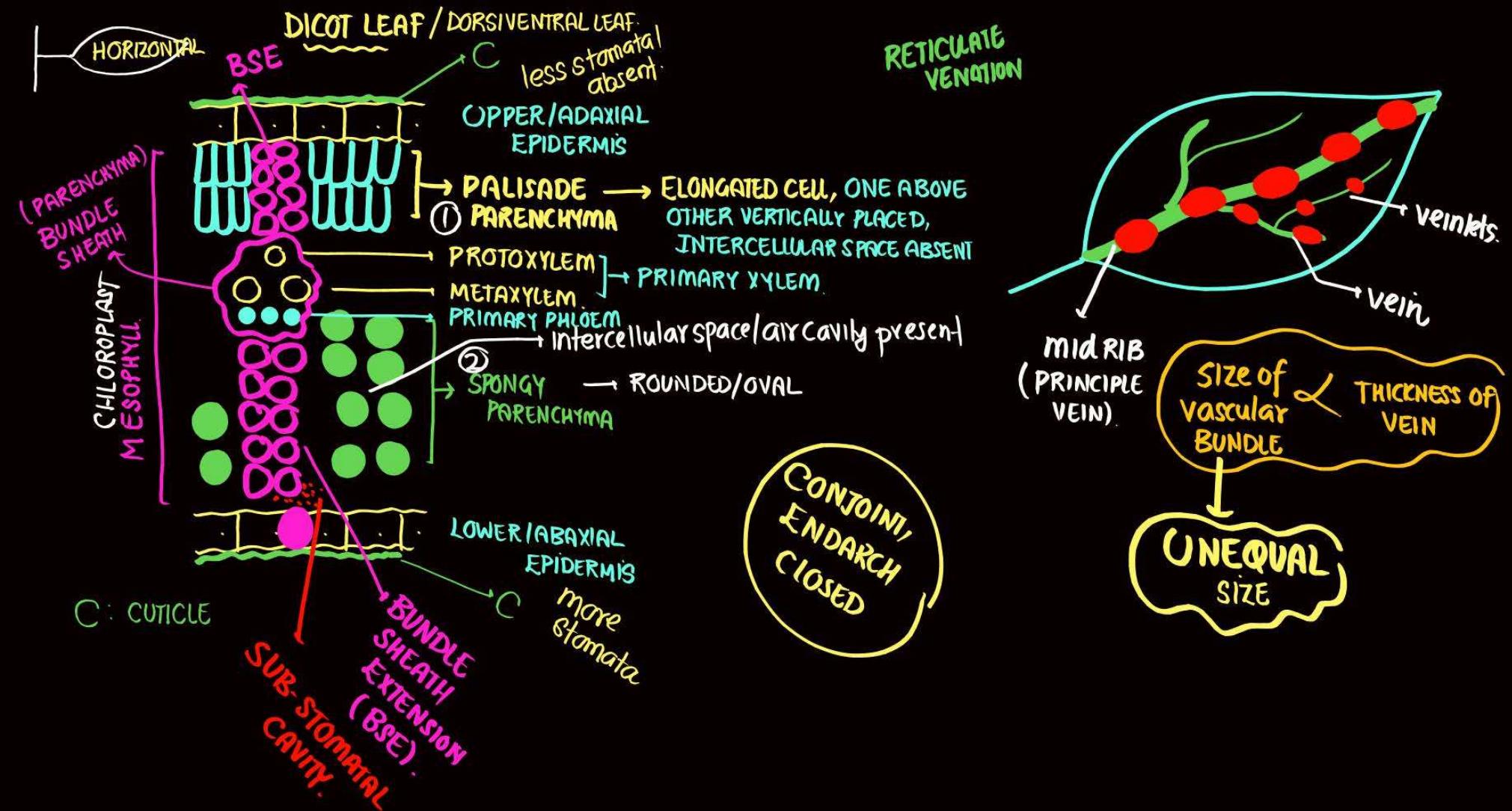
Collen  
chyma  
(DICOT  
STEM)  
SCLERENCHYMA  
(MONOCOT  
STEM)

P: PARENCHYMA.

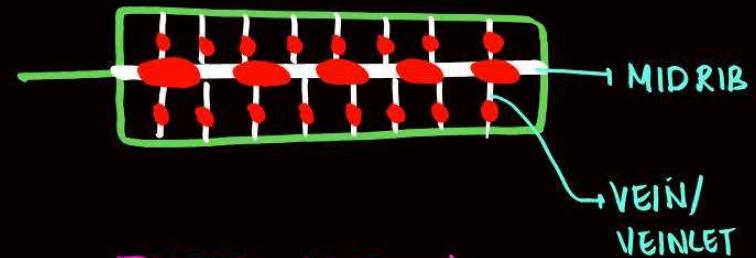
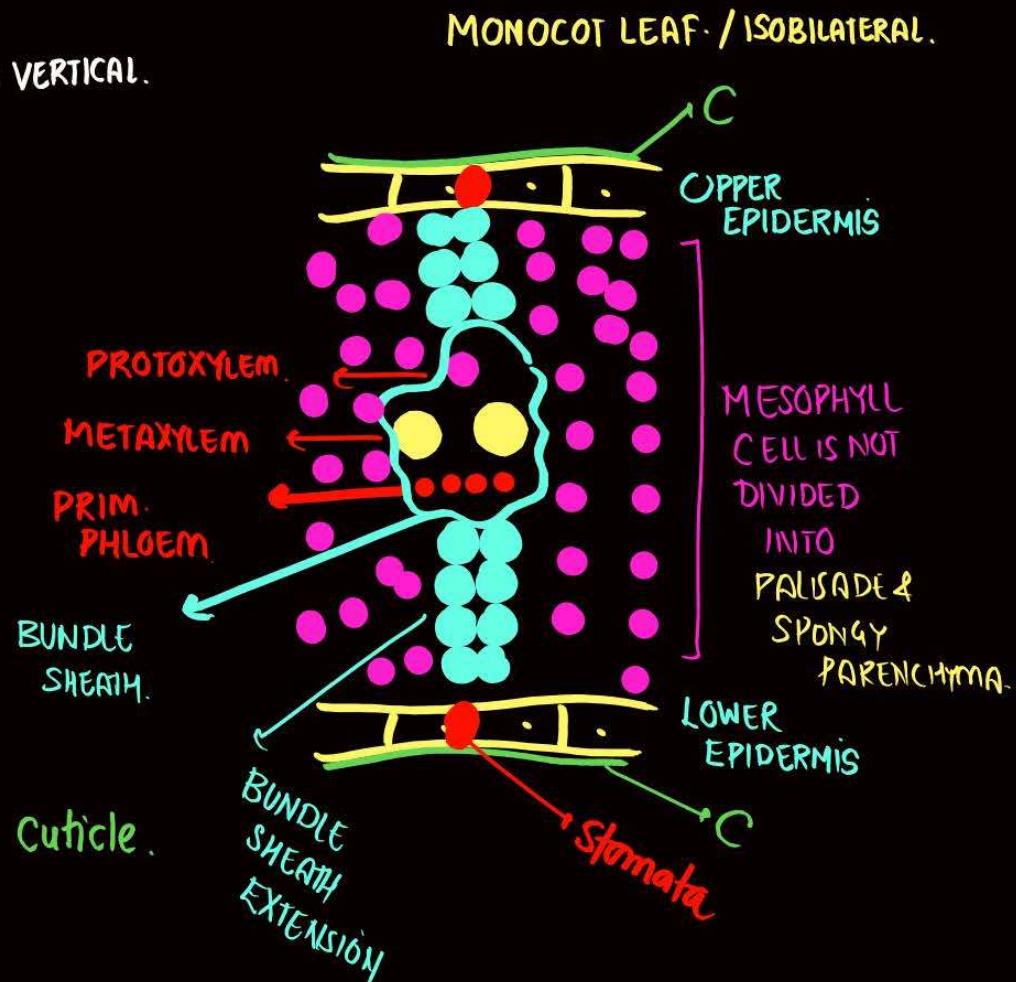
LEAF





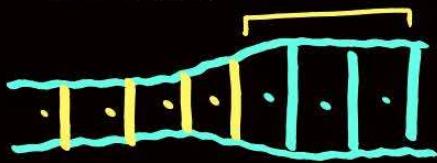


10 VERTICAL.



EXCEPT MIDRIB  
SIZE OF VASCULAR  
BUNDLE : EQUAL.

## BULLIFORM CELL (B.C.).



→ Monocot leaf

UPPER EPIDERMIS.

LARGE CELL, GROUP,  
COLOURLESS.,  
EMPTY

B.C.

$H_2O$  available → ✓ WATER SWELL (TURGID) EXPOSED.

$H_2O$  NOT AVAILABLE

✗ Shrink (FLACCID) CURL INWARD → SURFACE AREA DECREASE → TRANSPIRATION DECREASE

## QUESTION



(2024)

Bulliform cells are responsible for

- 1 Inward curling of leaves in monocots. ✓
- 2 Protecting the plant from salt stress. X
- 3 Increased photosynthesis in monocots. X
- 4 Providing large spaces for storage of sugars. X

## QUESTION

P  
W

GUARD CELL .

In the given figure, which component has thin outer walls and highly thickened inner walls?

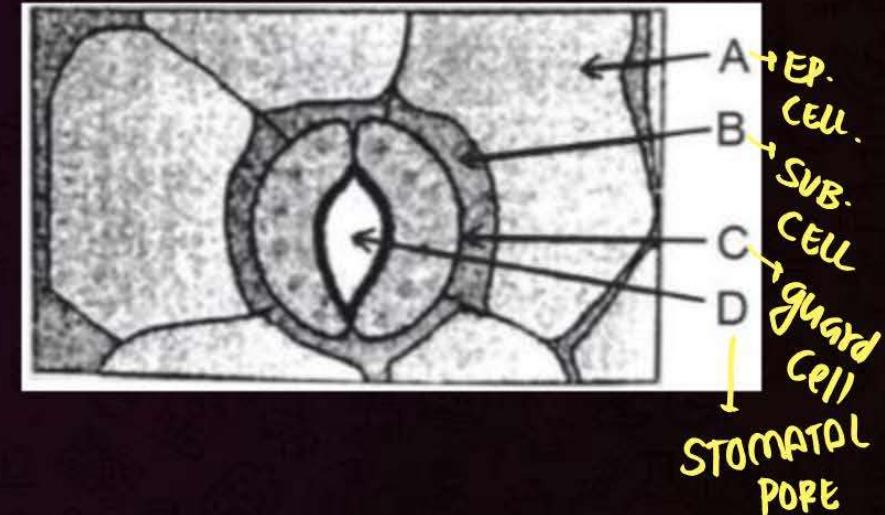
(2024)

1 C

2 D

3 A

4 B



## QUESTION



Formation of interfascicular cambium from fully developed parenchyma cells is an example for  
sec. meristem. (2024)

- 1 Differentiation
- 2 Redifferentiation
- 3 Dedifferentiation
- 4 Maturation

## QUESTION



LIVING.



**Statement I:** Parenchyma is living but collenchyma is ~~dead~~ tissue.

**Statement II:** Gymnosperms lack xylem vessels but presence of xylem vessels is the characteristic of angiosperms.

In the light of the above statements, choose the correct answer from the options given below:

(2024)

- 1** Both Statement I and Statement II are true
- 2** Both Statement I and Statement II are false
- 3** Statement I is true but Statement II is false
- 4** Statement I is false but Statement II is true

## QUESTION



Give below are two statements:

(2023)

**Statement I:** Endarch and exarch are the terms often used for describing the position of ~~secondary xylem~~ in the plant body.

~~PRIMARY XYLEM~~ ~~PROTO META~~

X

**Statement II:** Exarch condition is the most common feature of the root system.

In the light of the above statements, choose the correct answer from the options given below:

- 1** Statement I is incorrect but Statement II is true.
- 2** Both Statement I and Statement II are true.
- 3** Both Statement I and Statement II are false.
- 4** Statement I is correct but Statement II is false.

## QUESTION



The transverse section of plant part showed **polyarch**, **radial** and **exarch** xylem, with endodermis and pericycle. The plant is identified as: (2023)

more than six

ROOT

- 1 Monocot root
- 2 Dicot root
- 3 Dicot stem
- 4 Monocot stem

## QUESTION



Which of the following is NOT a character of collenchyma tissue?

(2022)

- 1 They provide mechanical support to the growing part of the plant C
- 2 They occur in layers below epidermis in dicotyledonous plants C
- 3 They consist of cells with thick corners due to cellulose deposition C
- 4 They are usually ~~dead~~<sup>LIVING</sup> and without ~~protoplasts~~ protoplasts ✓

## QUESTION



Initiation of lateral roots and vascular cambium during secondary growth takes place in cells of: (2022)

- 1 Epiblema X
- 2 Cortex X
- 3 Endodermis X
- 4 Pericycle ✓

## QUESTION



The type of tissue commonly found in the fruit wall of nuts is:

(2022)

- 1** Parenchyma
- 2** Collenchyma
- 3** Sclerenchyma
- 4** Sclereid



**QUESTION**

(2021)

Select the correct pair.

**1**

In dicot leaves, vascular bundles are surrounded by large thick-walled cells

~~Conjunctive tissue  
B.S.~~

**2**

Cells of medullary rays that form part of cambial rings

Interfascicular cambium

**3**

Loose parenchyma cells rupturing the epidermis and forming a lens-shaped opening in bark

~~Spongy parenchyma~~ <sup>Lenticel</sup>

(OUT OF  
NCERT)

**4**

Large colorless empty cells in the epidermis of grass leaves

~~Subsidiary cells~~ B.C.

## QUESTION



The transverse section of a plant shows following anatomical features:

(2020)

- A. Large number of scattered vascular bundles surrounded by bundle sheath.
- B. Large conspicuous parenchymatous ground tissue.
- C. Vascular bundles conjoint and closed. *stem* *monocot*
- D. Phloem parenchyma absent.

Identify the category of plant and its part:

- 1 Monocotyledonous root
- 2 Dicotyledonous stem
- 3 Dicotyledonous root
- 4 Monocotyledonous stem

## QUESTION



Large, empty colourless cells of the adaxial epidermis along the veins of grass leaves are  
(2020 Covid)

- 1** Guard cells
- 2** Bundle sheath cells
- 3** Bulliform cells
- 4** Lenticels

## QUESTION



Which of the following statements about cork cambium is incorrect?

(2020 Covid)

- 1** It forms a part of periderm
- 2** It is responsible for the formation of lenticels
- 3** It is a couple of layers thick
- 4** It forms secondary cortex on its outer side

## QUESTION



Grass leaves curl inwards during very dry weather. Select the most appropriate reason from the following (2019)

- 1 Closure of stomata
- 2 Flaccidity of bulliform cells
- 3 Shrinkage of air spaces in spongy mesophyll
- 4 Tyloses in vessels

## QUESTION



(2019)

Phloem in gymnosperms lacks

- 1** Albuminous cells and sieve cells
- 2** Sieve tubes only
- 3** Companion cells only
- 4** Both sieve tubes and companion cells

## QUESTION



(2018)

Secondary xylem and phloem in dicot stem are produced by

- 1 Apical meristem
- 2 Vascular cambium (Intra+inter) ✓
- 3 Phellogen
- 4 Axillary meristems

## QUESTION



(2018)

Casparian strips occur in

- 1 Epidermis
- 2 Pericycle
- 3 Cortex
- 4 Endodermis

## QUESTION



(2018)

Plants having little or no secondary growth are

1 Grasses / monocot

2 Deciduous angiosperms ✓

3 Conifers ↗ gymnospern ✓

4 Cycads ↗

absent  
monocot

## QUESTION



(2018)

Stomata in grass leaf are: (monocot).

- 1 Dumb-bell shaped
- 2 Kidney shaped
- 3 Rectangular
- 4 Barrel shaped

## QUESTION



Which of the following statements is true for phloem in plants?

(2017-Gujarat)

- 1 Phloem fibres are made up of ~~collenchymatous~~ <sup>Sclerenchyma</sup> cells
- 2 Sieve tube elements are multicellular with wide lumen and ~~rich~~ <sup>thin (periphery)</sup> cytoplasm
- 3 Companion cells help in maintaining the pressure gradient in sieve tubes
- 4 Phloem parenchyma is abundantly ~~present~~ <sup>absent</sup> in monocots

## QUESTION



Specialised epidermal cells surrounding the guard cells are called

(2016-I)

- 1 Complementary cells
- 2 Subsidiary cells
- 3 Bulliform cells
- 4 Lenticels



## QUESTION



Vascular bundles in monocotyledons are considered closed because:

- 1 There are no vessels with perforations
- 2 Xylem is surrounded all around by phloem
- 3 A bundle sheath surrounds each bundle
- 4 Cambium is absent

(2015)

## QUESTION



(2013)

Interfascicular cambium develops from the cells of:

- 1 Pericycle
- 2 Medullary rays / pith Rays ✓
- 3 Xylem parenchyma
- 4 Endodermis