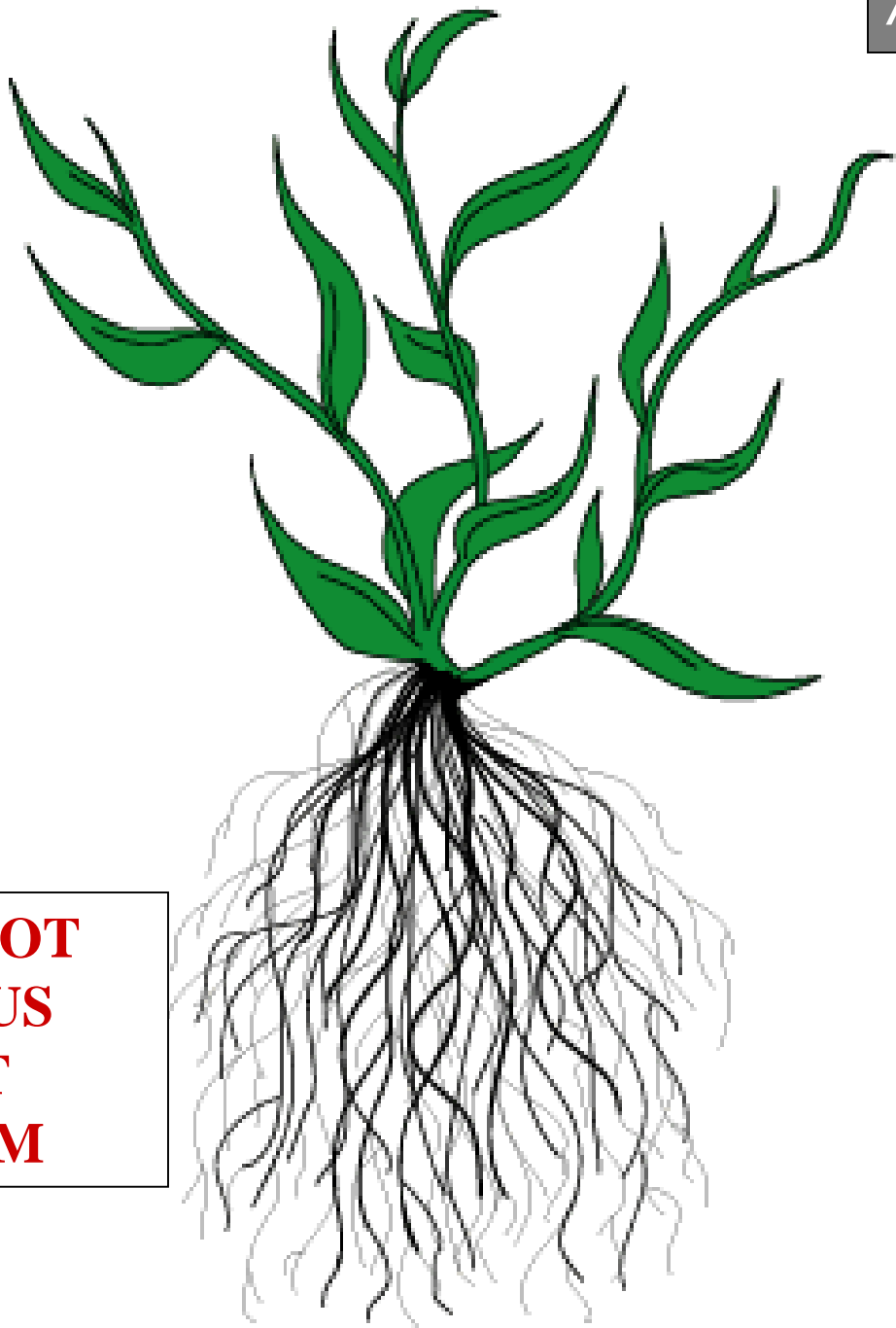


**DICOT  
TAP  
ROOT  
SYSTEM**



**MONOCOT  
FIBROUS  
ROOT  
SYSTEM**



**TAP ROOT  
SYSTEM  
VS  
FIBROUS ROOT  
SYSTEM**

# TAP ROOT SYSTEM

# **TAP ROOT SYSTEM**

**ROOT  
MORPHOLOGY  
TAP-ROOT SYSTEM**



**ASSOCIATED WITH DICOTS**

**ROOT  
MORPHOLOGY  
TAP-ROOT SYSTEM**



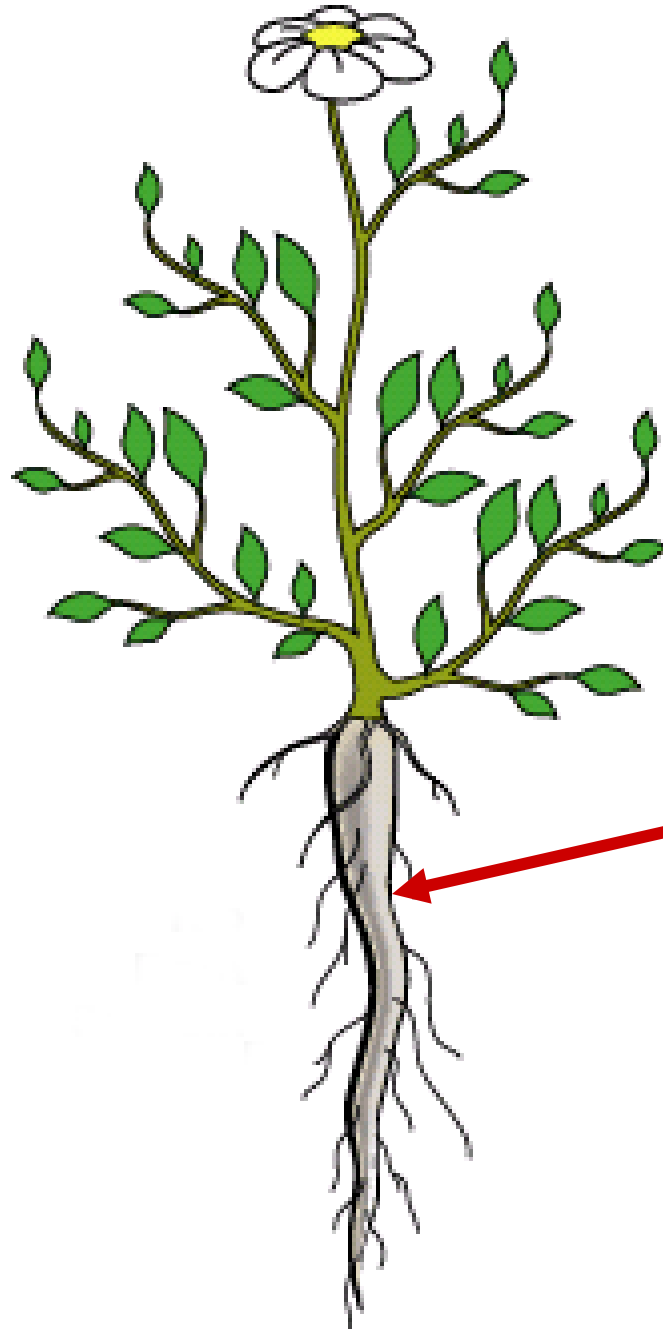
# DICOTS



**DICOT  
ROOT**

**TAP  
ROOT  
SYSTEM**

**SL**

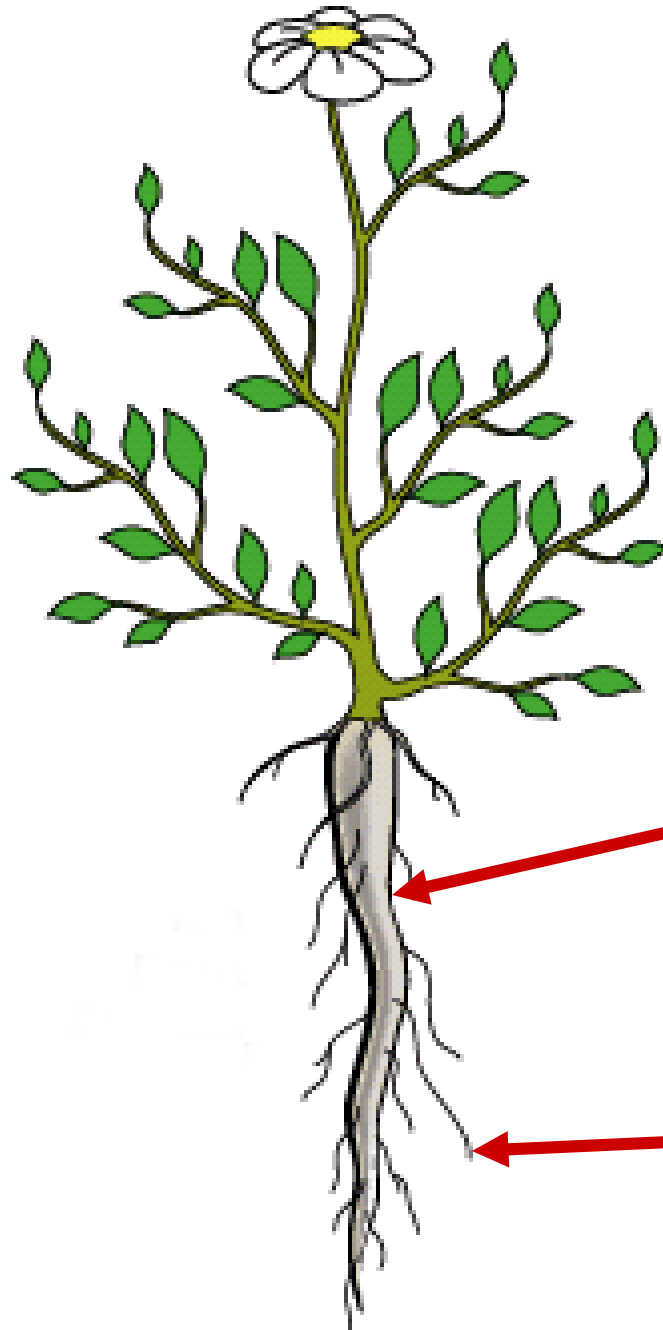


**PRIMARY  
ROOT  
PRESENT**

**DICOT  
ROOT**

**TAP  
ROOT  
SYSTEM**

**DS**



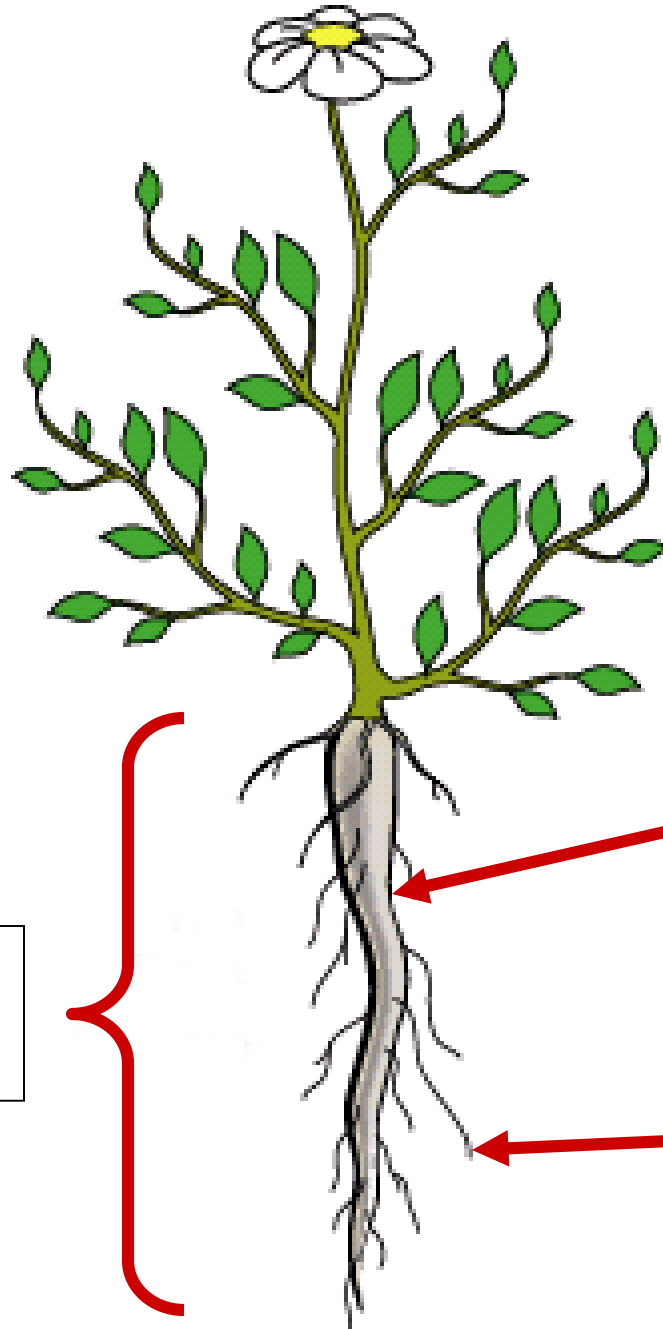
**PRIMARY  
ROOT  
PRESENT**

**STOUT  
LATERAL  
ROOTS  
PRESENT**



**DICOT  
ROOT**

**TAP  
ROOT  
SYSTEM**



**DEEP SOIL  
PENETRATION**

**PRIMARY  
ROOT  
PRESENT**

**STOUT  
LATERAL  
ROOTS  
PRESENT**



# **FIBROUS ROOT SYSTEM**

# **FIBROUS ROOT SYSTEM**

**ROOT  
MORPHOLOGY  
FIBROUS-ROOT SYSTEM**



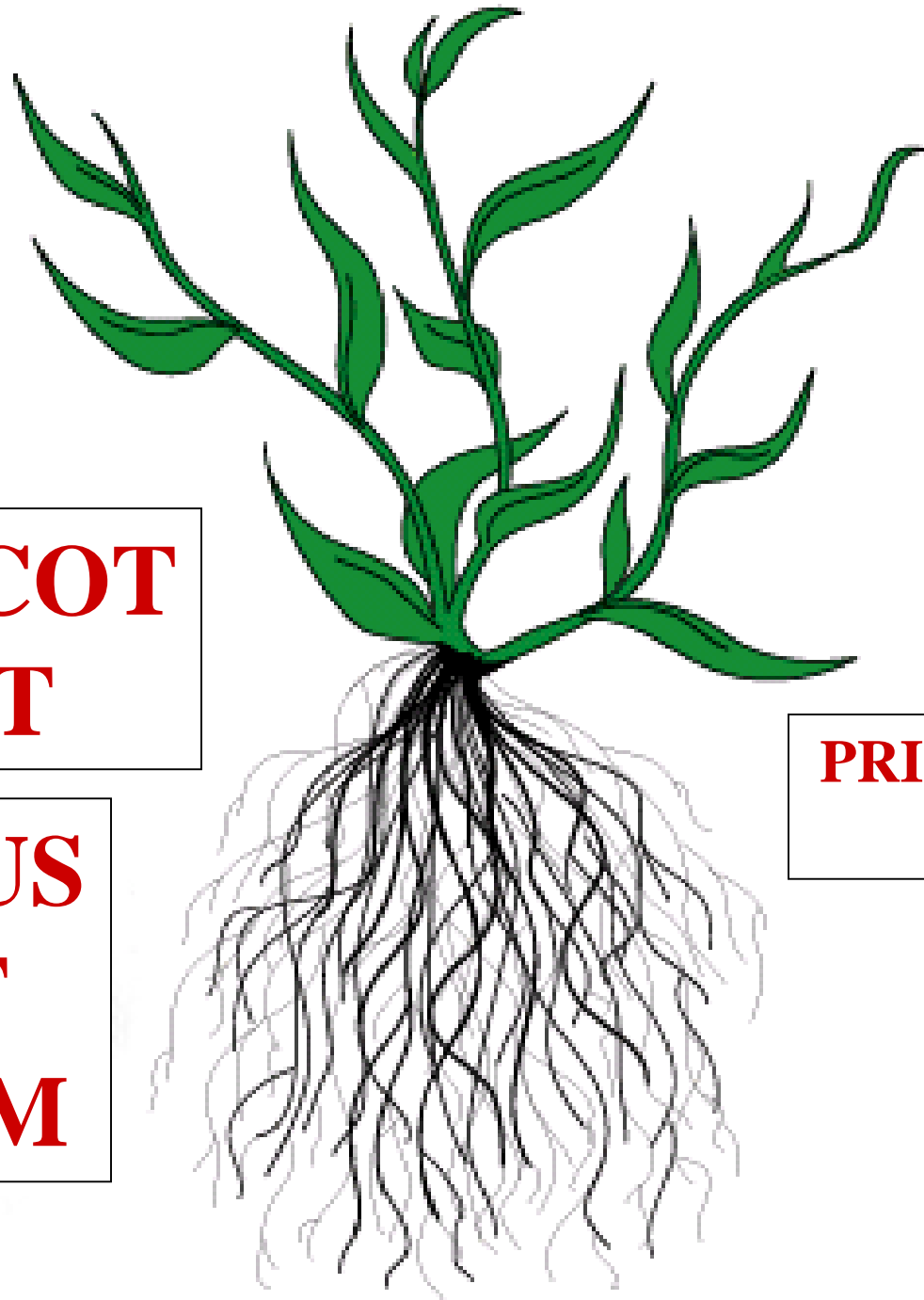
**ASSOCIATED WITH MONOCOTS**

**ROOT  
MORPHOLOGY  
FIBROUS-ROOT SYSTEM**



# MONOCOTS

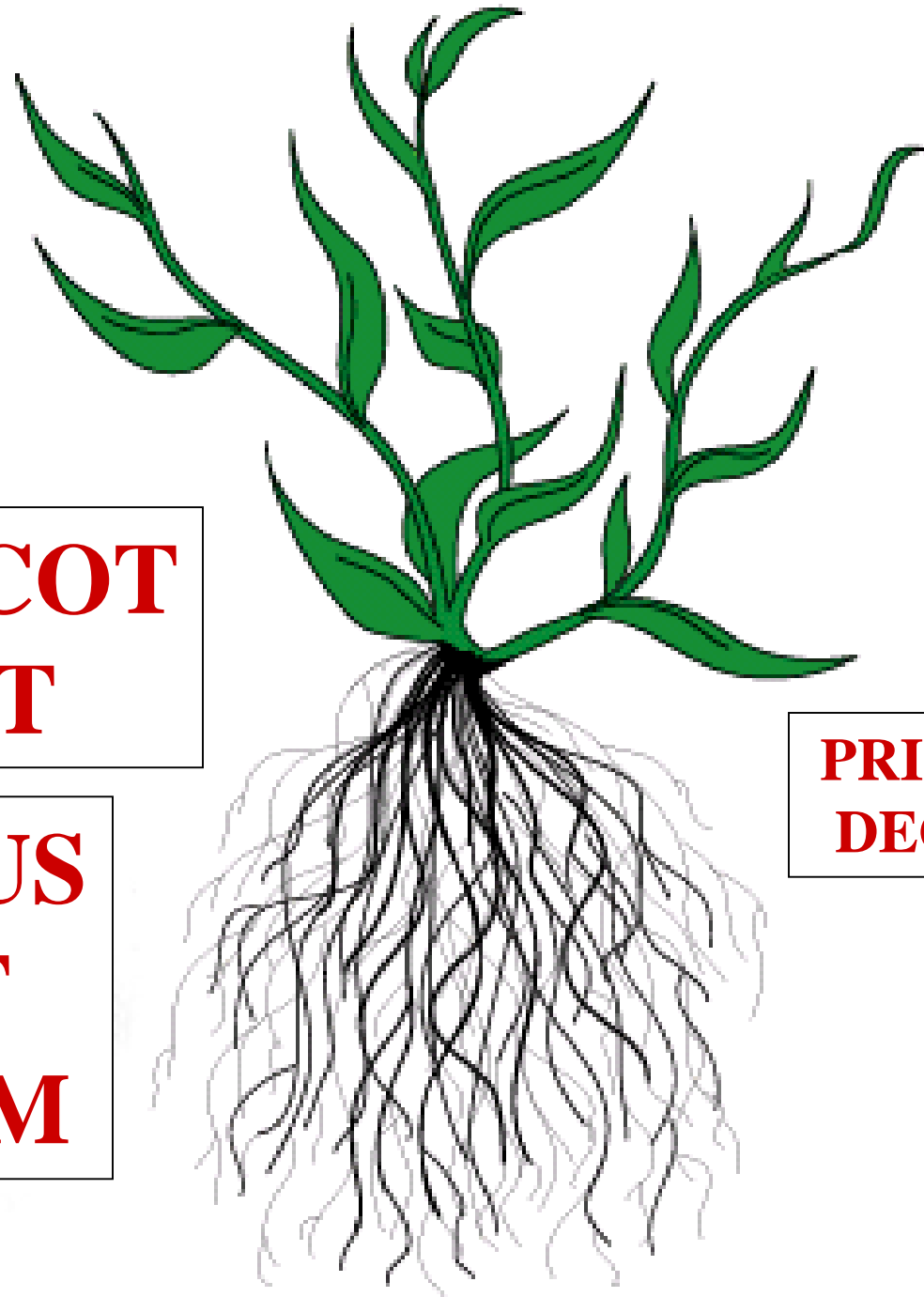




**MONOCOT  
ROOT**

**FIBROUS  
ROOT  
SYSTEM**

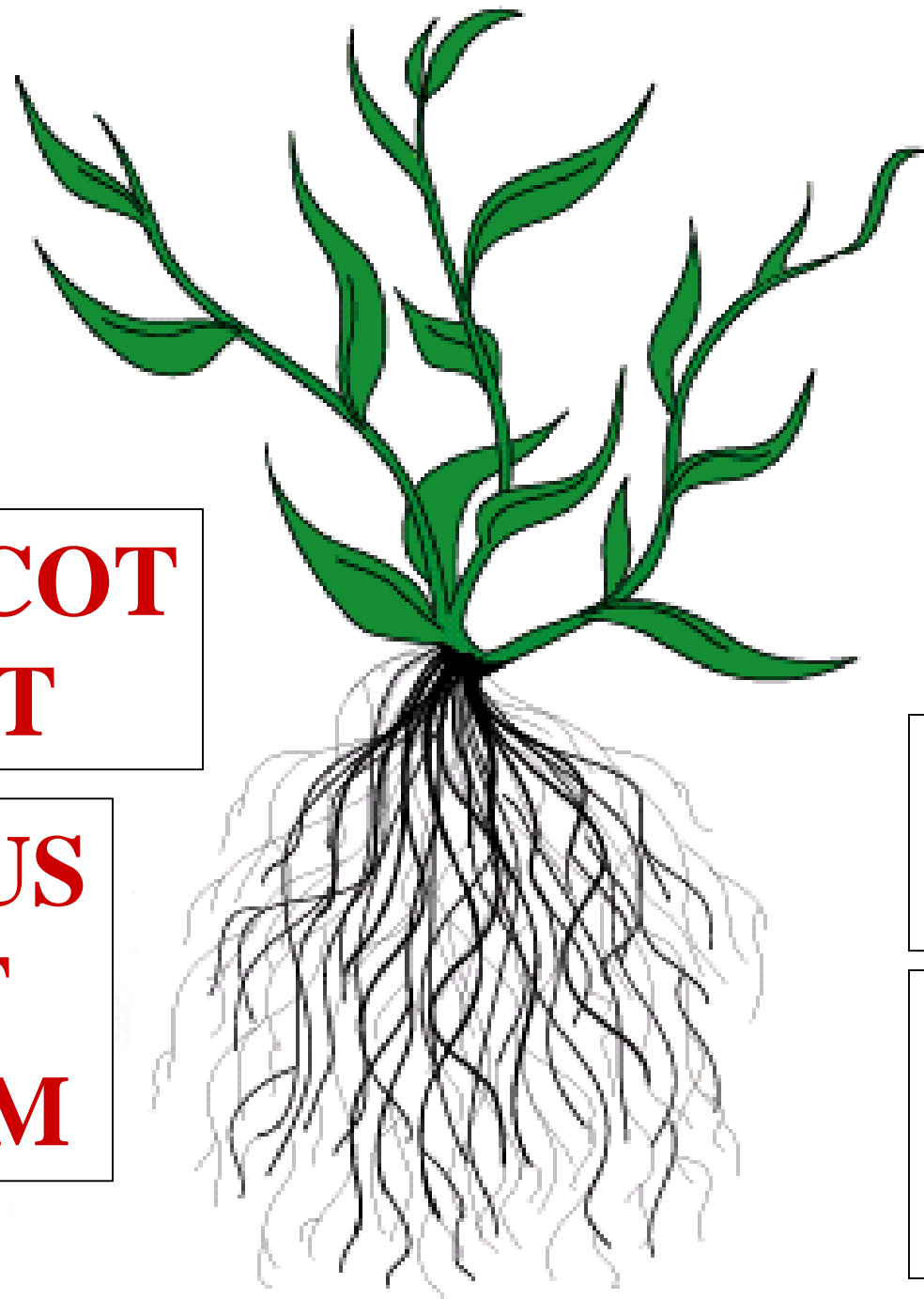
**PRIMARY ROOT  
ABSENT**



**MONOCOT  
ROOT**

**FIBROUS  
ROOT  
SYSTEM**

**PRIMARY ROOT  
DEGENERATES**



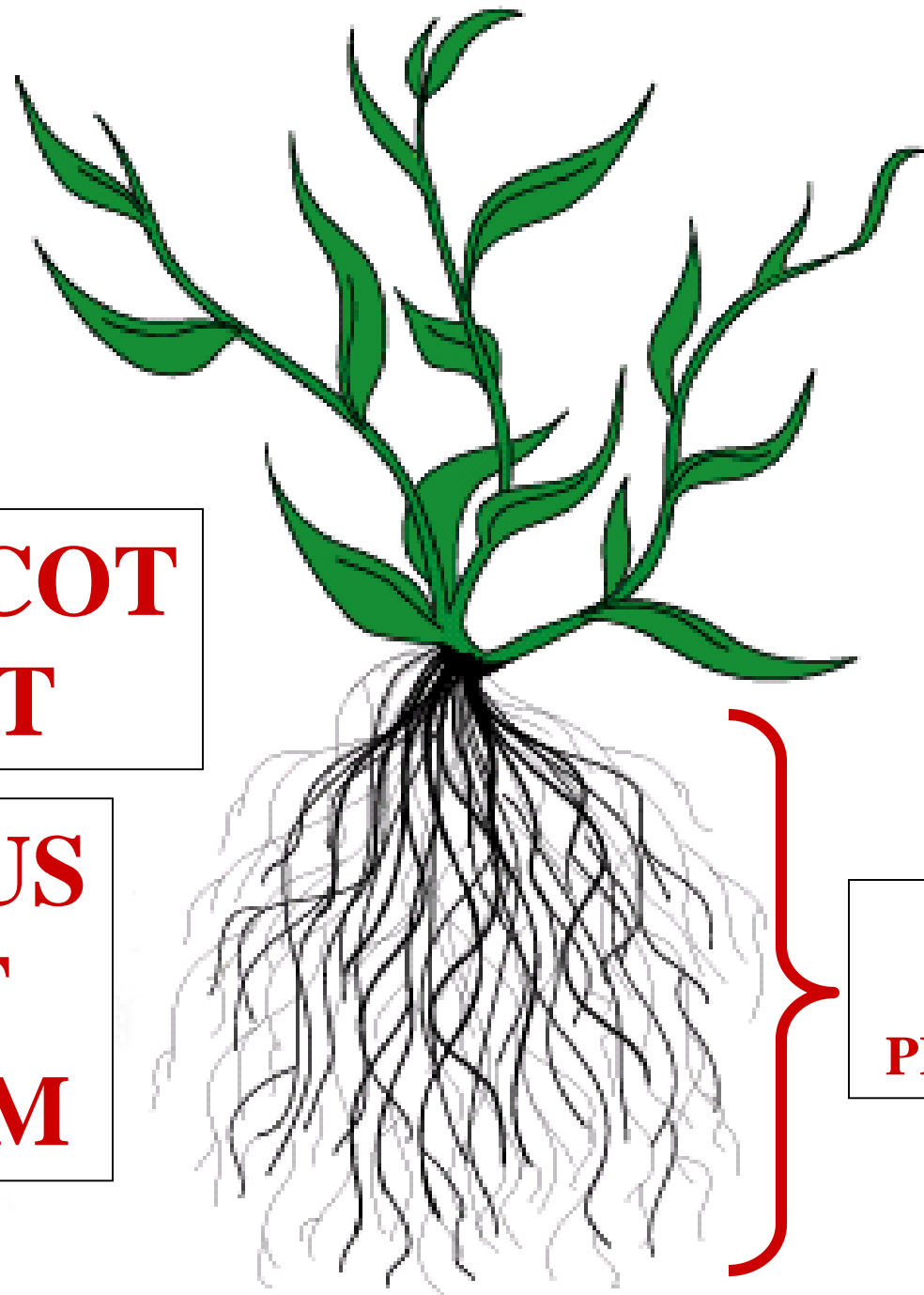
**MONOCOT  
ROOT**

**FIBROUS  
ROOT  
SYSTEM**

**PRIMARY  
ROOT  
ABSENT**

**STOUT  
LATERAL  
ROOTS  
ABSENT**

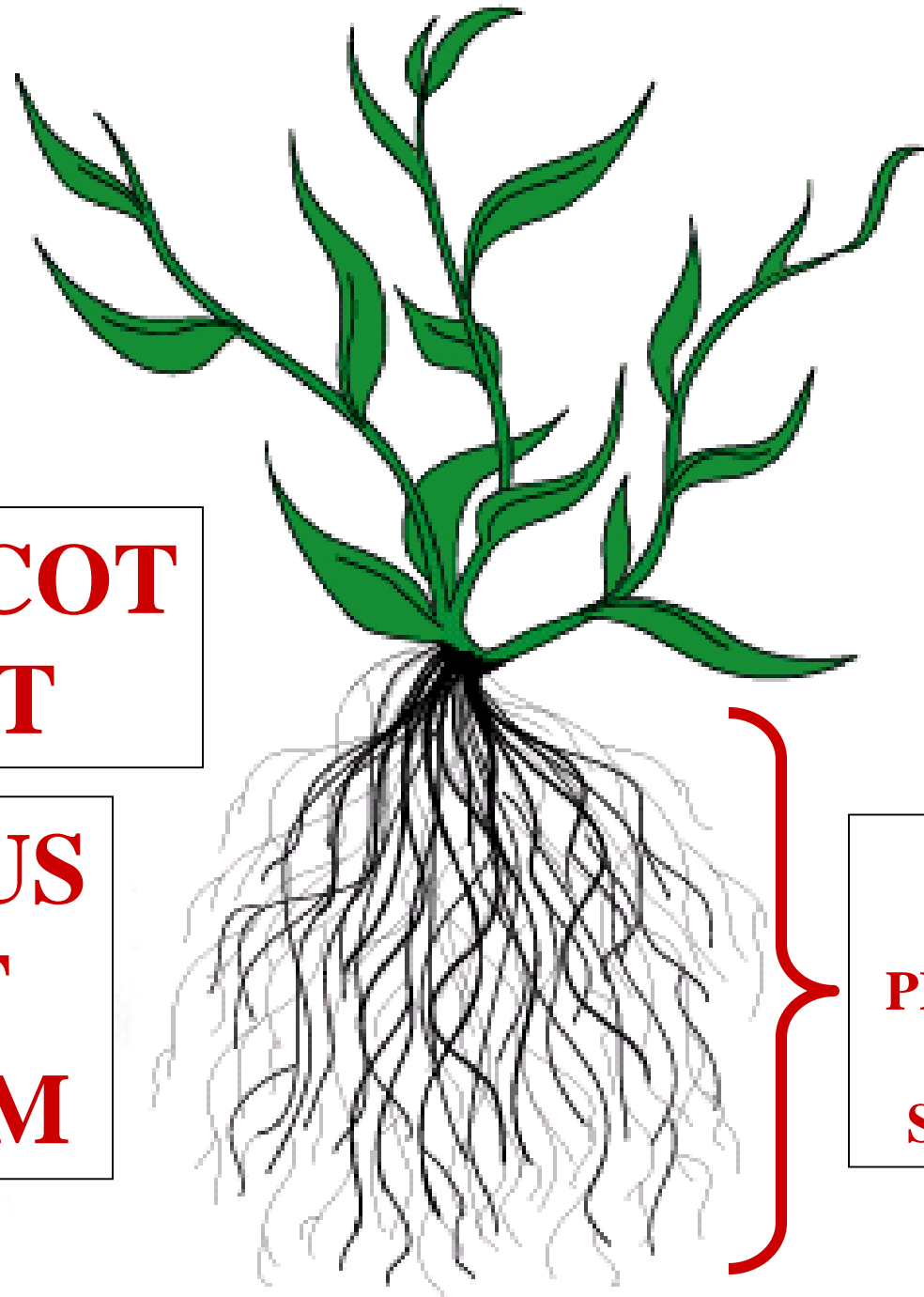




**MONOCOT  
ROOT**

**FIBROUS  
ROOT  
SYSTEM**

**SHALLOW  
SOIL  
PENETRATION**



**MONOCOT  
ROOT**

**FIBROUS  
ROOT  
SYSTEM**

**SHALLOW  
SOIL  
PENETRATION  
PREVENTS  
SOIL EROSION**

# MONOCOT: GRASS



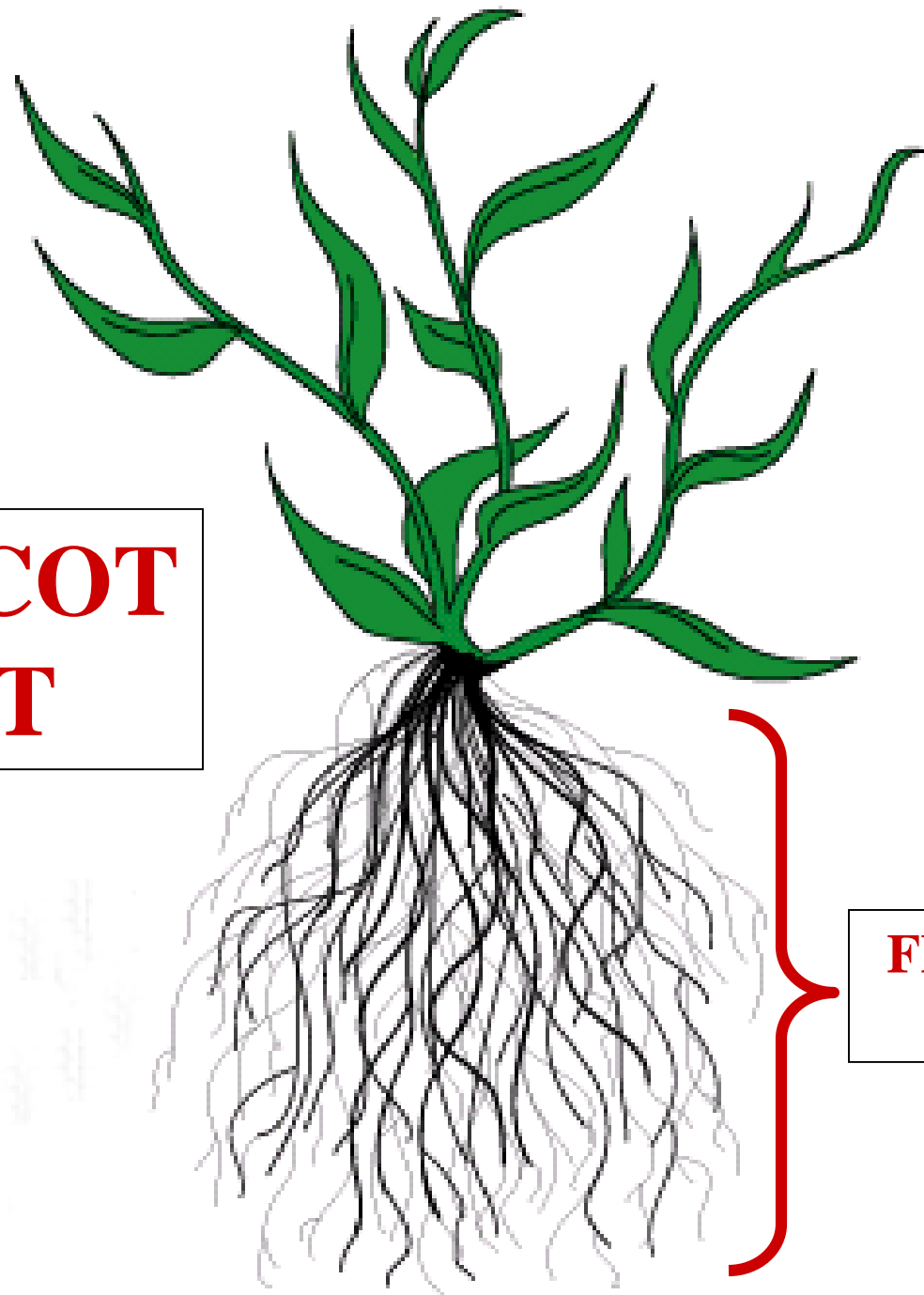
**FIBROUS ROOT SYSTEM**

**PREVENTS SOIL EROSION**

# MONOCOT: GRASS

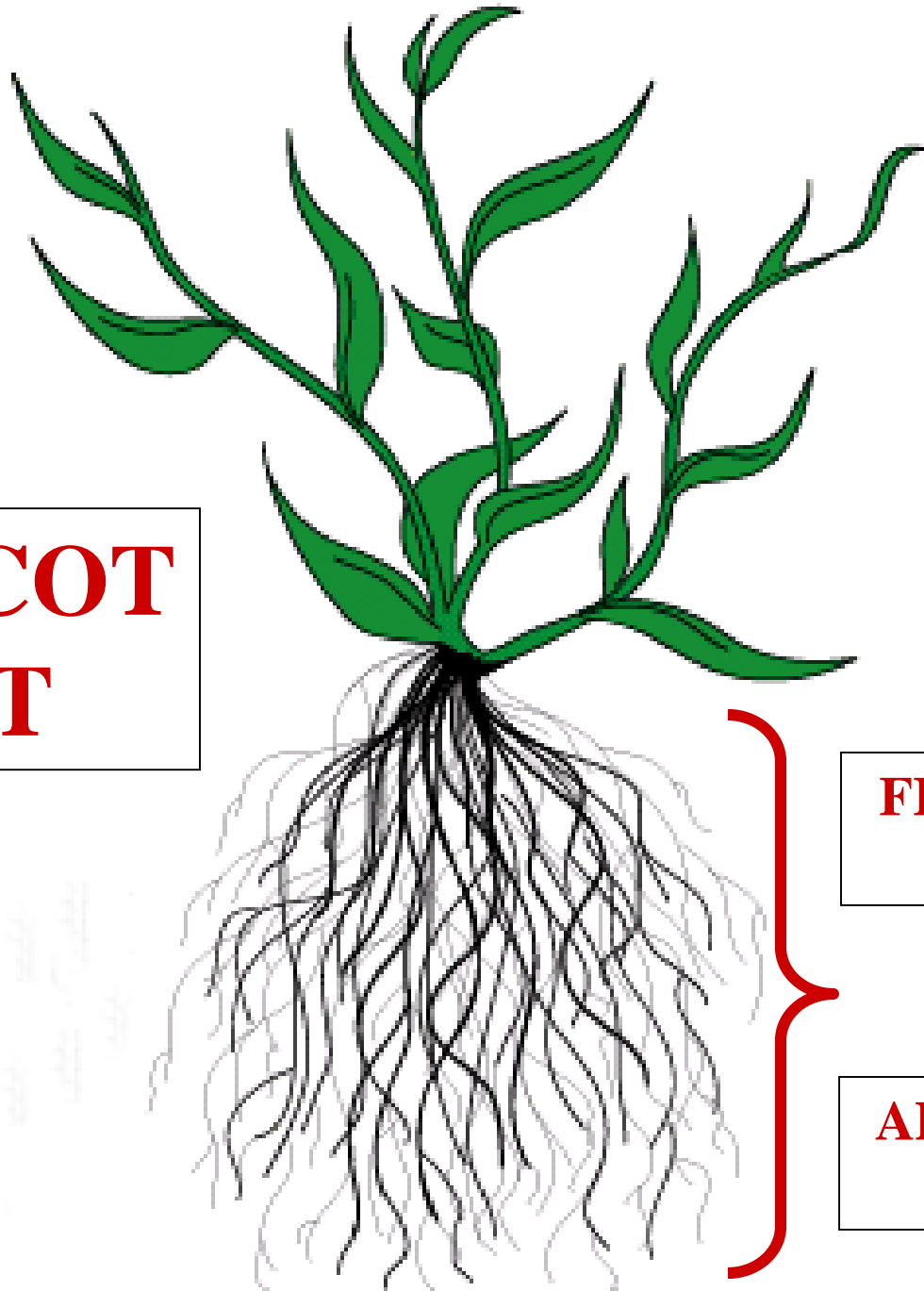


**FIBROUS ROOT SYSTEM**  
**PREVENTS SOIL EROSION**



**MONOCOT  
ROOT**

**FIBROUS ROOT  
SYSTEM**



**MONOCOT  
ROOT**

**FIBROUS ROOT  
SYSTEM**

**ADVENTITIOUS  
ROOTS**

# ADVENTITIOUS ROOTS

**ADVENTITIOUS  
ROOT**

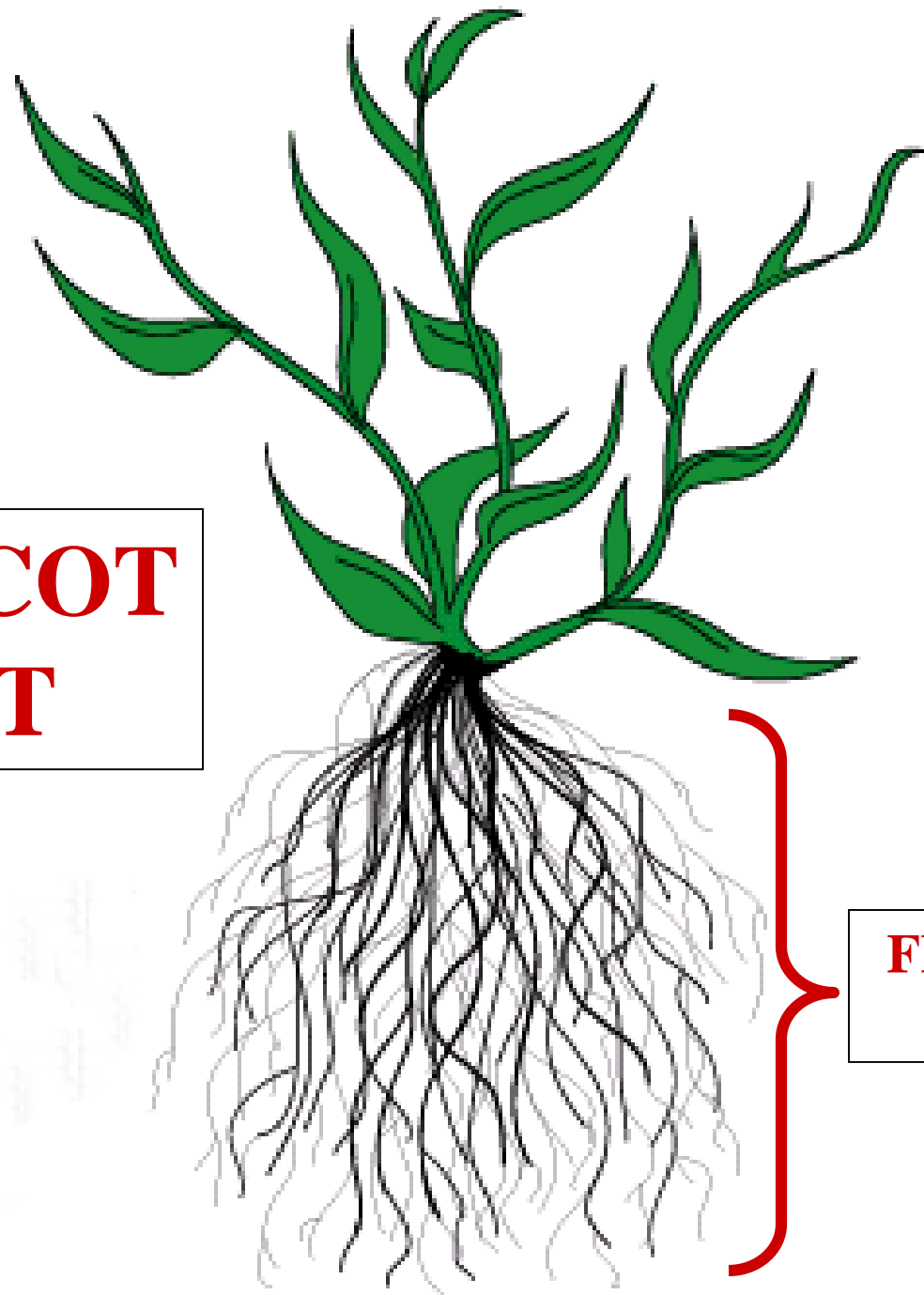




**FIBROUS-ROOT SYSTEM  
ADVENTITIOUS ROOT**

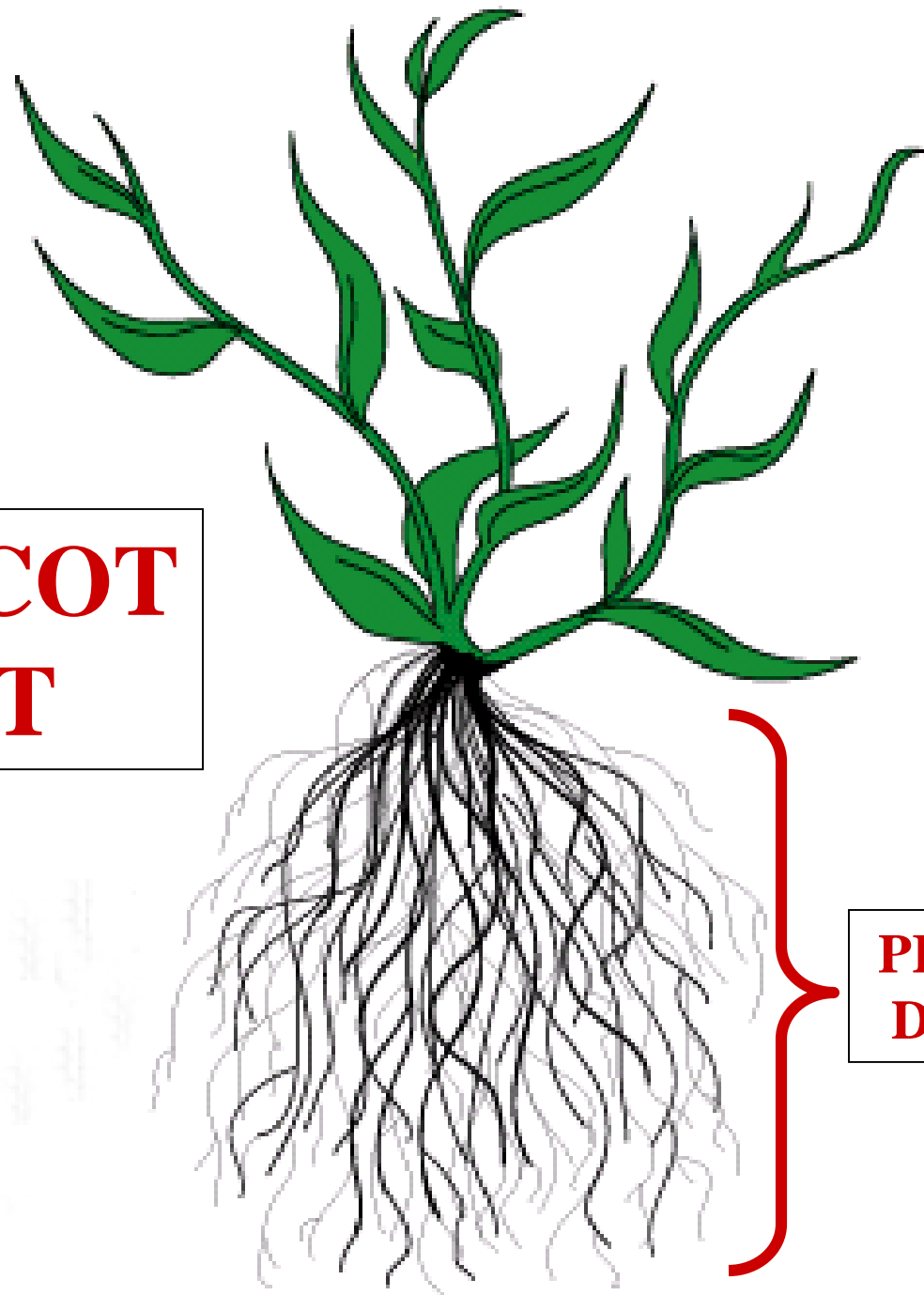
**NON-EMBRYONIC ROOT  
DERIVED FROM  
STEM OR LEAF**

**FIBROUS-ROOT SYSTEM  
ADVENTITIOUS ROOT**



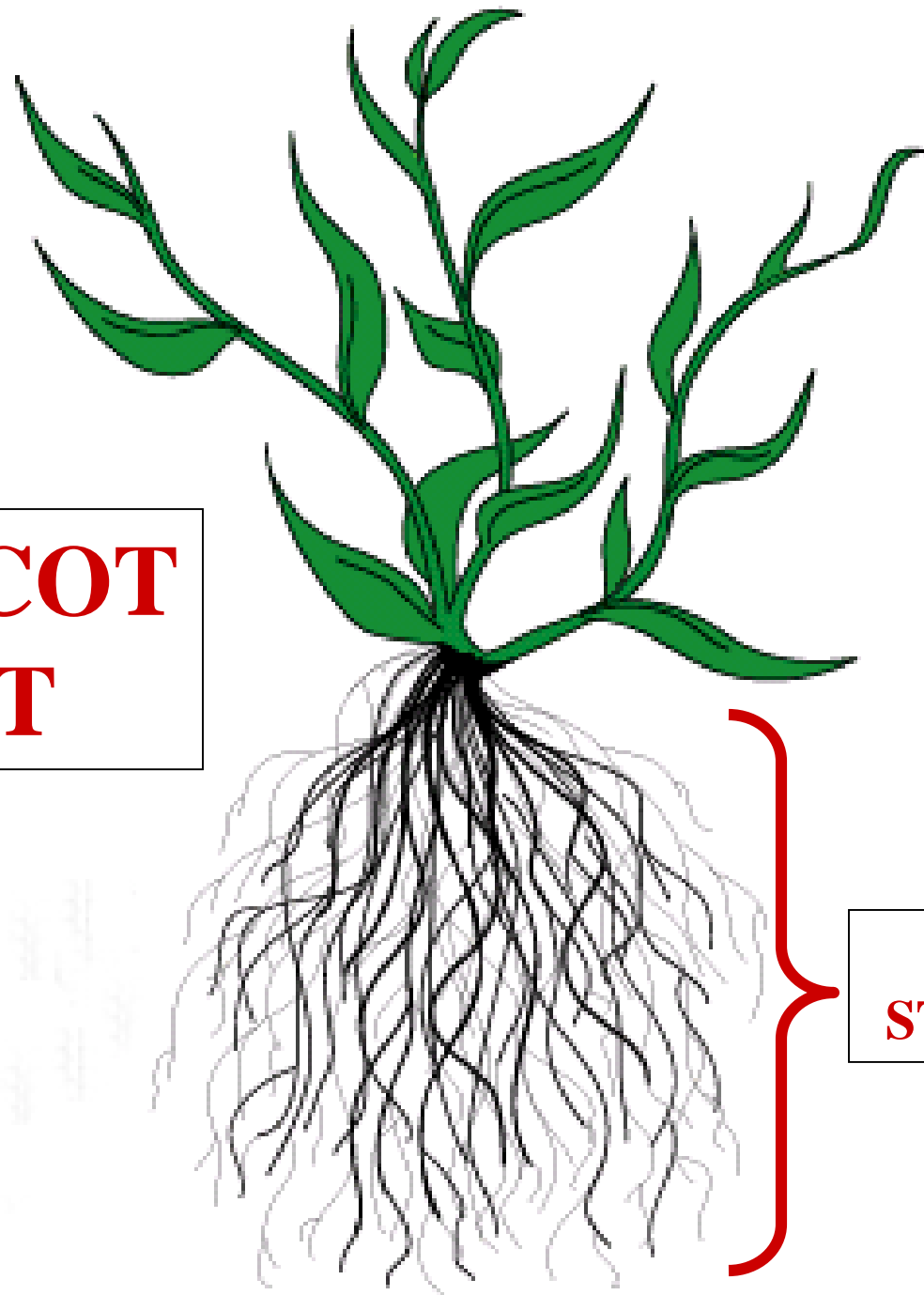
**MONOCOT  
ROOT**

**FIBROUS ROOT  
SYSTEM**



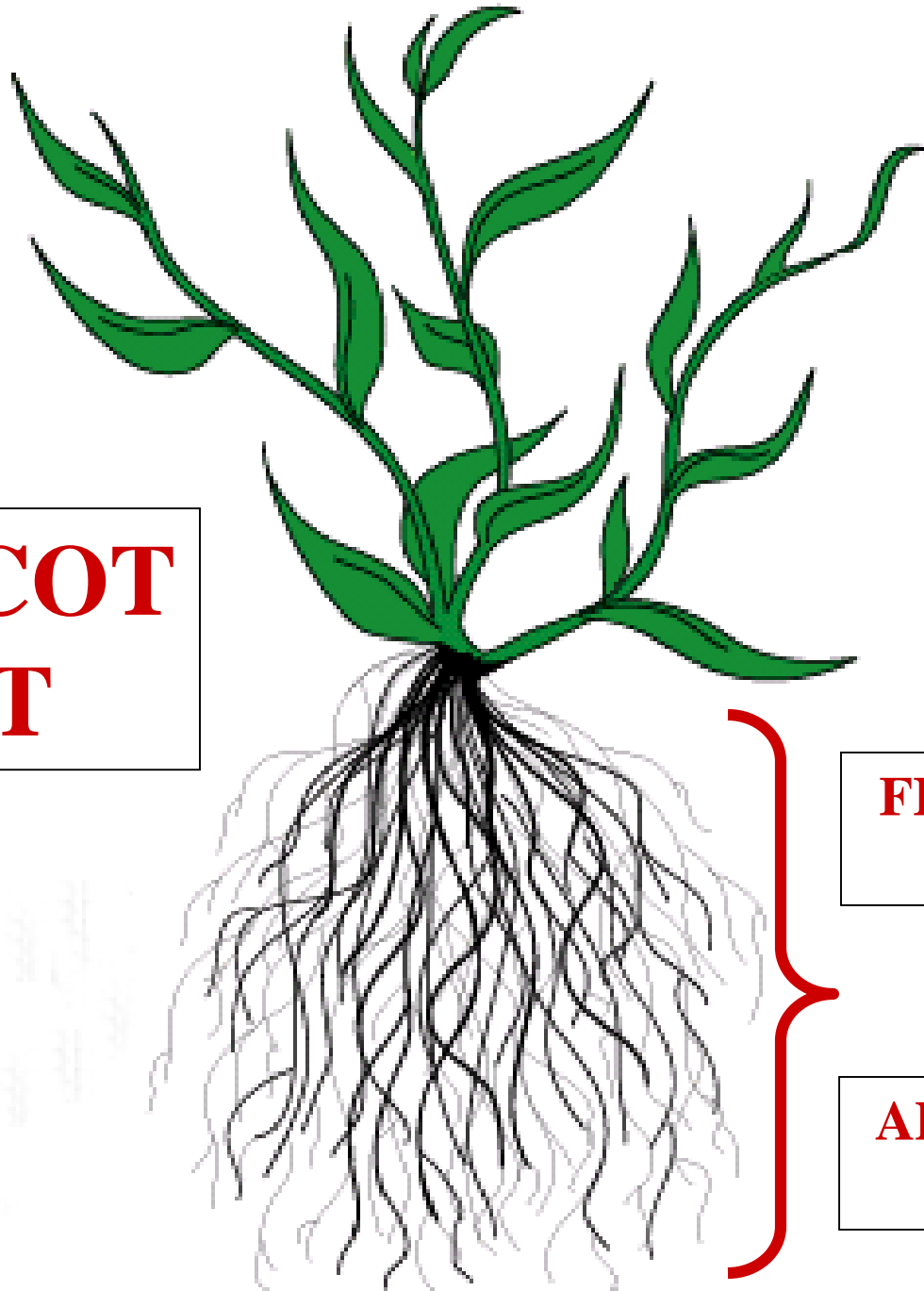
**MONOCOT  
ROOT**

**PRIMARY ROOT  
DEGENERATES**



**MONOCOT  
ROOT**

**ROOTS  
STEM DERIVED**



**MONOCOT  
ROOT**

**FIBROUS ROOT  
SYSTEM**

**ADVENTITIOUS  
ROOTS**

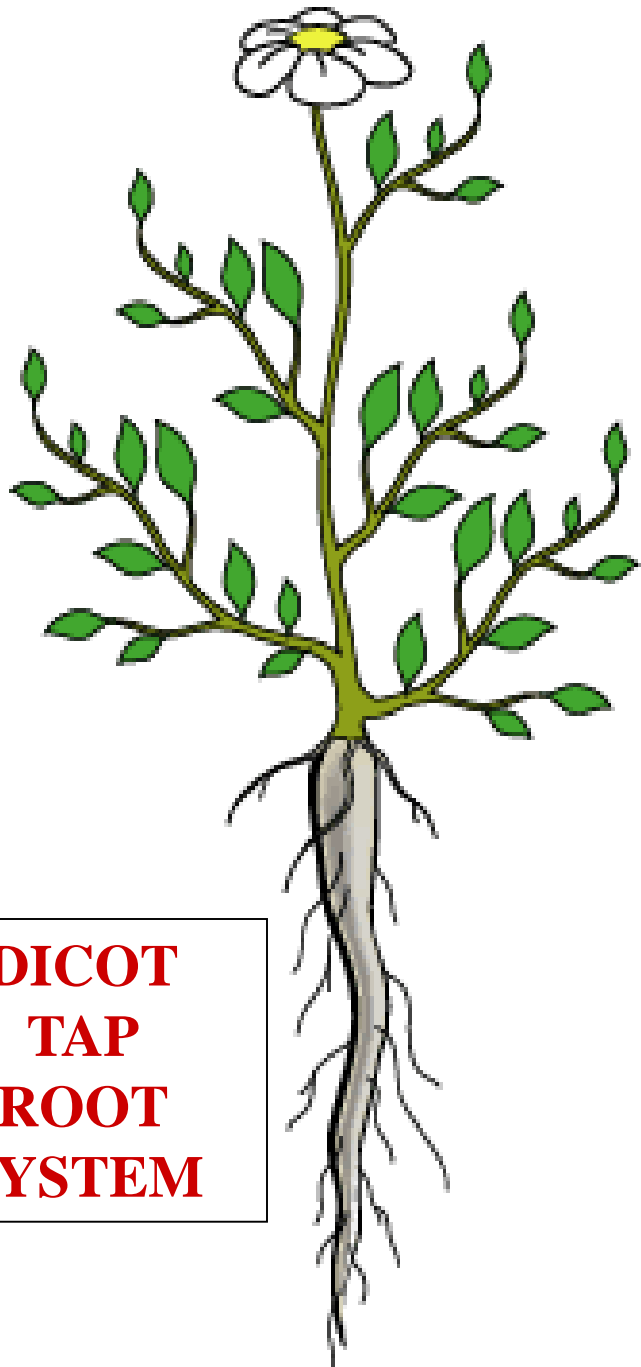


**DICOT ROOT  
MORPHOLOGY  
VS  
MONOCOT ROOT  
MORPHOLOGY  
SUMMARY**



# DICOTS





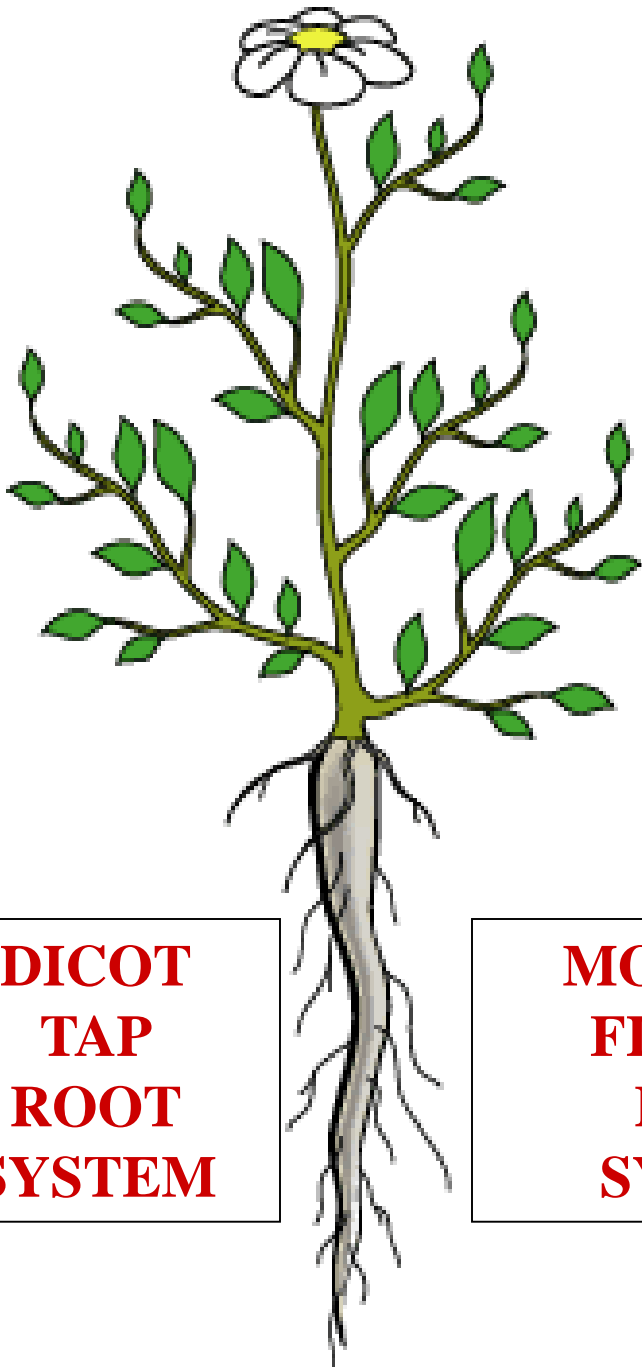
**DICOT  
TAP  
ROOT  
SYSTEM**



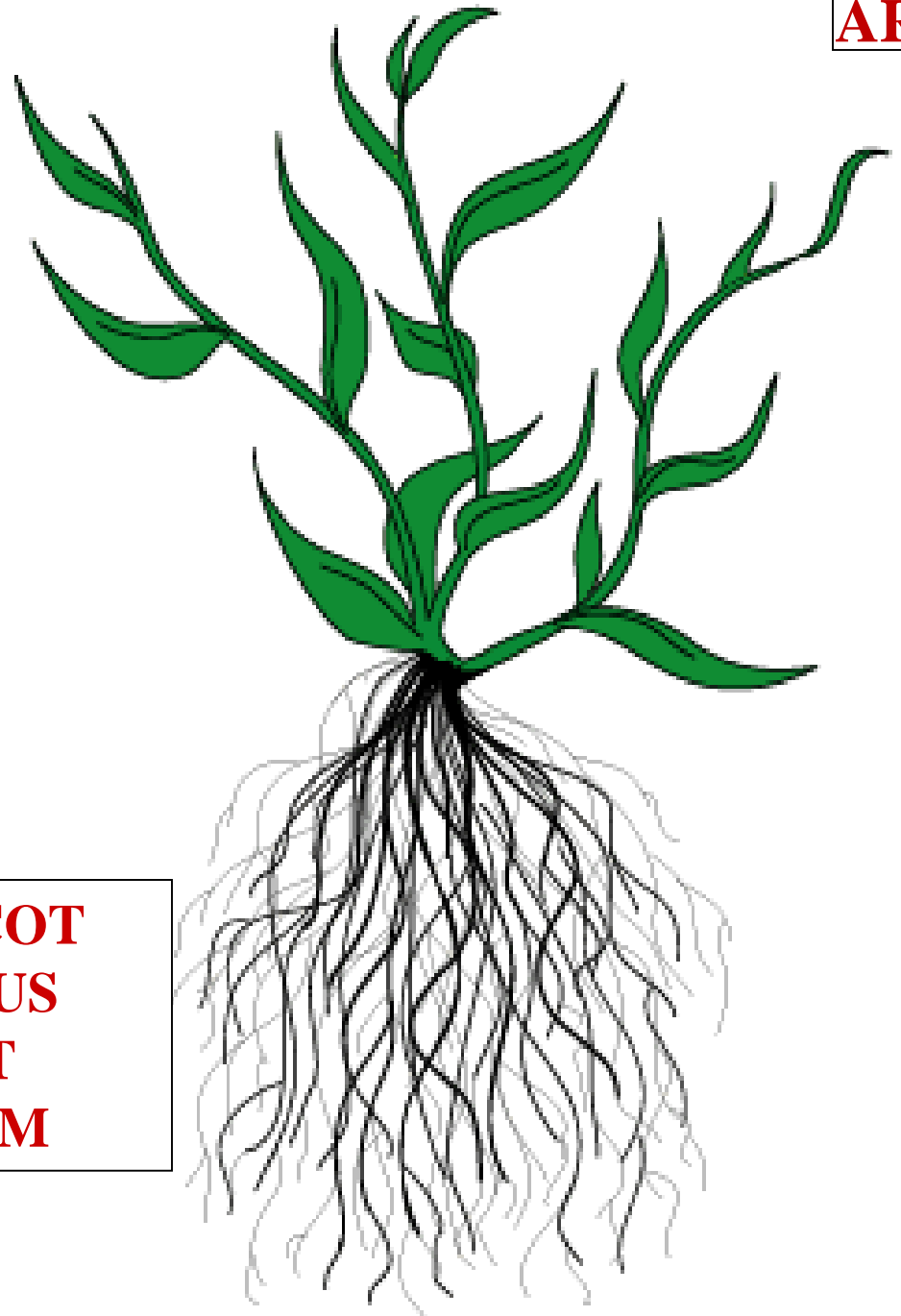


# MONOCOTS

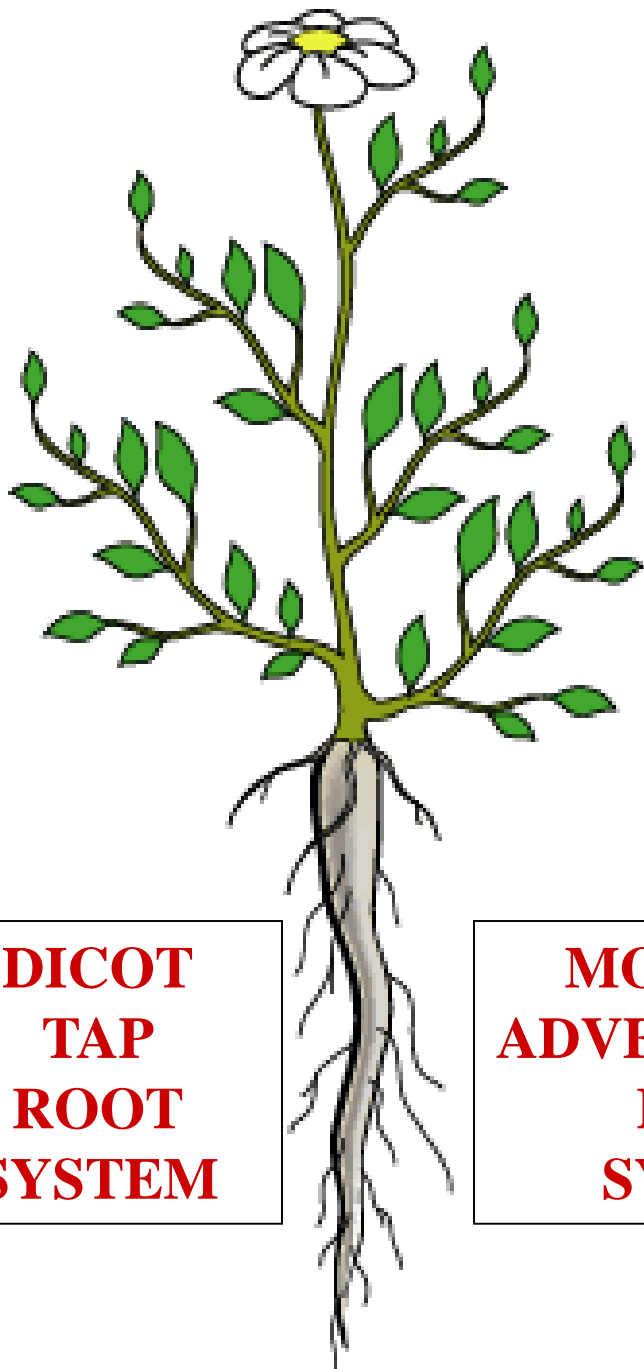




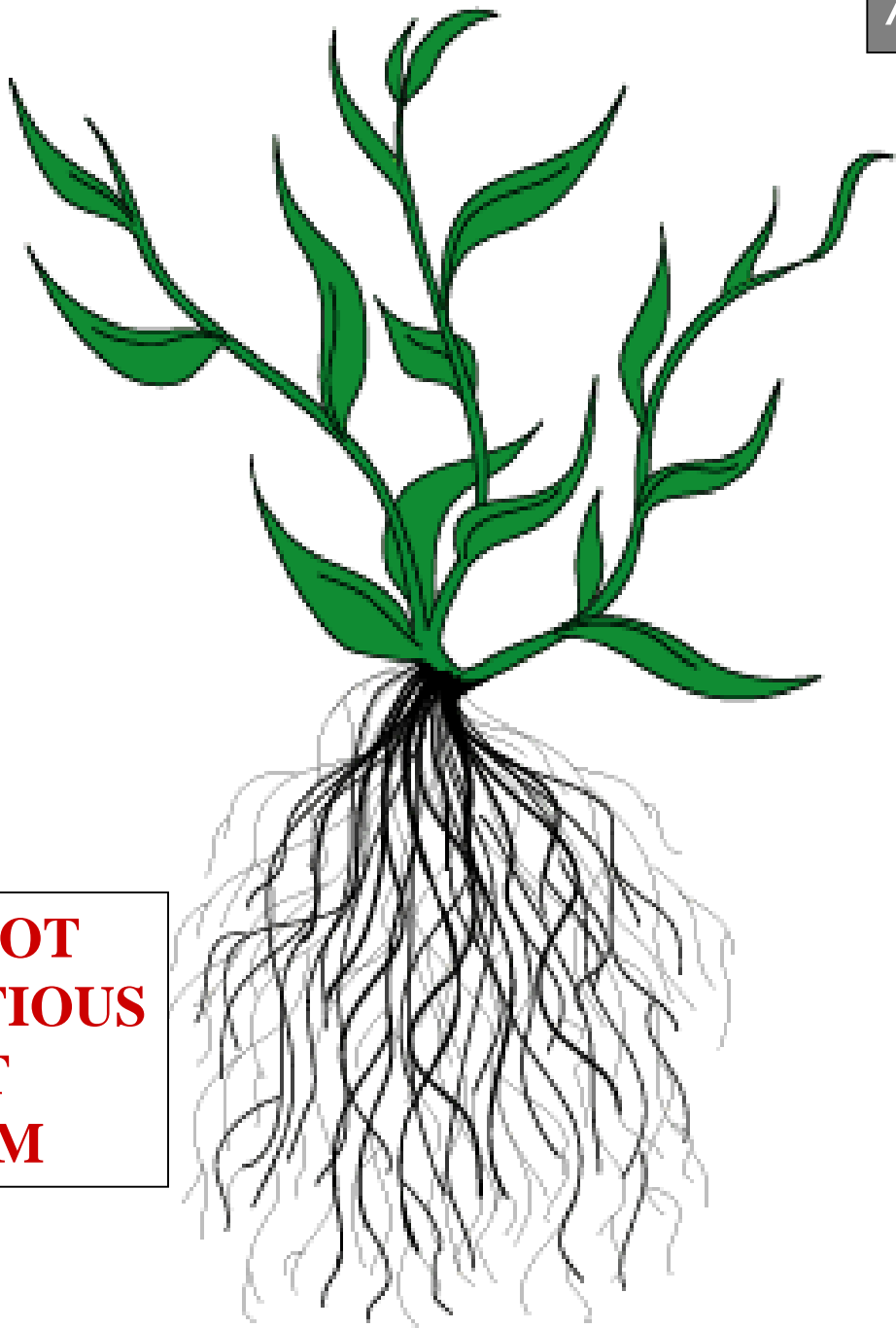
**DICOT  
TAP  
ROOT  
SYSTEM**



**MONOCOT  
FIBROUS  
ROOT  
SYSTEM**



**DICOT  
TAP  
ROOT  
SYSTEM**



**MONOCOT  
ADVENTITIOUS  
ROOT  
SYSTEM**



# ROOT ANATOMY

# ROOT CAP

**ROOT CAP**



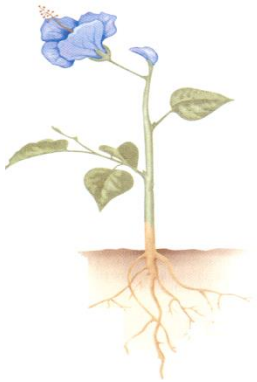
**ROOT  
ANATOMY  
ROOT CAP**

**PROTECTS ROOT  
APICAL MERISTEM**

**ROOT  
ANATOMY  
ROOT CAP**

**ROOT**

**L.S**



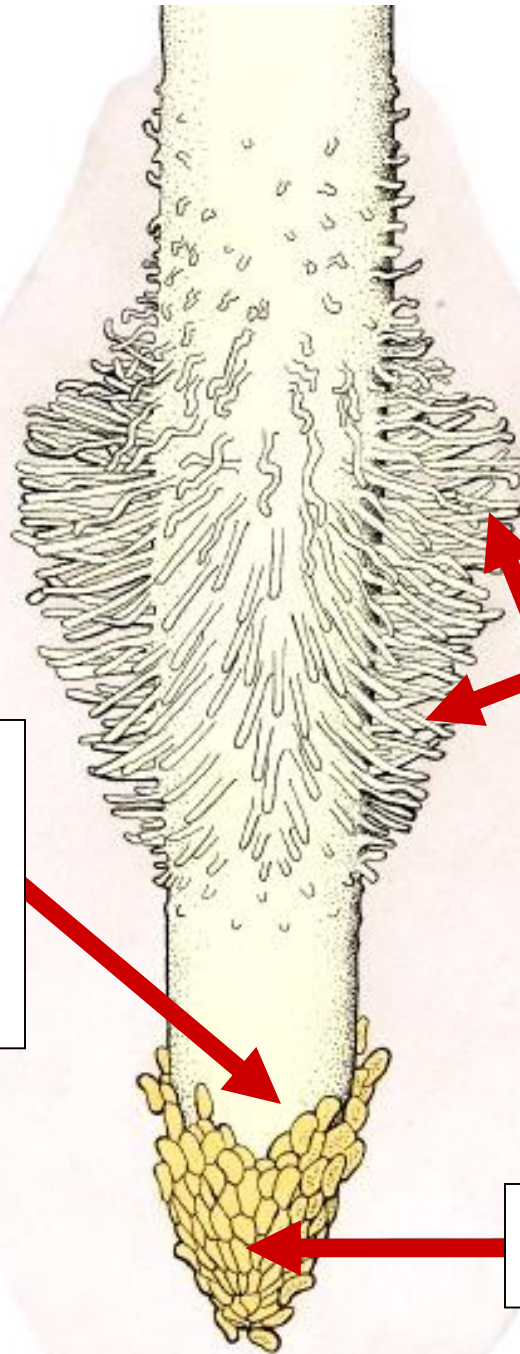
**TYPICAL  
ANGIOSPERM**

**+G**

**ROOT  
APICAL  
MERISTEM**

**ROOT HAIRS**

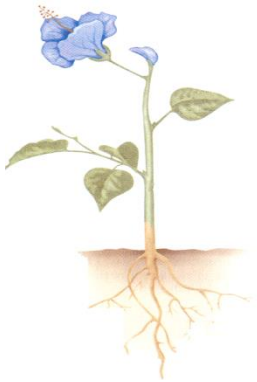
**ROOT CAP**





**ROOT**

**L.S**



**TYPICAL  
ANGIOSPERM**

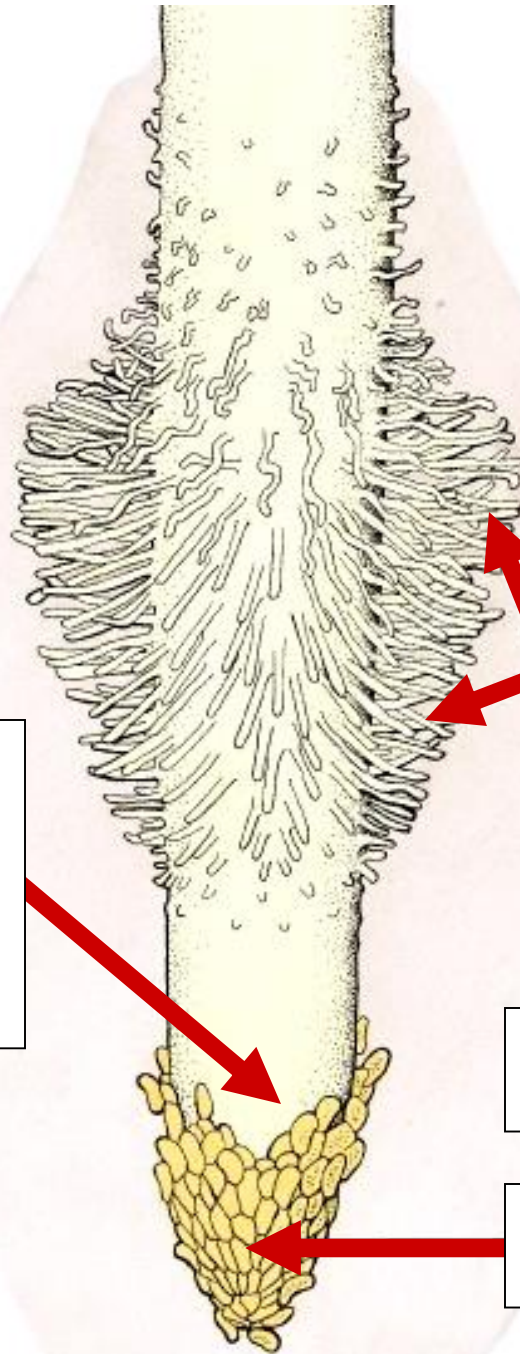
**M**

**ROOT  
APICAL  
MERISTEM**

**ROOT HAIRS**

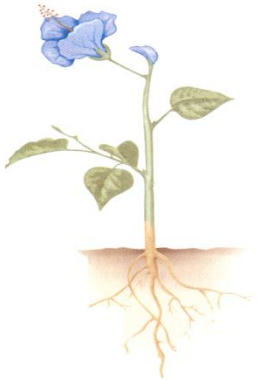
**+ GEOTROPIC**

**ROOT CAP**



**ROOT**

**L.S**



**TYPICAL  
ANGIOSPERM**

**AS**

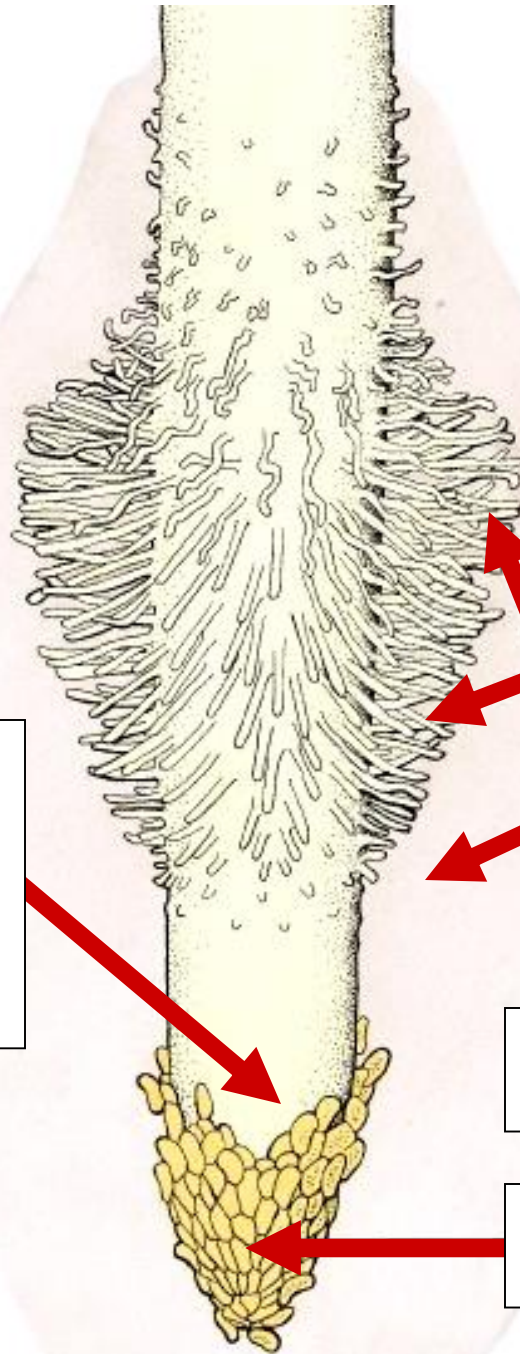
**ROOT  
APICAL  
MERISTEM**

**ROOT HAIRS**

**MUCILAGE**

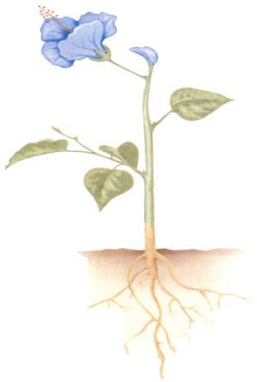
**+ GEOTROPIC**

**ROOT CAP**



**ROOT**

**L.S**



**TYPICAL  
ANGIOSPERM**



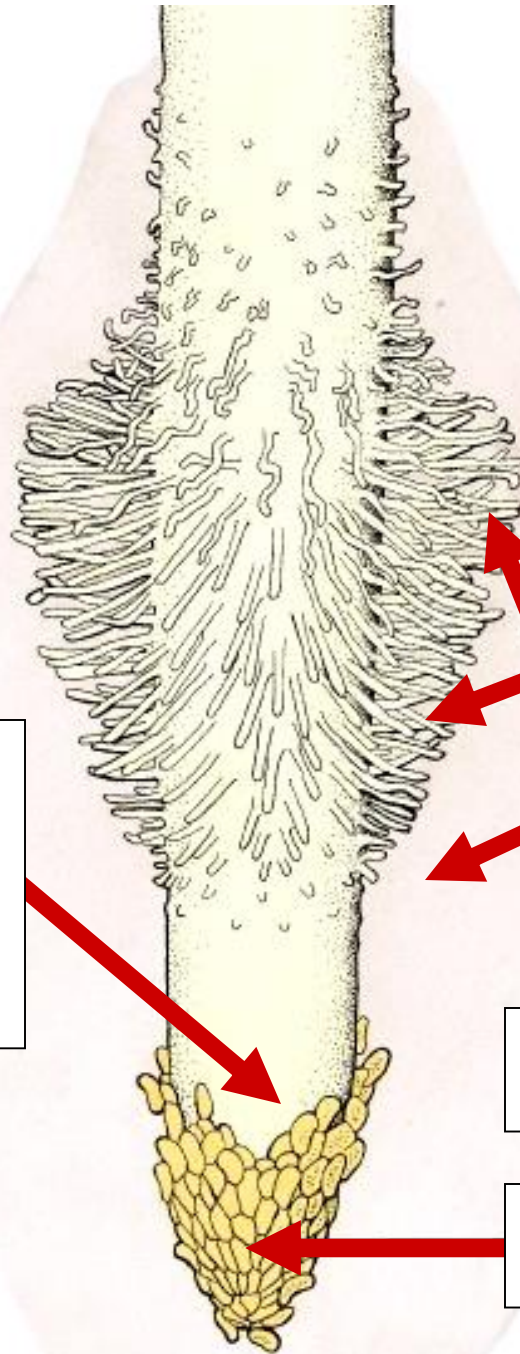
**ROOT  
APICAL  
MERISTEM**

**ROOT HAIRS**

**MUCILAGE**  
AIDS SOIL PASSAGE

**+ GEOTROPIC**

**ROOT CAP**





# ROOT APICAL MERISTEM

**PC**

**ROOT  
APICAL  
MERISTEM**

**ROOT CAP**



**ROOT**



**L.S**

**MC**

**PARENCHYMA  
CELLS**

**PARENCHYMA  
CELLS**

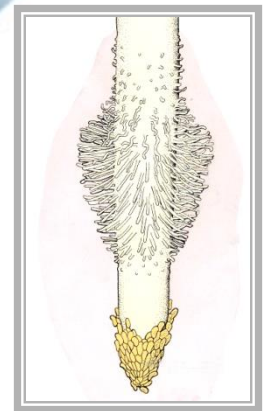
**PARENCHYMA  
CELLS**

**ROOT  
APICAL MERISTEM**

**ROOT CAP**



**ROOT**



**L.S**

**MERISTEM  
CELL INITIALS**

**MERISTEM  
CELL INITIALS**

**MERISTEM  
CELL INITIALS**

**ROOT  
APICAL MERISTEM**

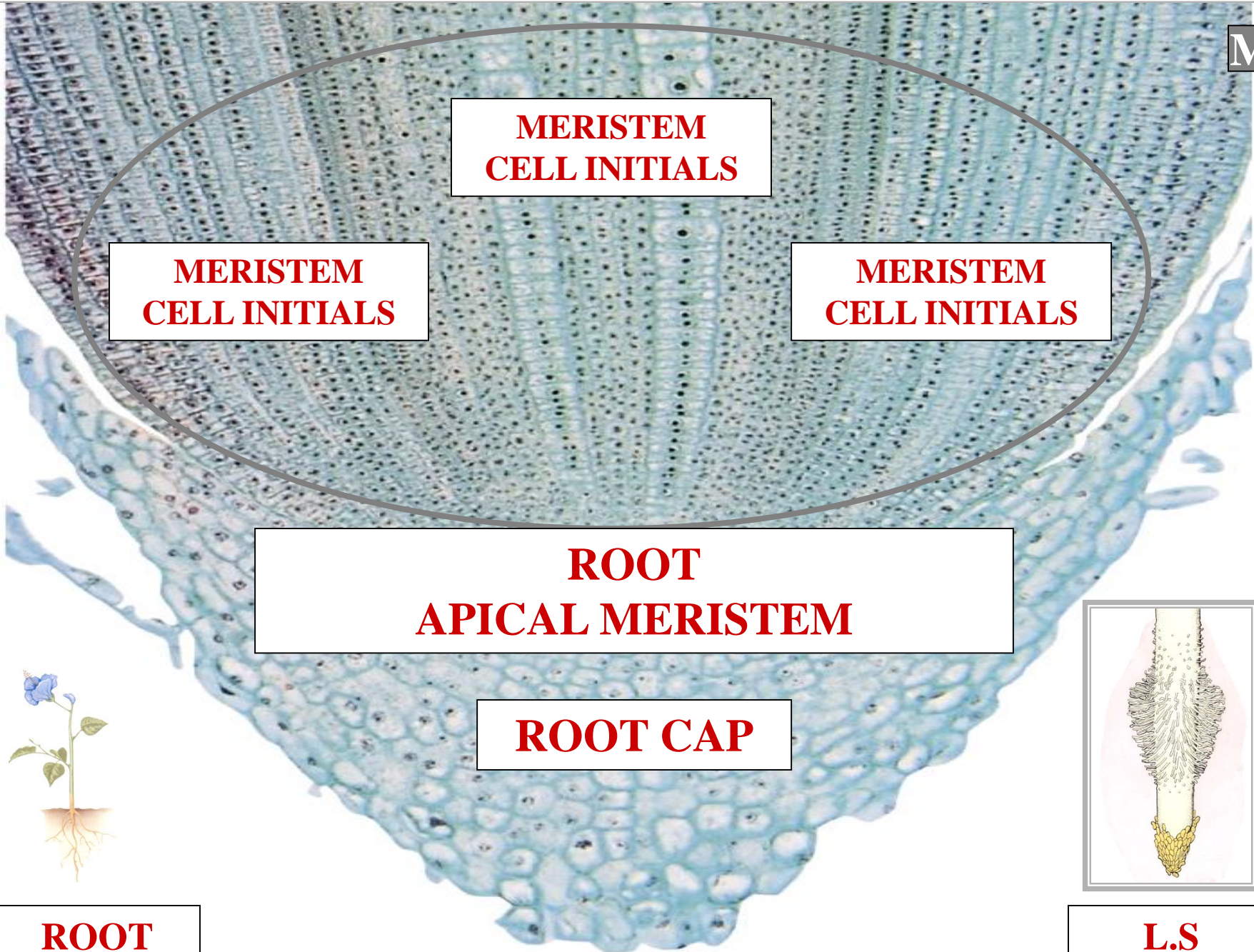
**ROOT CAP**



**ROOT**



**L.S**



QC

MITOSIS

MITOSIS

MITOSIS

**ROOT  
APICAL MERISTEM**

**ROOT CAP**

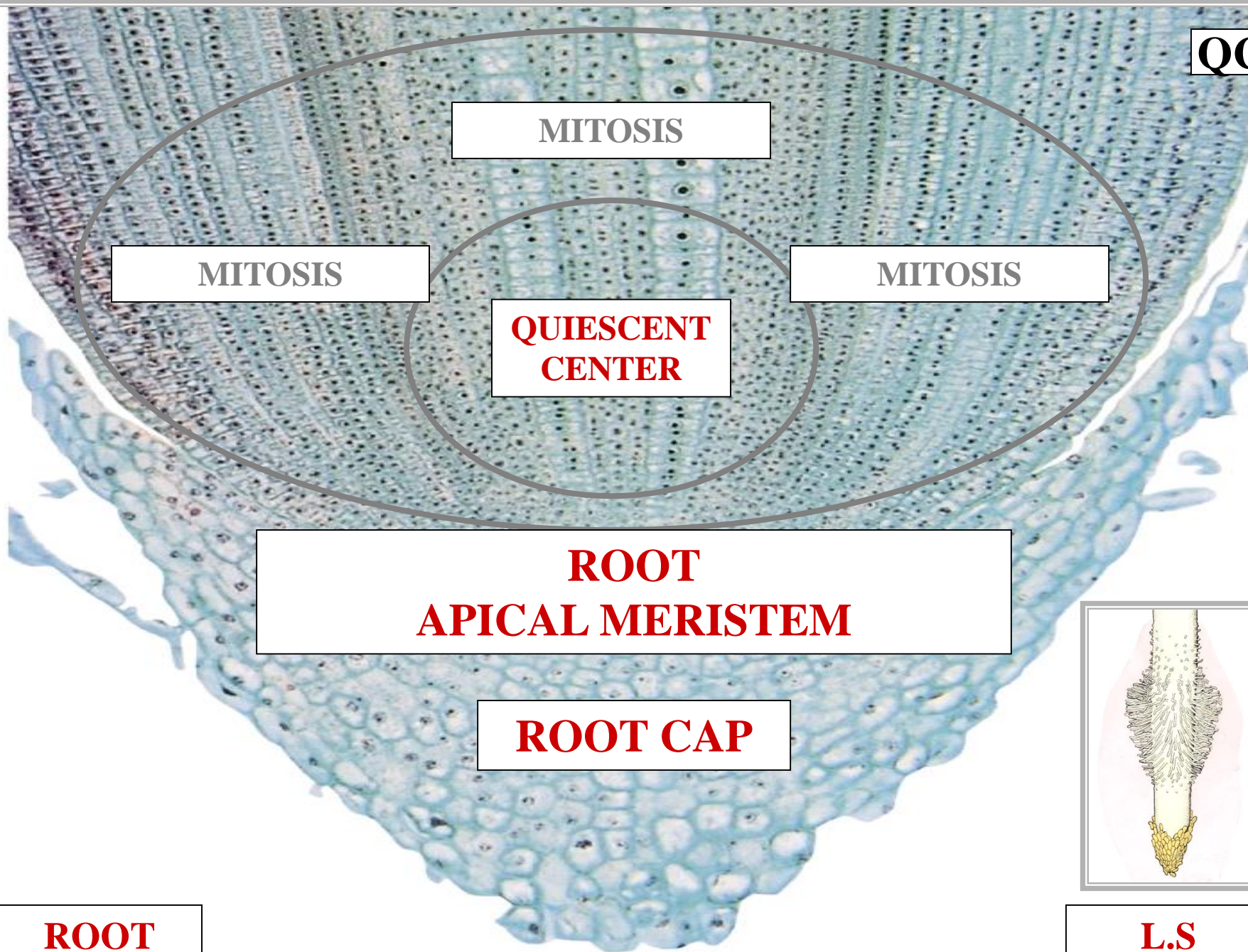


**ROOT**



**L.S**





**QC**

**MITOSIS**

**MITOSIS**

**MITOSIS**

**QUIESCENT  
CENTER**

**ROOT  
APICAL MERISTEM**

**ROOT CAP**



**ROOT**

**L.S**

# QUIESCENT CENTER



I

**ROOT  
ANATOMY  
QUIESCENT CENTER**

**INACTIVE MITOSIS REGION  
ASSOCIATED WITH  
ROOT APICAL MERISTEM**

**ROOT  
ANATOMY  
QUIESCENT CENT**

QC

MITOSIS

MITOSIS

MITOSIS

INACTIVE  
MITOSIS  
REGION

**ROOT  
APICAL MERISTEM**

**ROOT CAP**

**ROOT**



**L.S**

**MERISTEM  
CELL INITIALS**

**MERISTEM  
CELL INITIALS**

**MERISTEM  
CELL INITIALS**

**QUIESCENT  
CENTER**

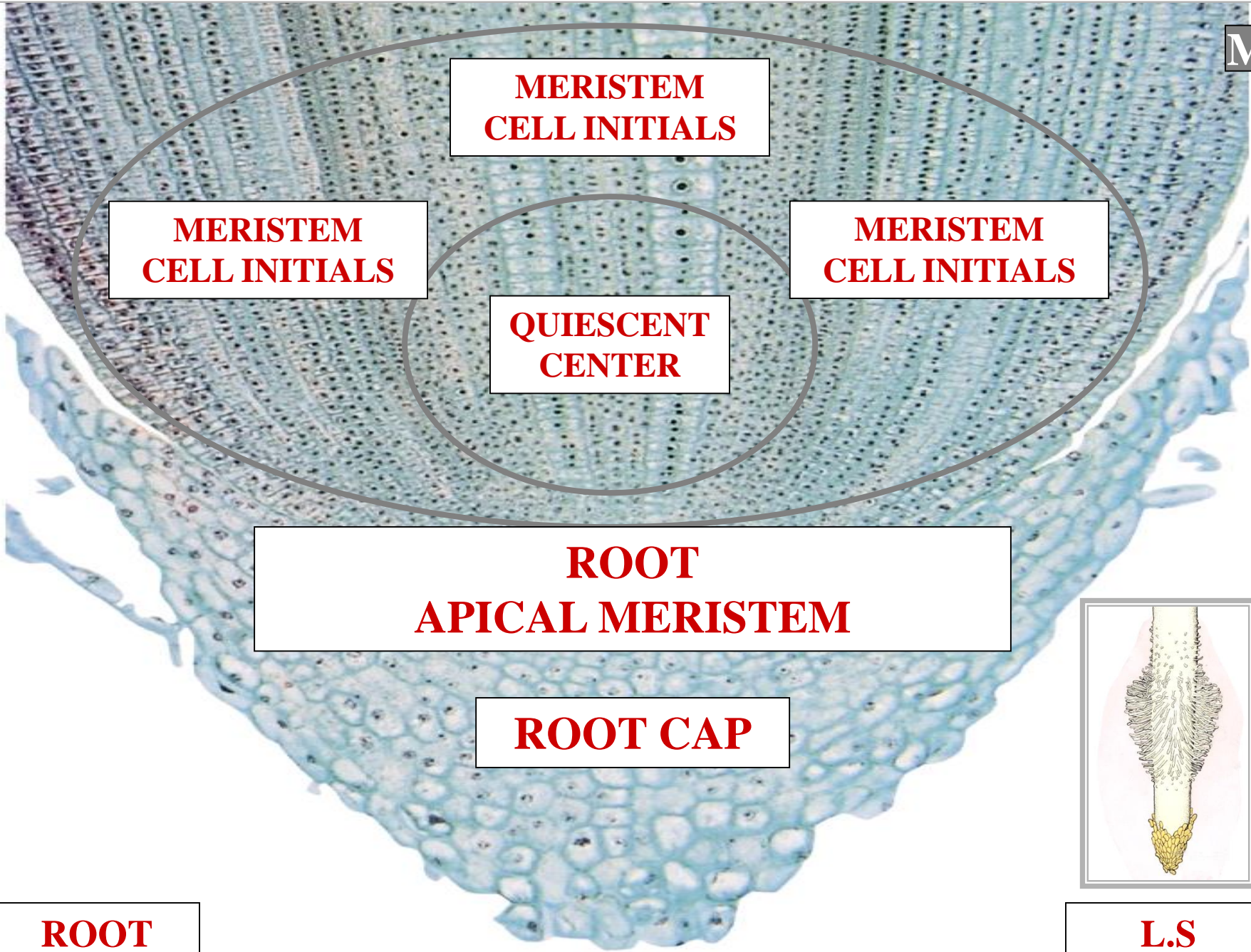
**ROOT  
APICAL MERISTEM**

**ROOT CAP**

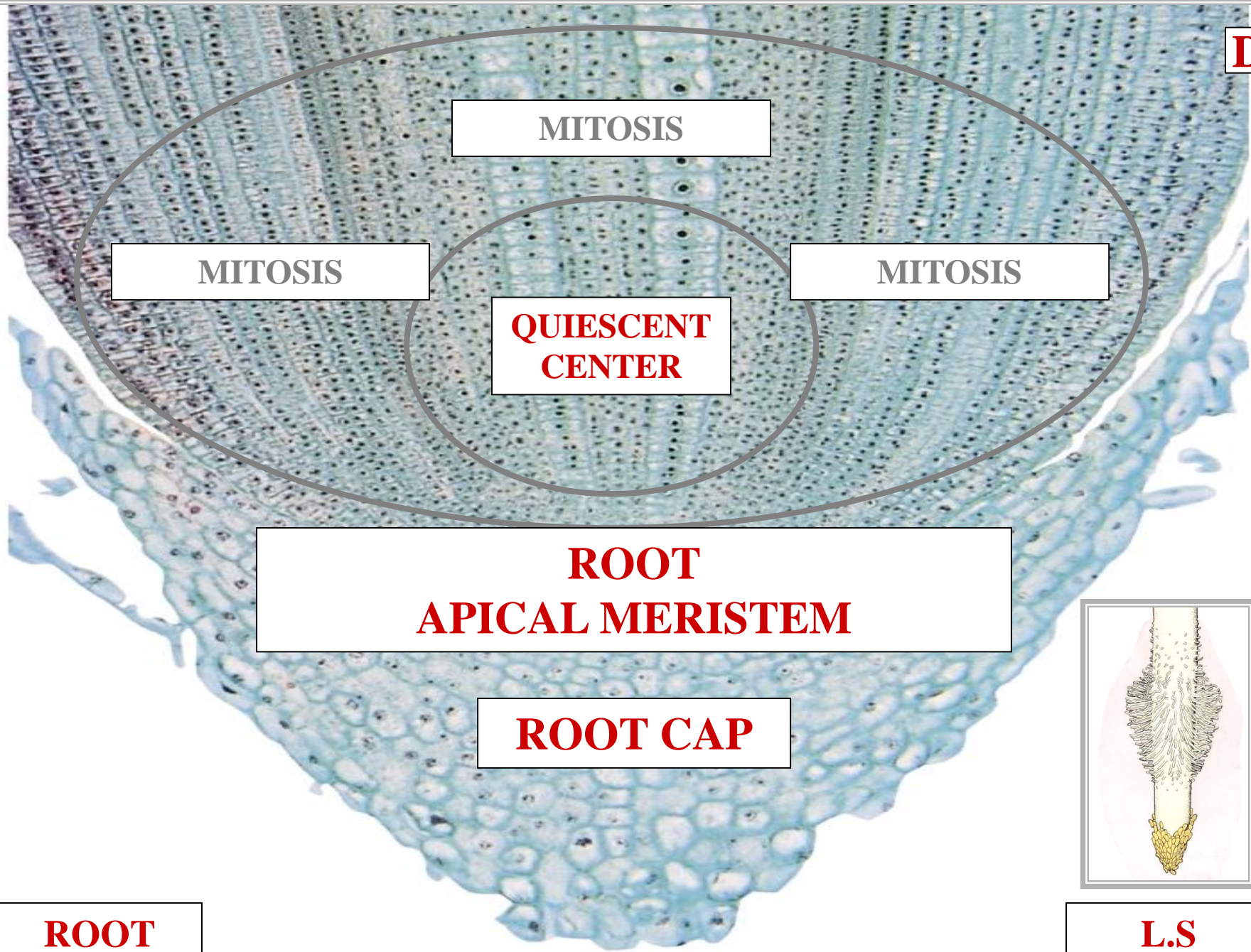
**ROOT**



**L.S**



**D**



**MITOSIS**

**MITOSIS**

**MITOSIS**

**QUIESCENT  
CENTER**

**ROOT  
APICAL MERISTEM**

**ROOT CAP**



**ROOT**

**L.S**

**D**

**DERIVATIVES**

**DERIVATIVES**

**DERIVATIVES**

**QUIESCENT  
CENTER**

**ROOT  
APICAL MERISTEM**

**ROOT CAP**

**ROOT**



**L.S**



**DEFFERENTIATE**

**DIFFERENTIATE**

**DEFFERENITATE**

**QUIESCENT  
CENTER**

**ROOT  
APICAL MERISTEM**

**ROOT CAP**

**ROOT**



**L.S**





# ROOT DIFFERENTIATION REGIONS

**ROOT**

**L.S**

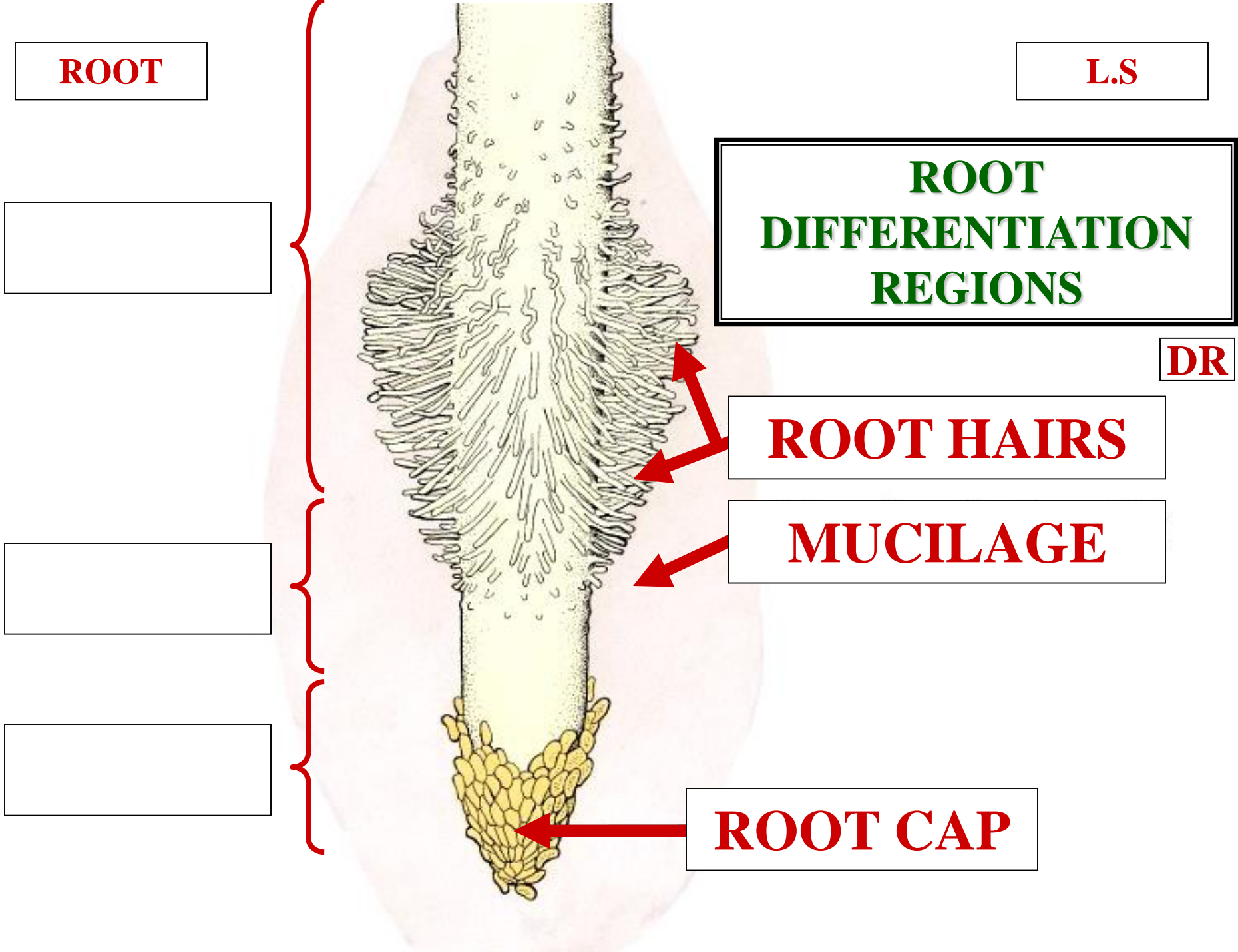
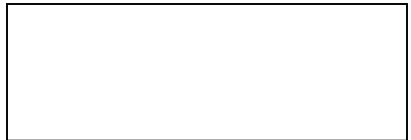
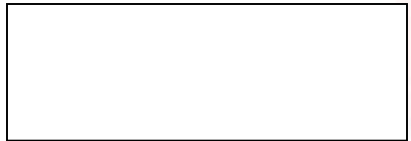
**ROOT  
DIFFERENTIATION  
REGIONS**

**DR**

**ROOT HAIRS**

**MUCILAGE**

**ROOT CAP**



**ROOT**

**L.S**

**ROOT  
DIFFERENTIATION  
REGIONS**

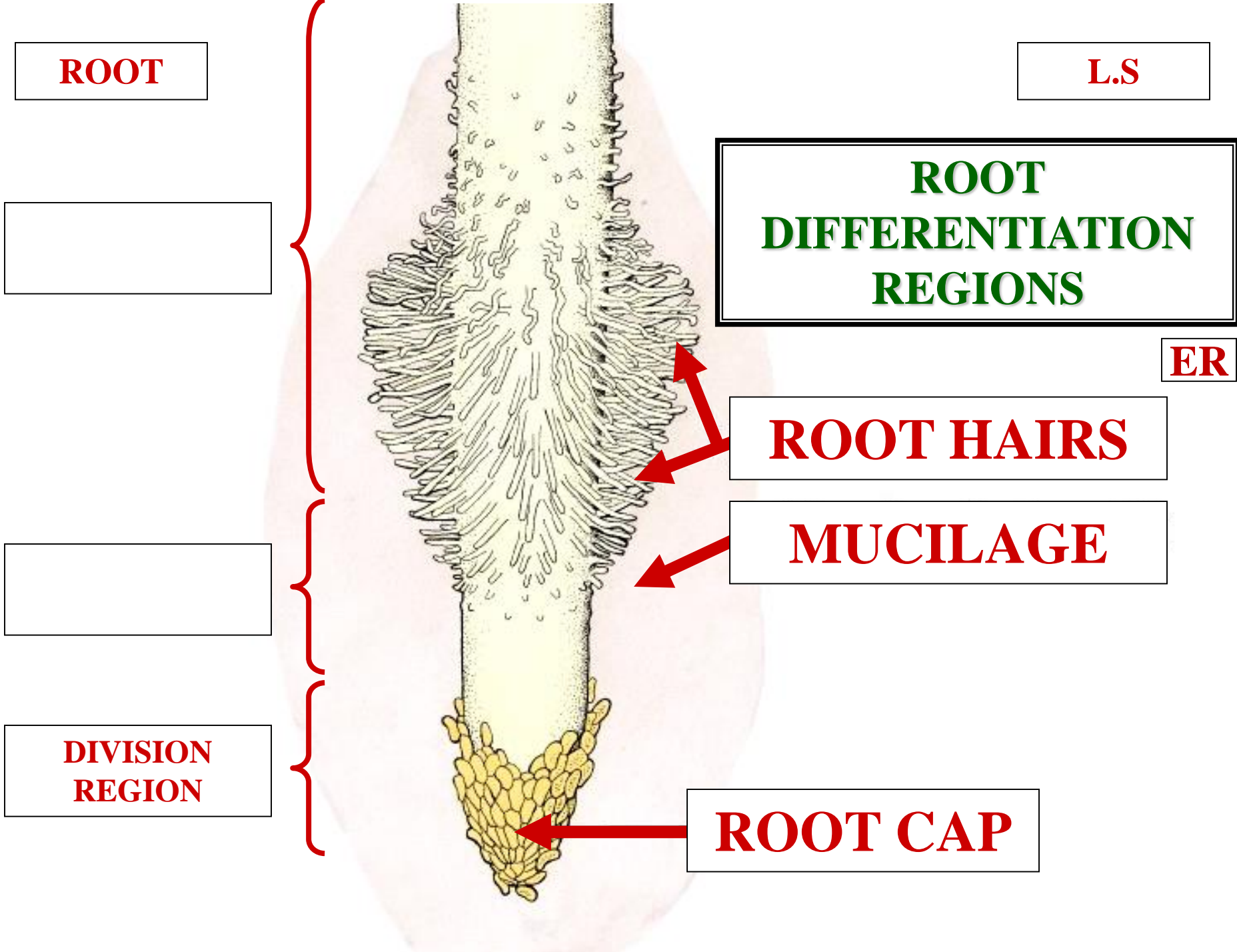
**ER**

**ROOT HAIRS**

**MUCILAGE**

**DIVISION  
REGION**

**ROOT CAP**



**ROOT**

**L.S**

**ROOT  
DIFFERENTIATION  
REGIONS**

**MR**

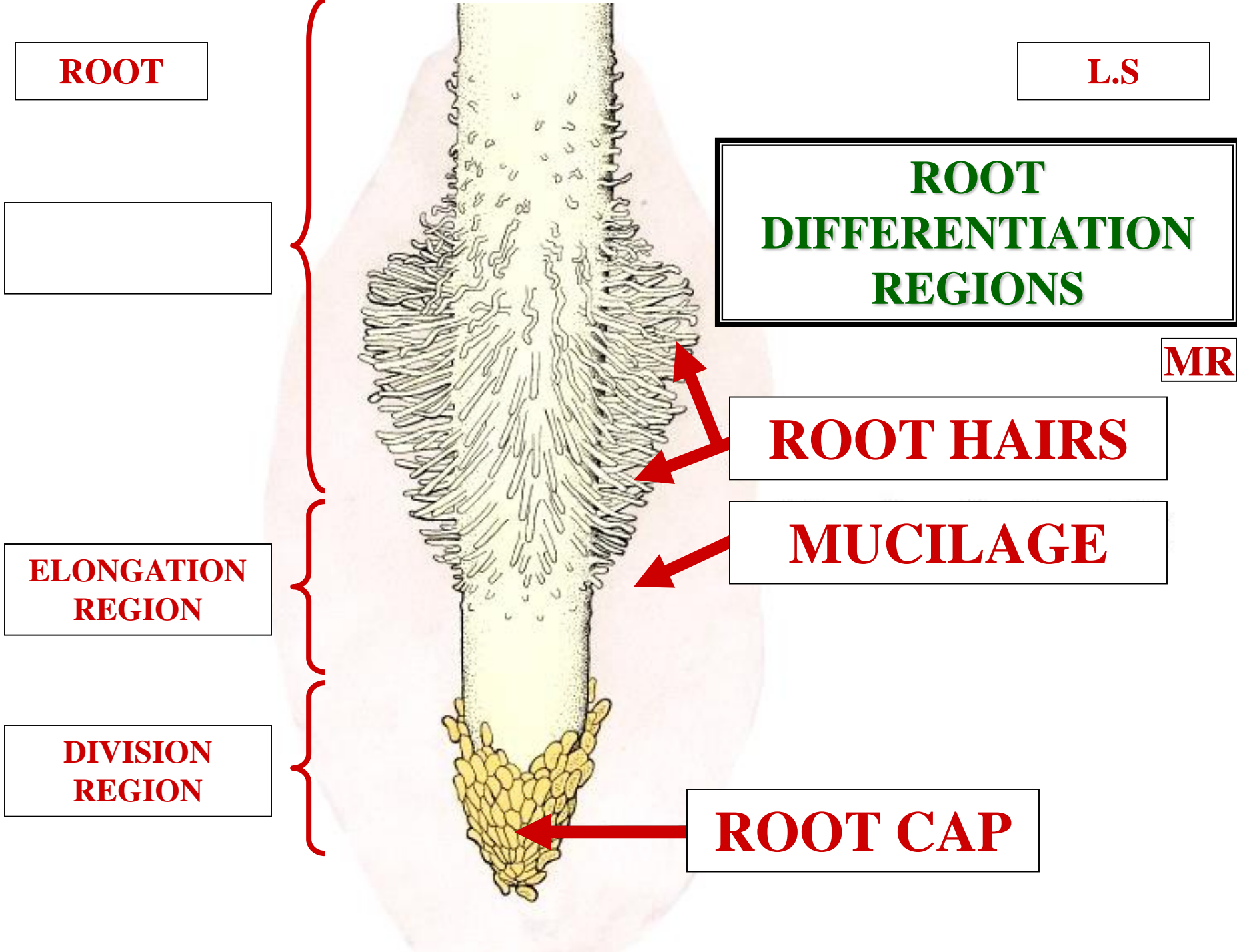
**ROOT HAIRS**

**MUCILAGE**

**ELONGATION  
REGION**

**DIVISION  
REGION**

**ROOT CAP**



**ROOT**

**L.S**

**MATURATION  
REGION**

**ROOT  
DIFFERENTIATION  
REGIONS**

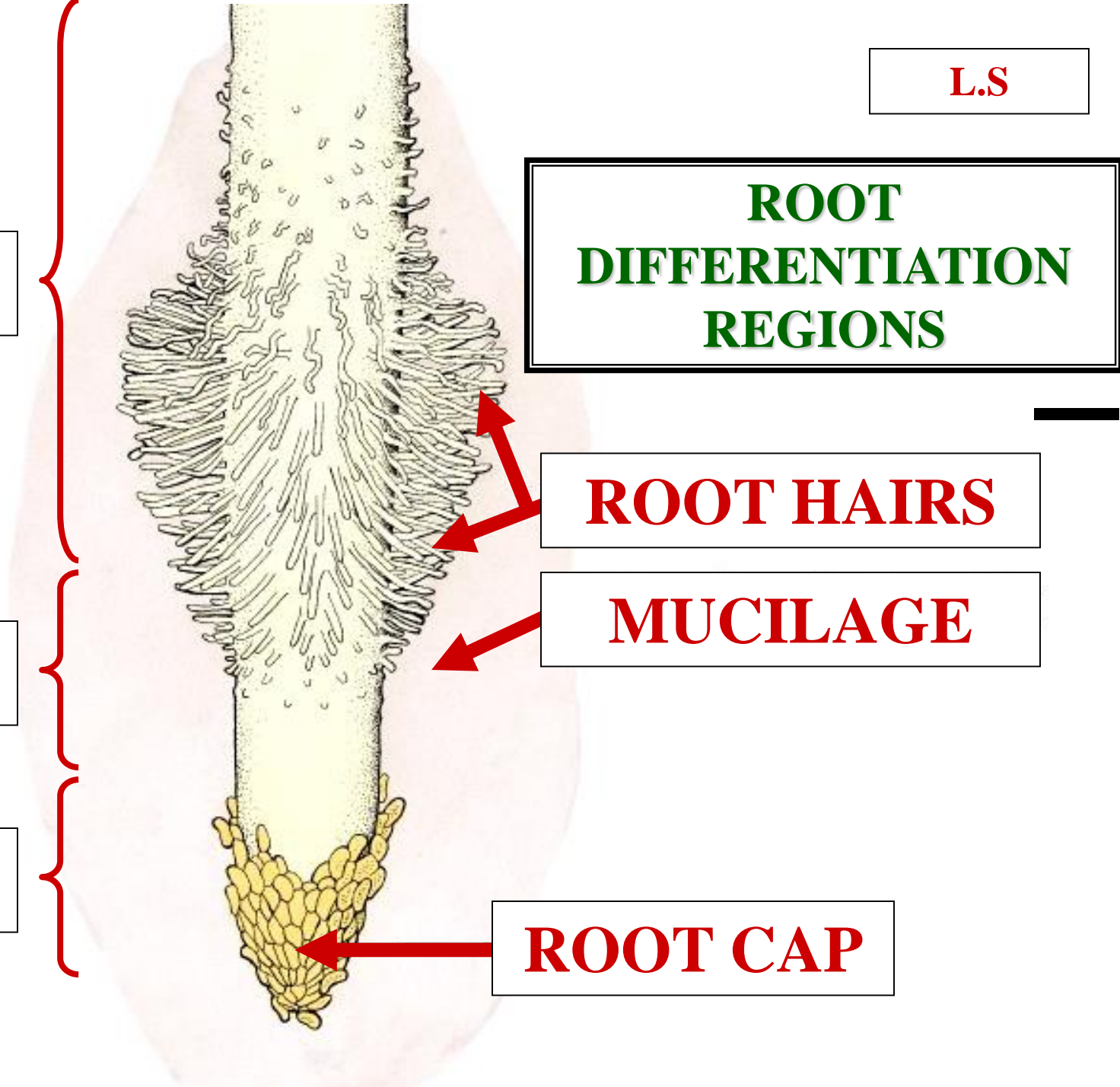
**ELONGATION  
REGION**

**ROOT HAIRS**

**MUCILAGE**

**DIVISION  
REGION**

**ROOT CAP**



**ROOT**

**L.S**

**MATURATION  
REGION**

**ROOT  
DIFFERENTIATION  
REGIONS**

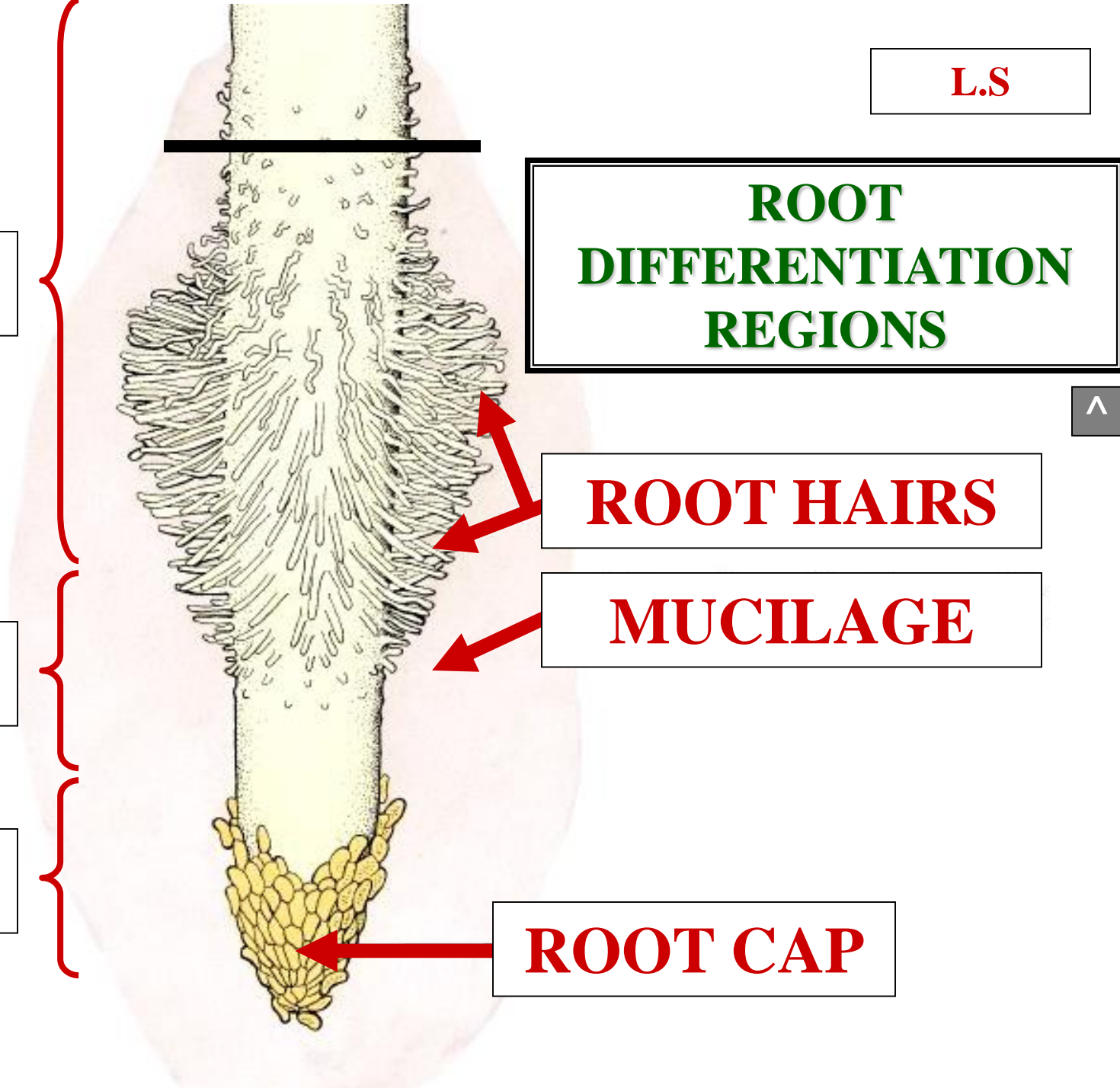
**ELONGATION  
REGION**

**ROOT HAIRS**

**MUCILAGE**

**DIVISION  
REGION**

**ROOT CAP**





# ROOT PRIMARY GROWTH



# ROOT DERMAL TISSUE





**ROOT**  
**DERMAL TISSUE**  
**PRIMARY**  
**MERISTEM**

**ROOT**

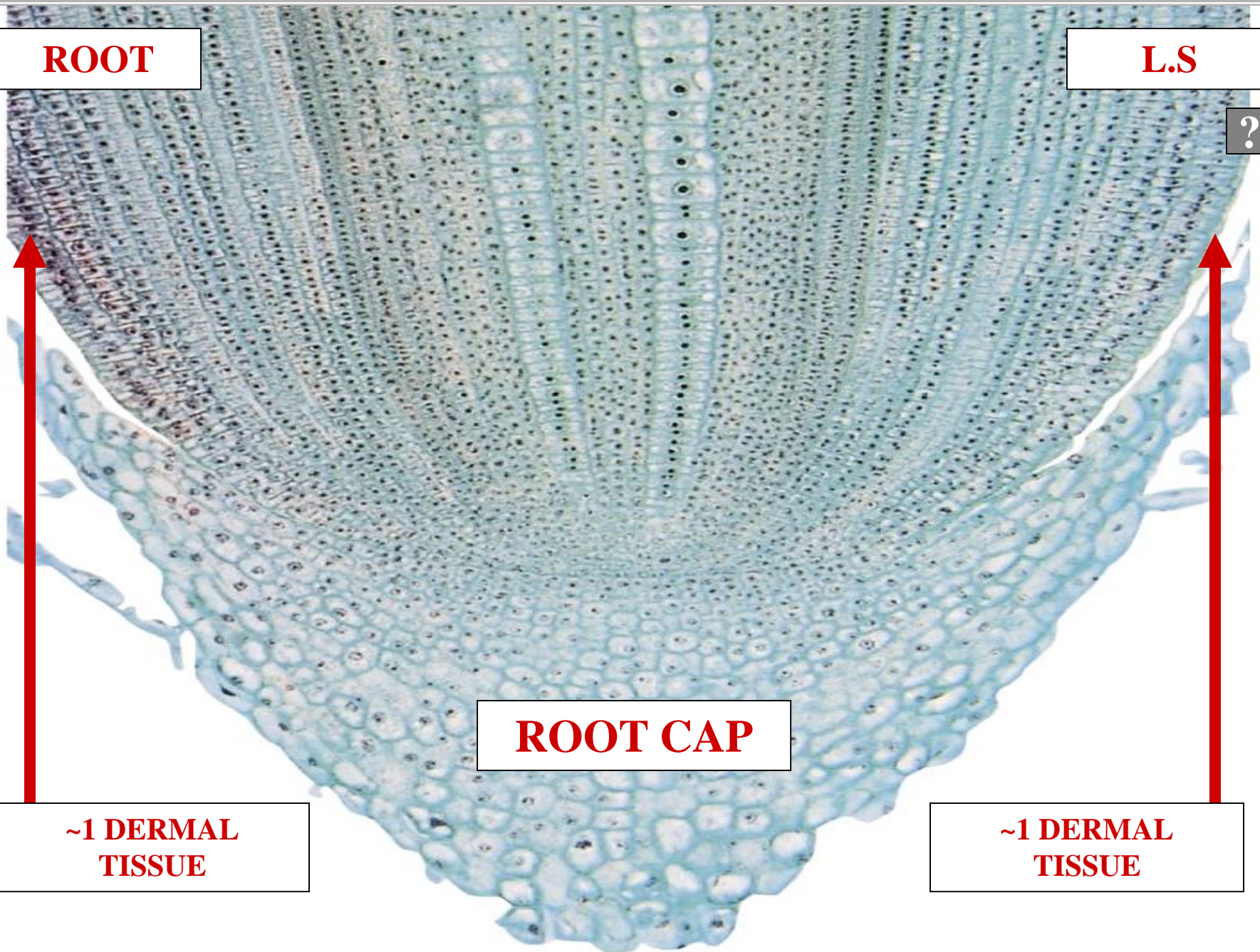
**L.S**

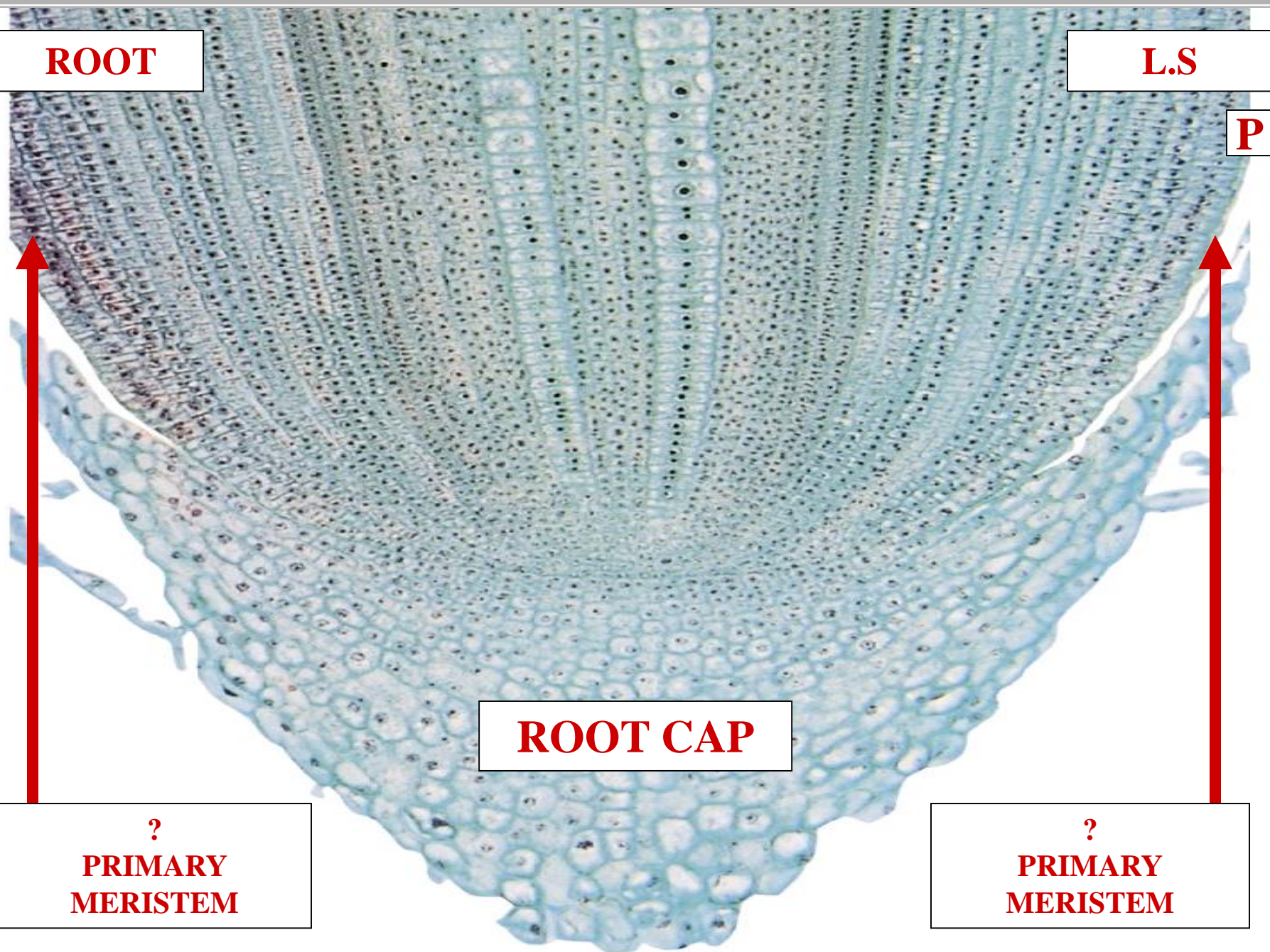
?

**ROOT CAP**

**~1 DERMAL  
TISSUE**

**~1 DERMAL  
TISSUE**





**ROOT**

**L.S**

**P**

**ROOT CAP**

**?  
PRIMARY  
MERISTEM**

**?  
PRIMARY  
MERISTEM**

**ROOT**

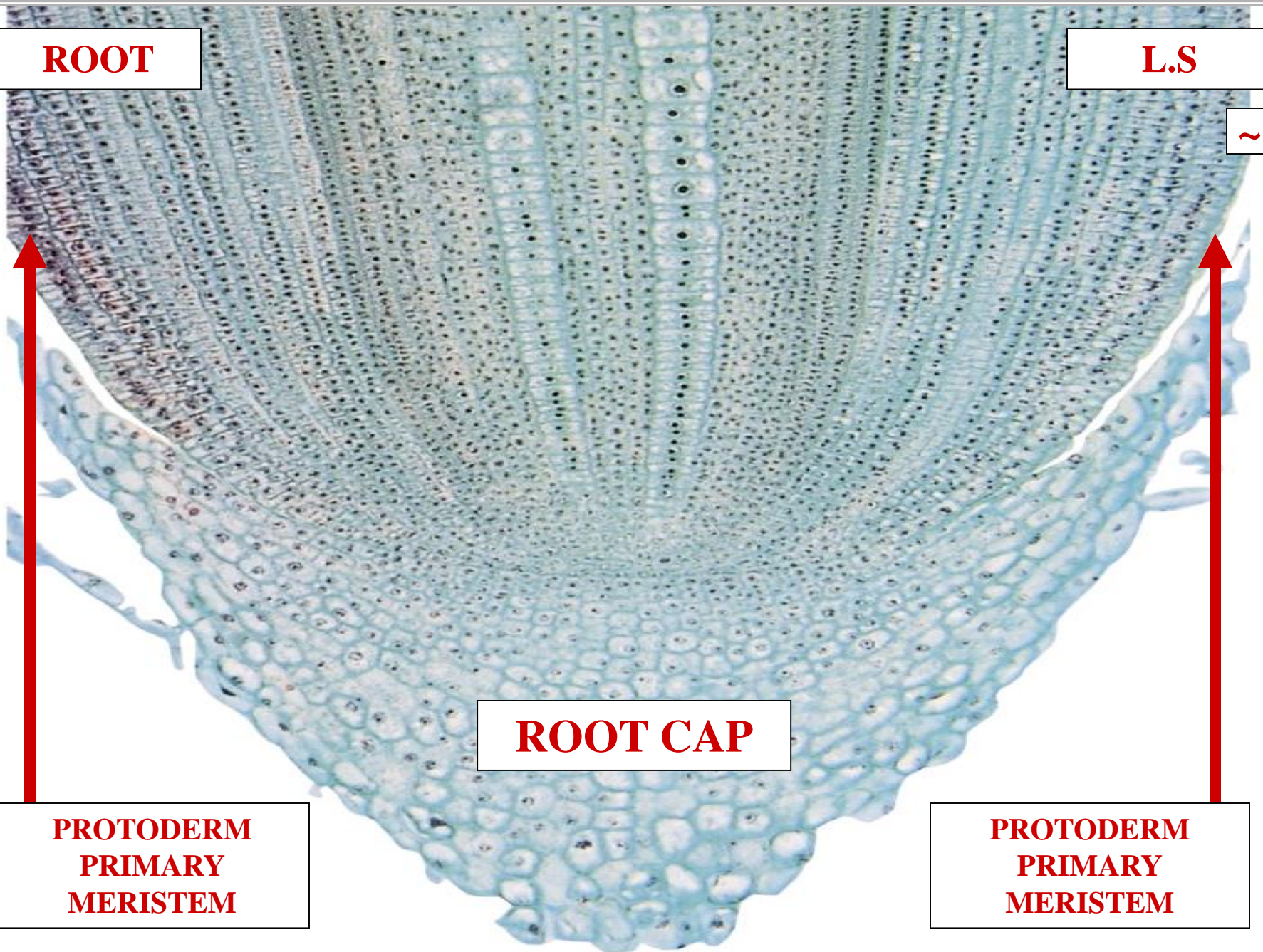
**L.S**

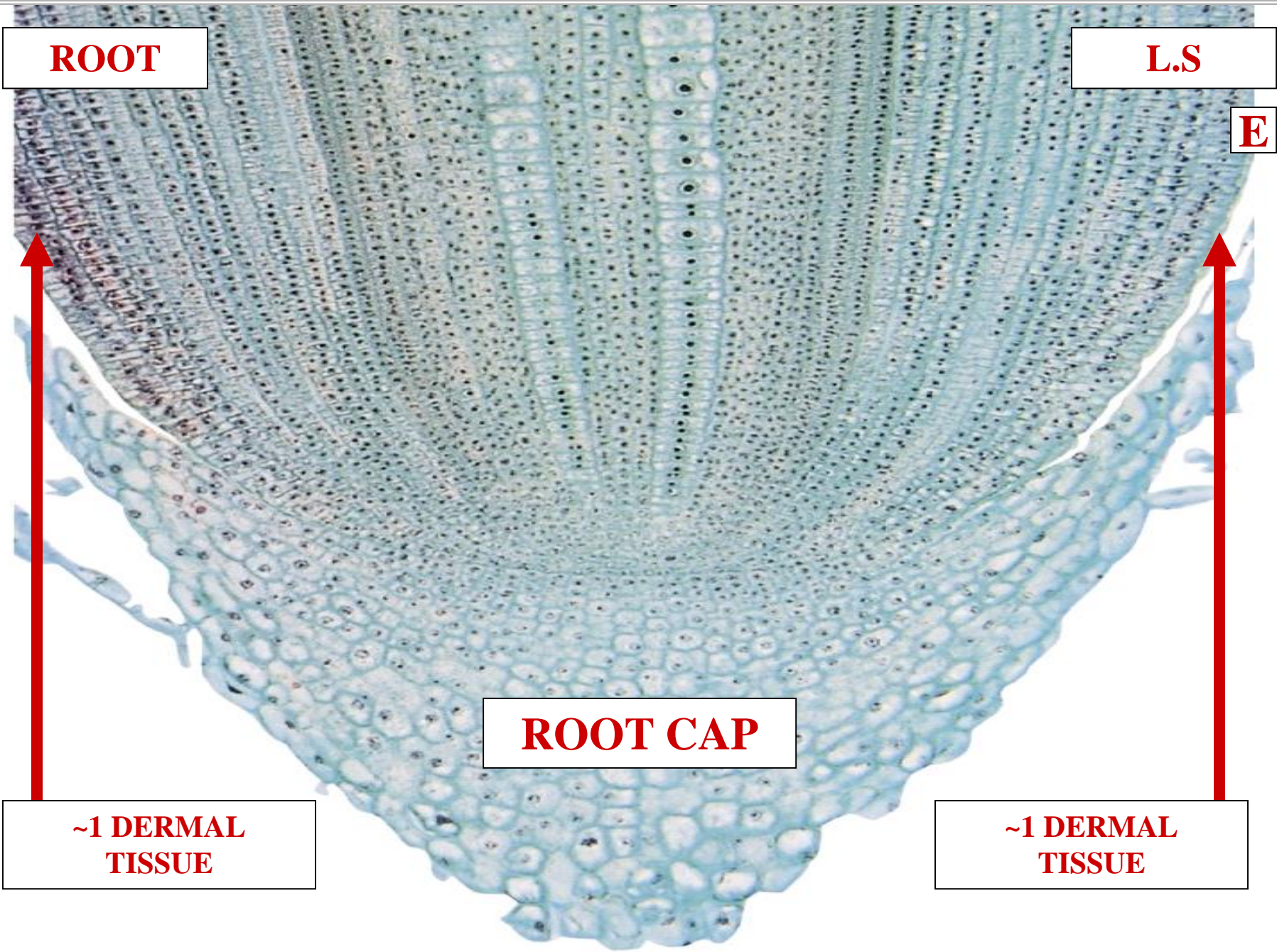
~

**ROOT CAP**

**PROTODERM  
PRIMARY  
MERISTEM**

**PROTODERM  
PRIMARY  
MERISTEM**





**ROOT**

**L.S**

**E**

**ROOT CAP**

**~1 DERMAL  
TISSUE**

**~1 DERMAL  
TISSUE**

**ROOT**

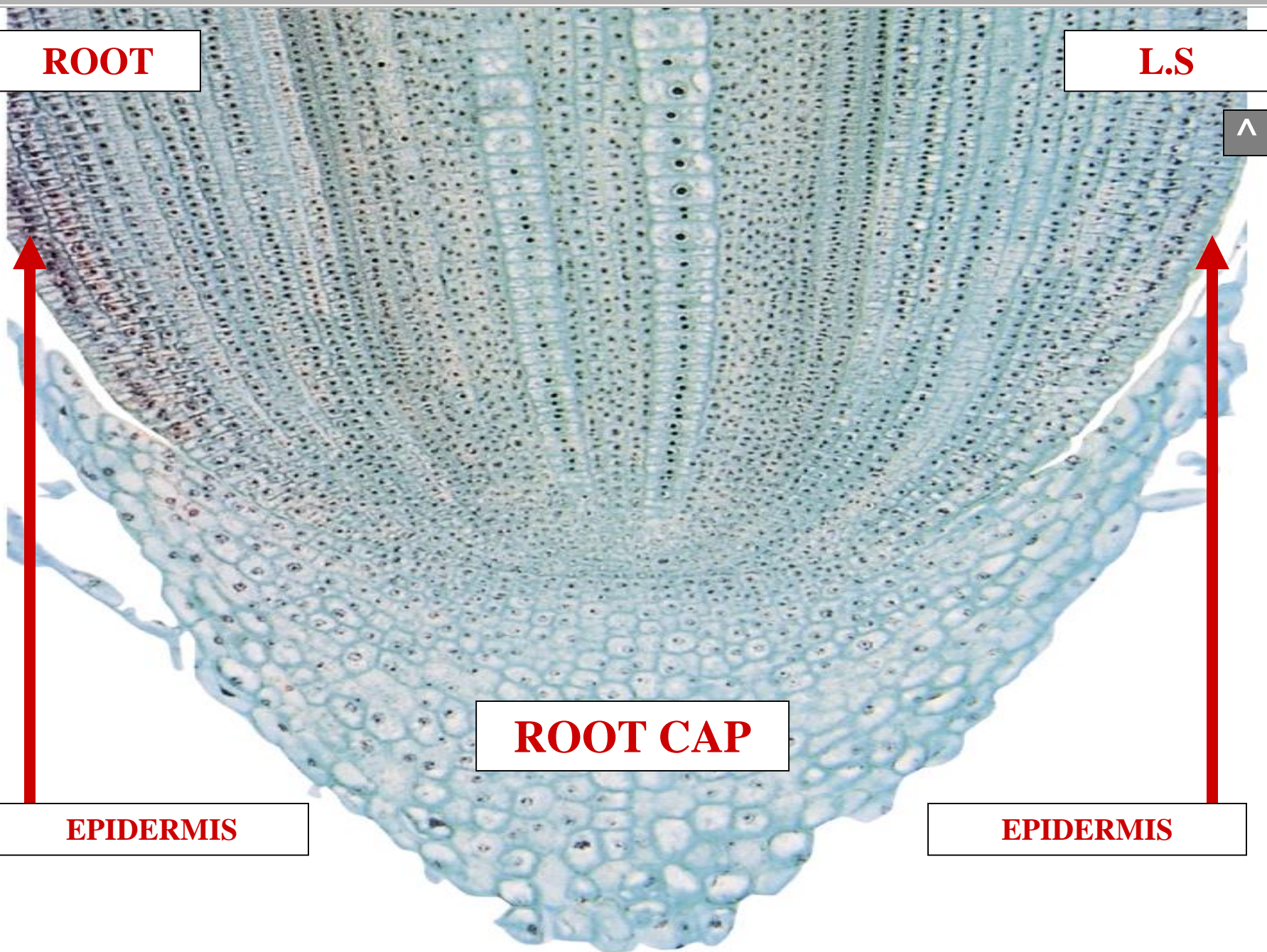
**L.S**



**ROOT CAP**

**EPIDERMIS**

**EPIDERMIS**



# ROOT EPIDERMIS

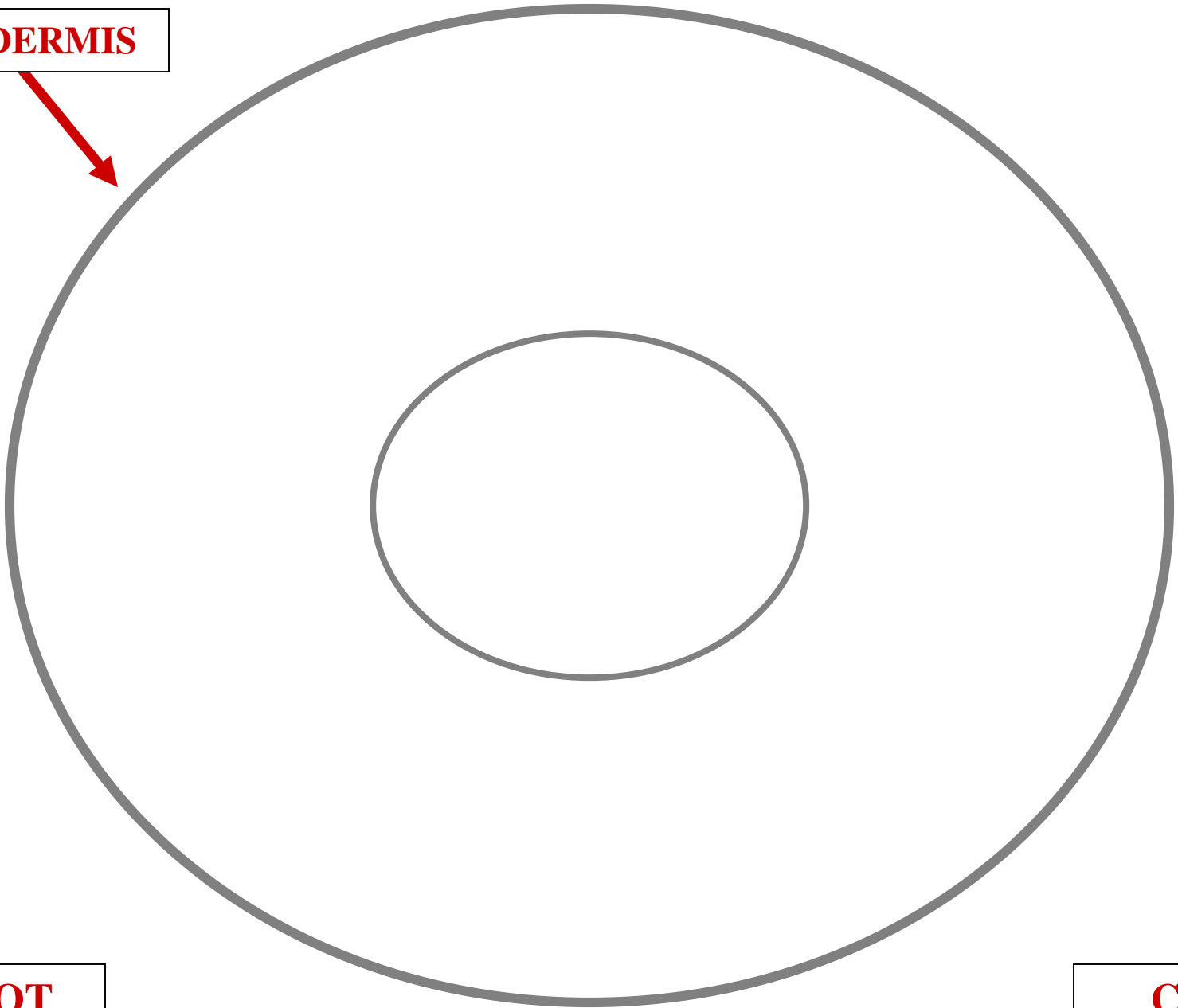


**EPIDERMIS**



**ROOT**

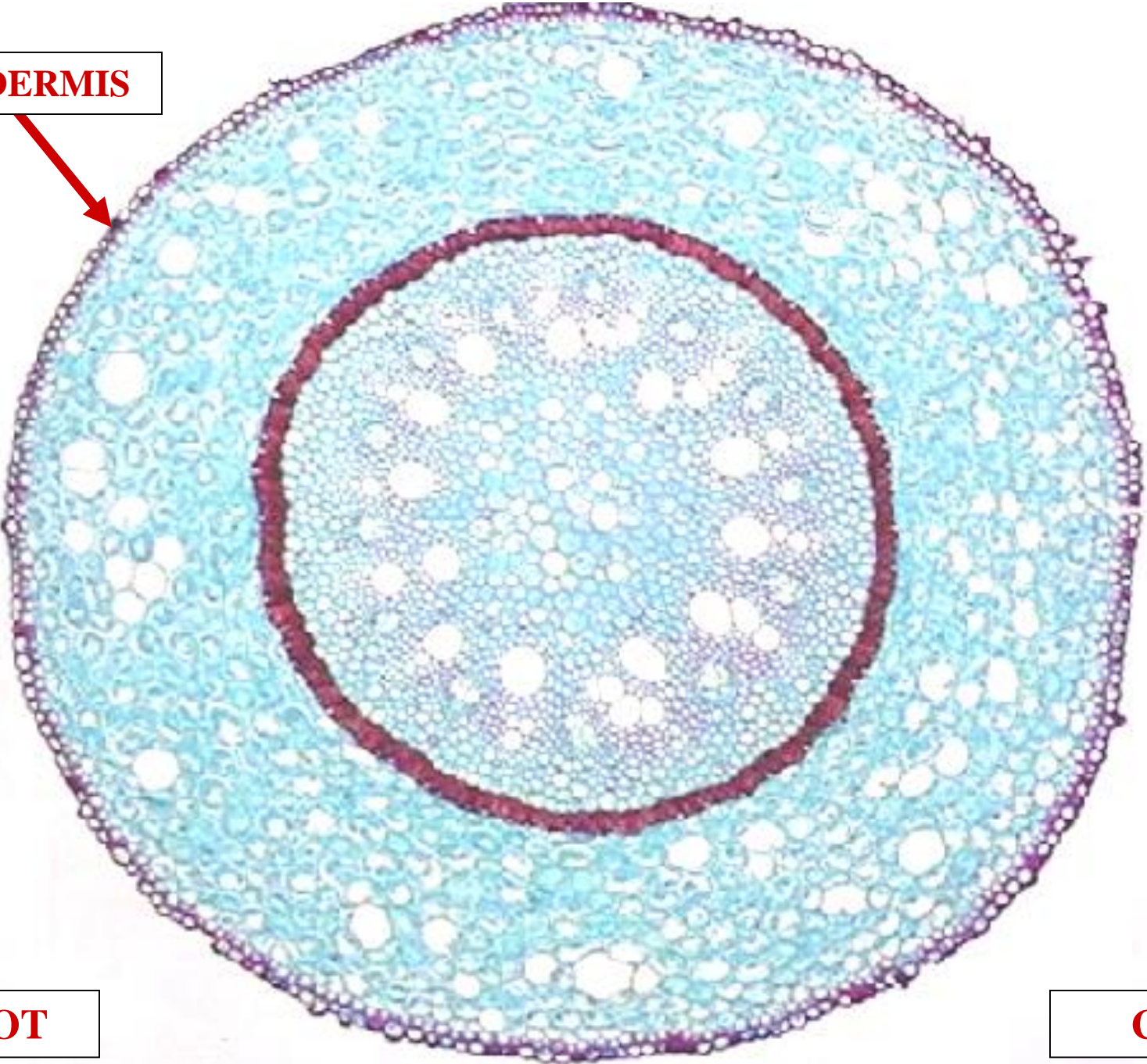
**C.S.**







**EPIDERMIS**



**ROOT**

**C.S**

**ROOT  
EPIDERMIS  
CELL TYPES**

# **VEGETATIVE CELL**



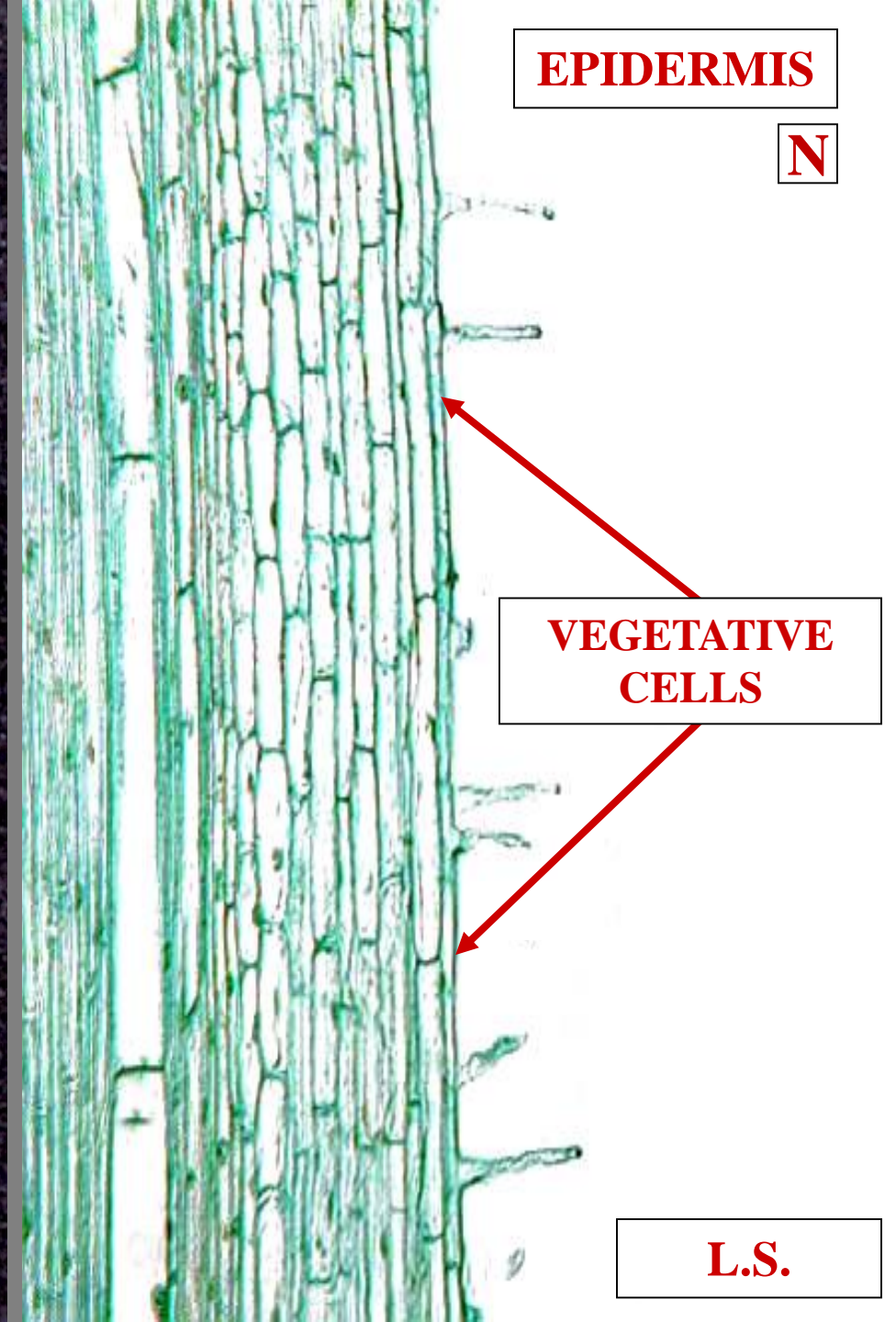
**ROOT EPIDERMIS  
CELL TYPES  
VEGETATIVE CELL**

**NON-MODIFIED CELL**

**ROOT EPIDERMIS  
CELL TYPES  
VEGETATIVE CELL**



**ROOT**



**EPIDERMIS**

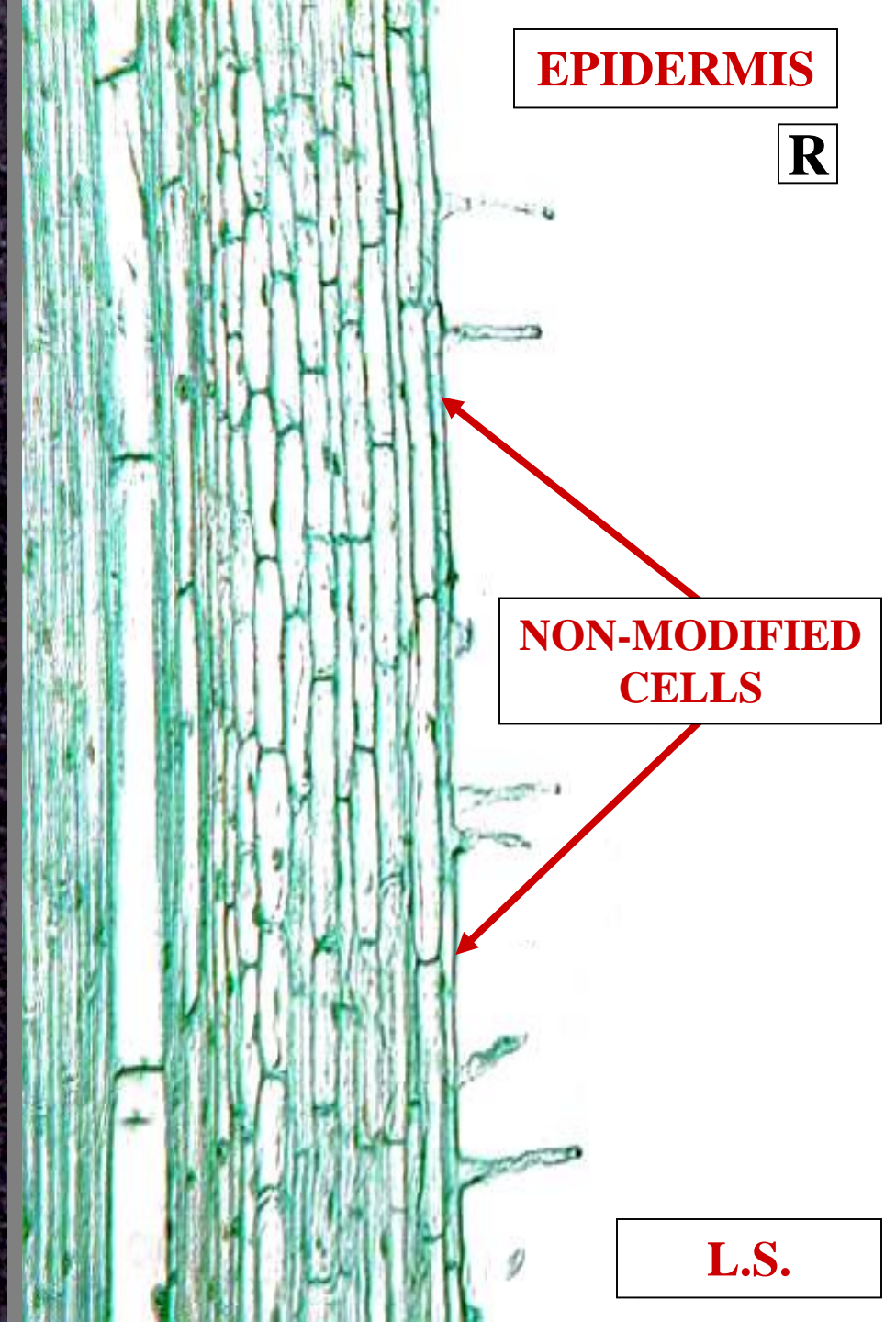
**N**

**VEGETATIVE  
CELLS**

**L.S.**



**ROOT**



**EPIDERMIS**

**R**

**NON-MODIFIED  
CELLS**

**L.S.**

# **ROOT HAIR CELL**

**ROOT EPIDERMIS**

**CELL TYPES**

**ROOT HAIR CELL**



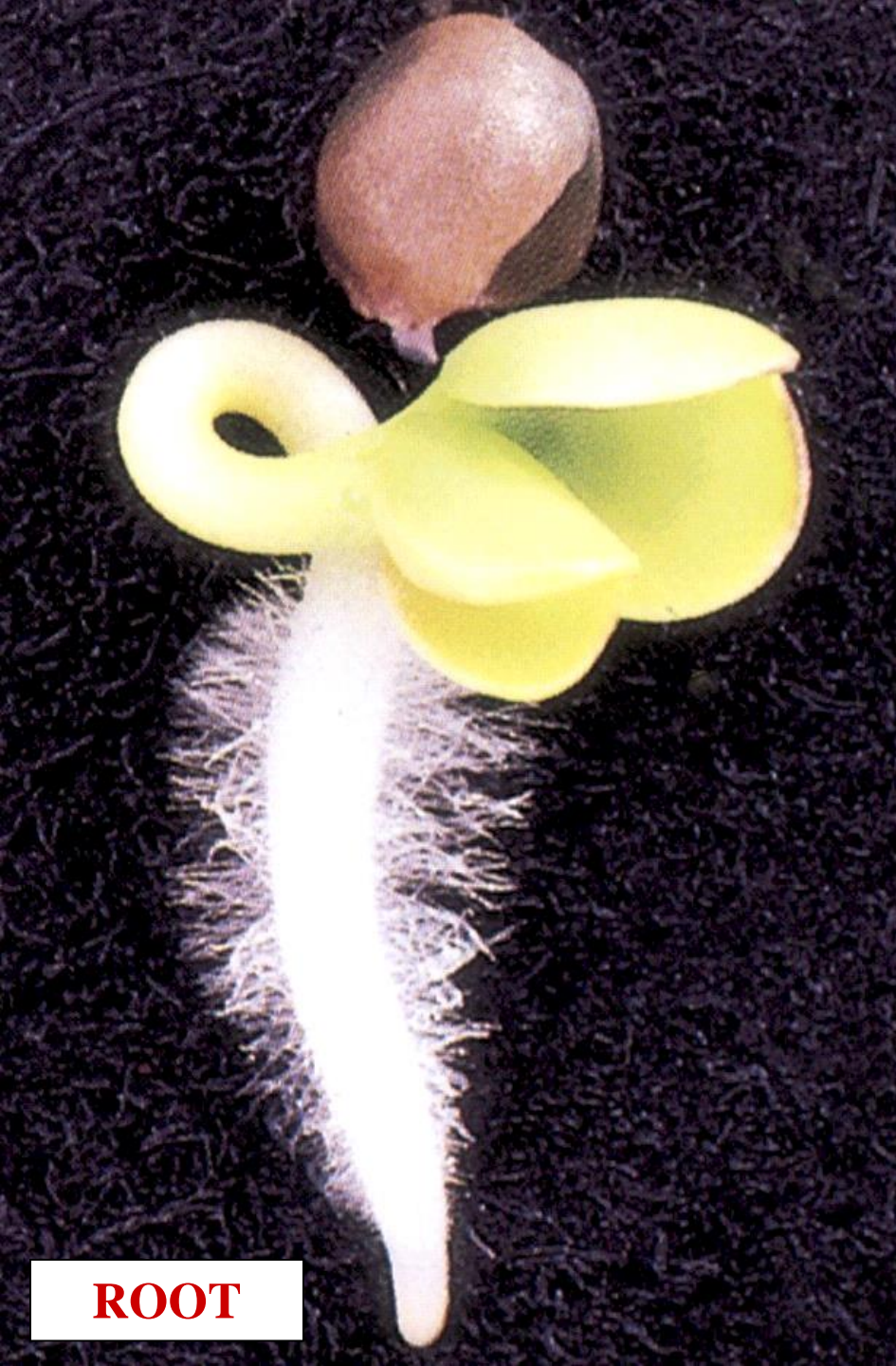
**MODIFIED CELL**

**ROOT EPIDERMIS**

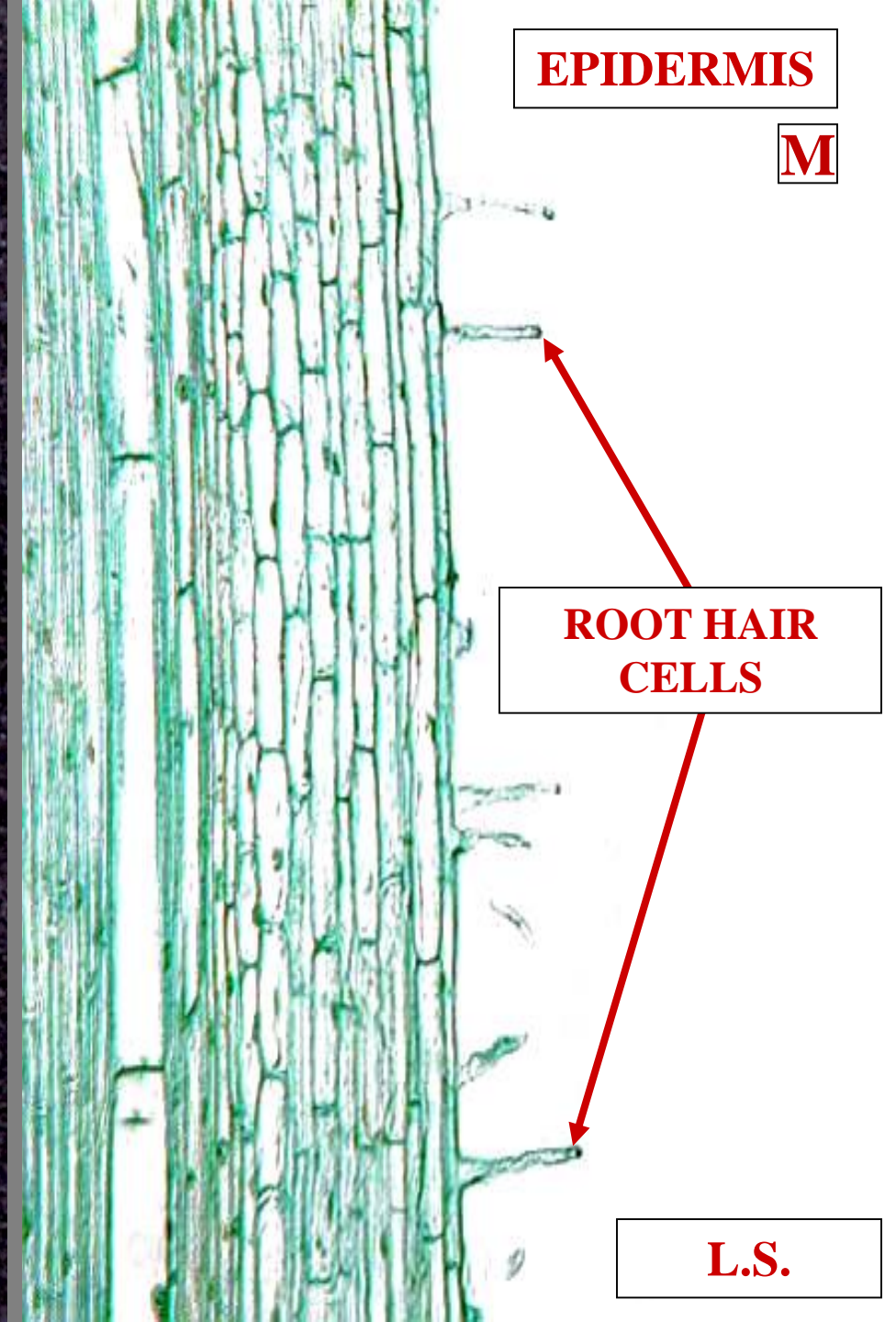
**CELL TYPES**

**ROOT HAIR CELL**





**ROOT**



**EPIDERMIS**

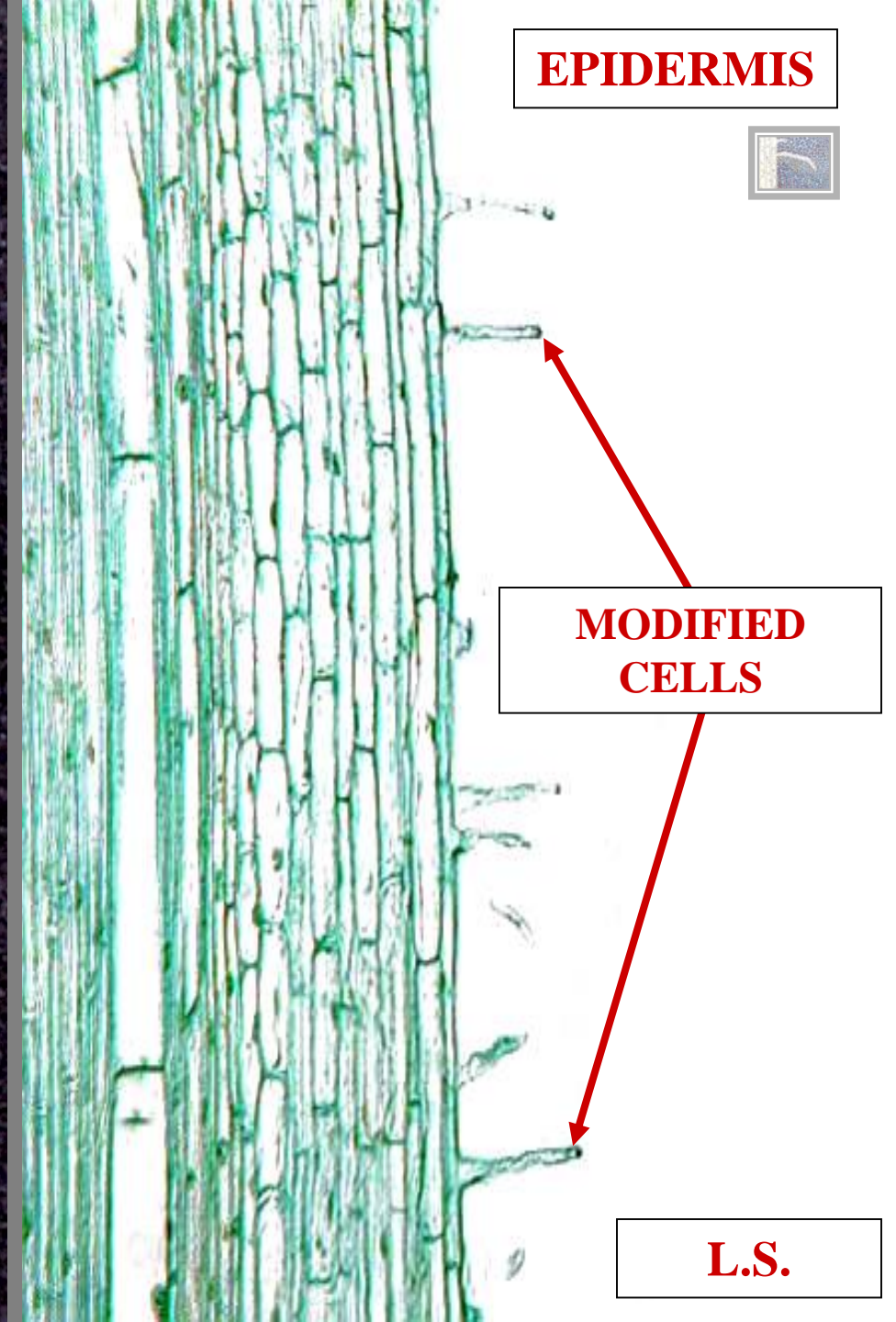
**M**

**ROOT HAIR  
CELLS**

**L.S.**



**ROOT**



**EPIDERMIS**



**MODIFIED CELLS**

**L.S.**

**ROOT**

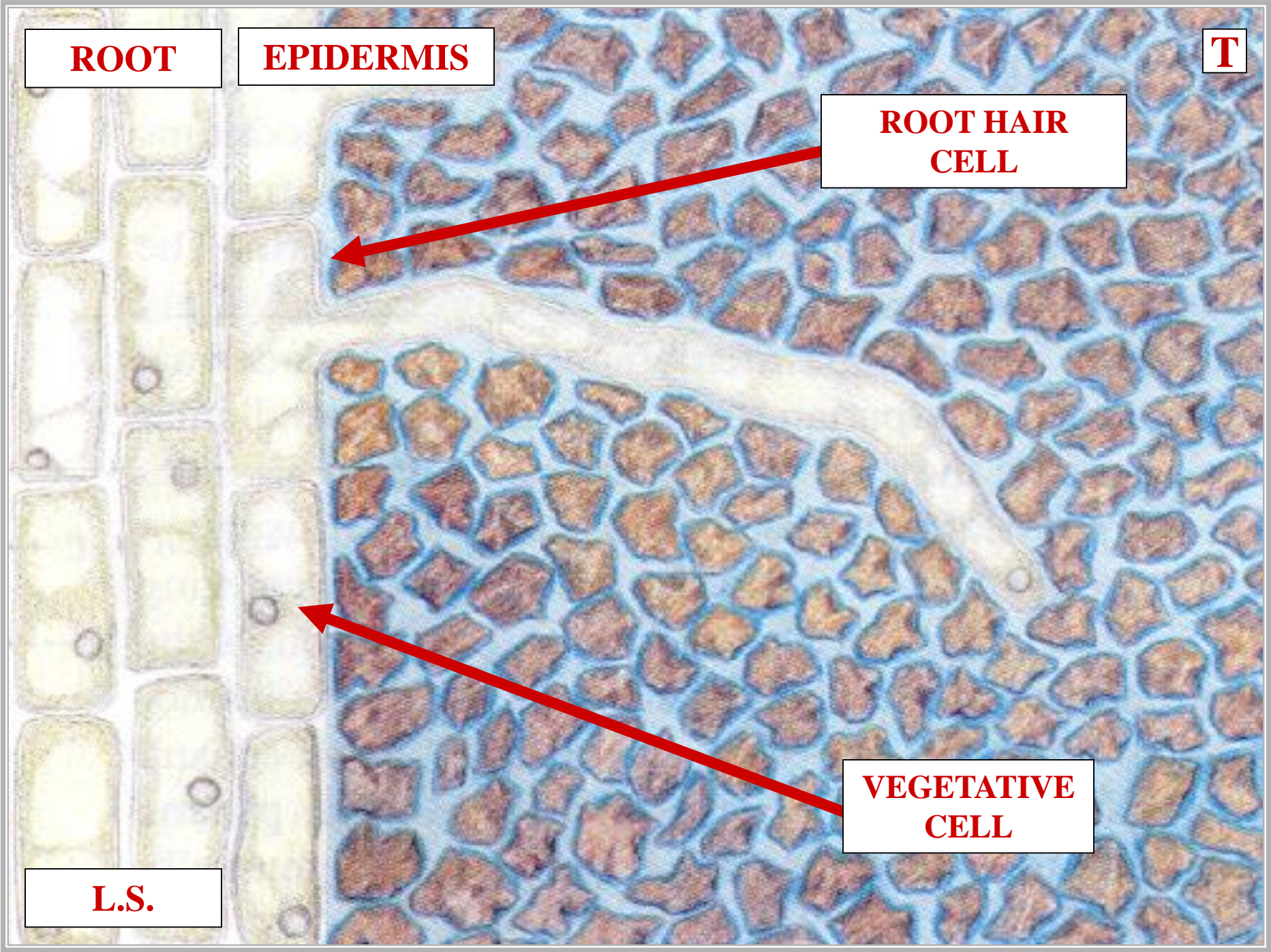
**EPIDERMIS**

**T**

**ROOT HAIR  
CELL**

**VEGETATIVE  
CELL**

**L.S.**



**ROOT**

**EPIDERMIS**

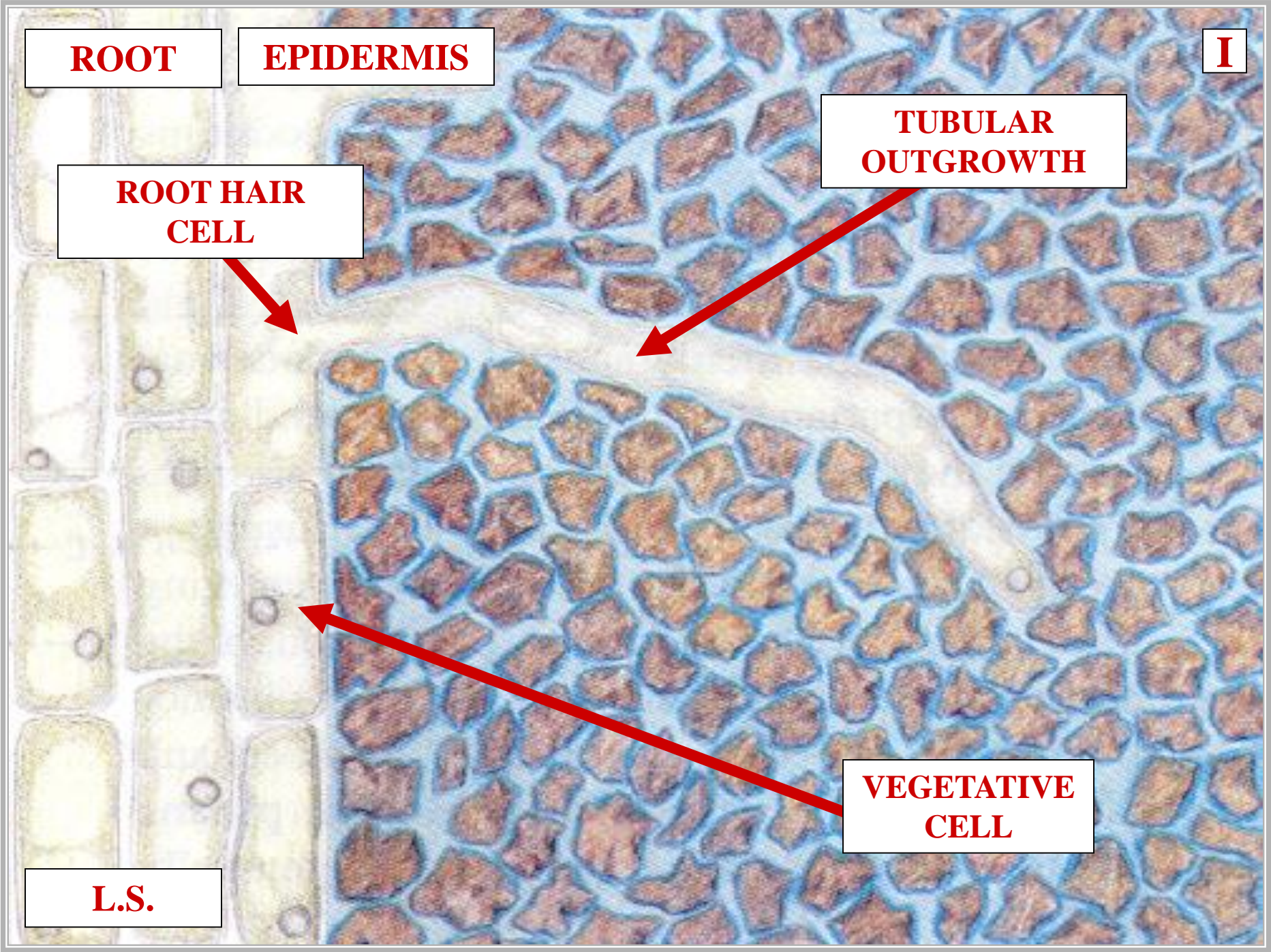
**I**

**ROOT HAIR  
CELL**

**TUBULAR  
OUTGROWTH**

**VEGETATIVE  
CELL**

**L.S.**



**ROOT**

**EPIDERMIS**

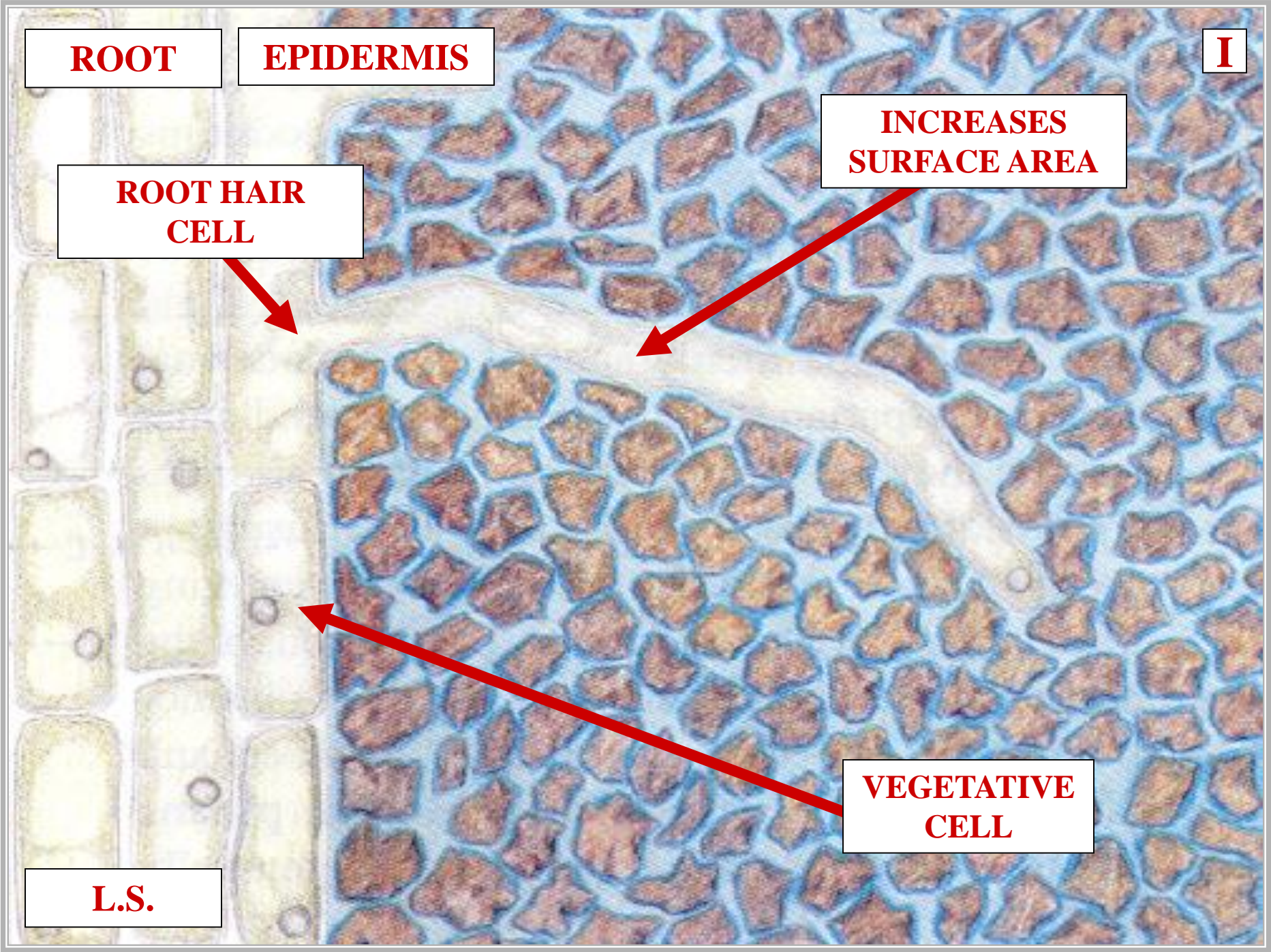
**I**

**ROOT HAIR  
CELL**

**INCREASES  
SURFACE AREA**

**VEGETATIVE  
CELL**

**L.S.**



**ROOT**

**EPIDERMIS**

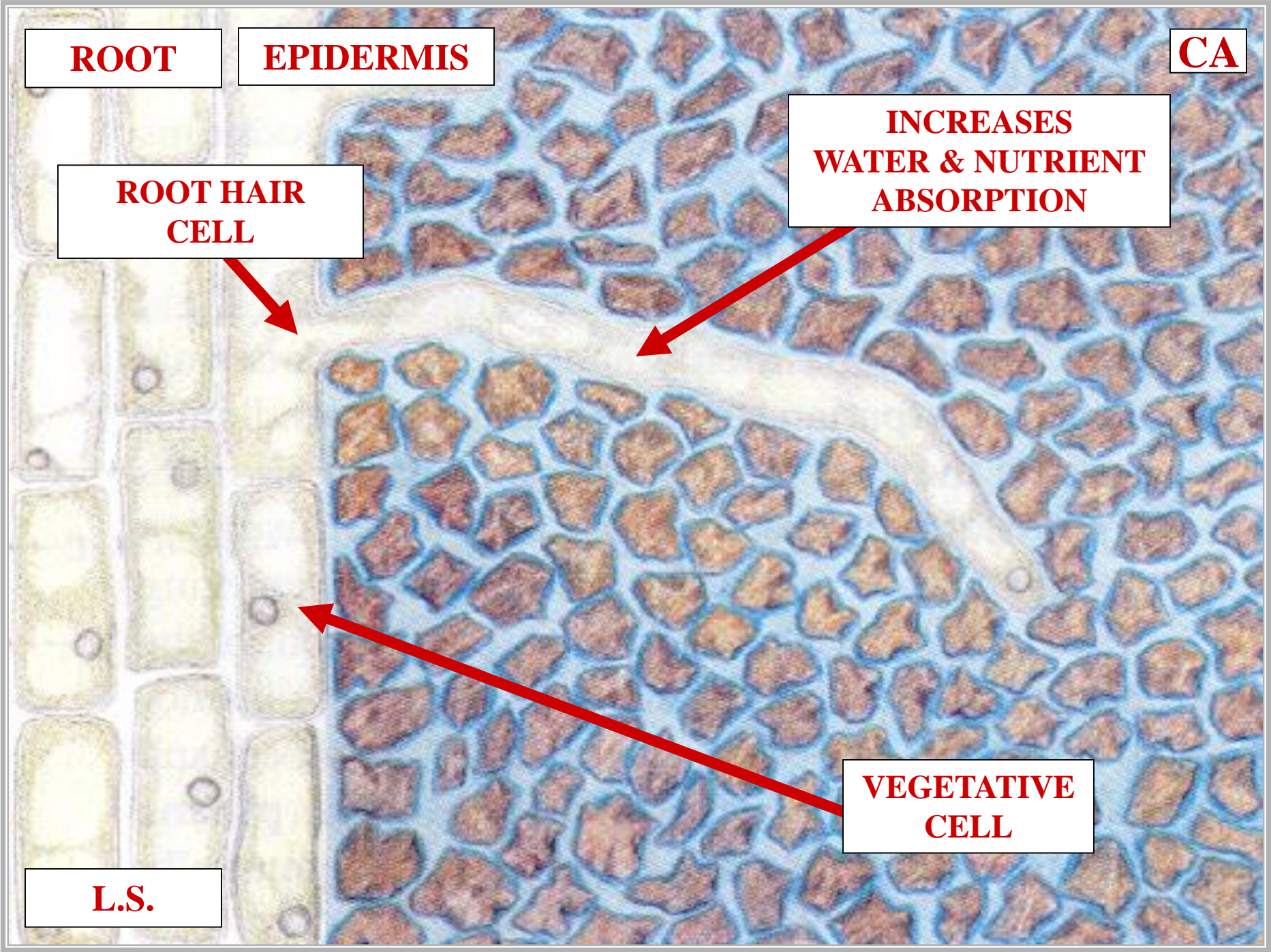
**CA**

**ROOT HAIR  
CELL**

**INCREASES  
WATER & NUTRIENT  
ABSORPTION**

**VEGETATIVE  
CELL**

**L.S.**



**ROOT**

**EPIDERMIS**

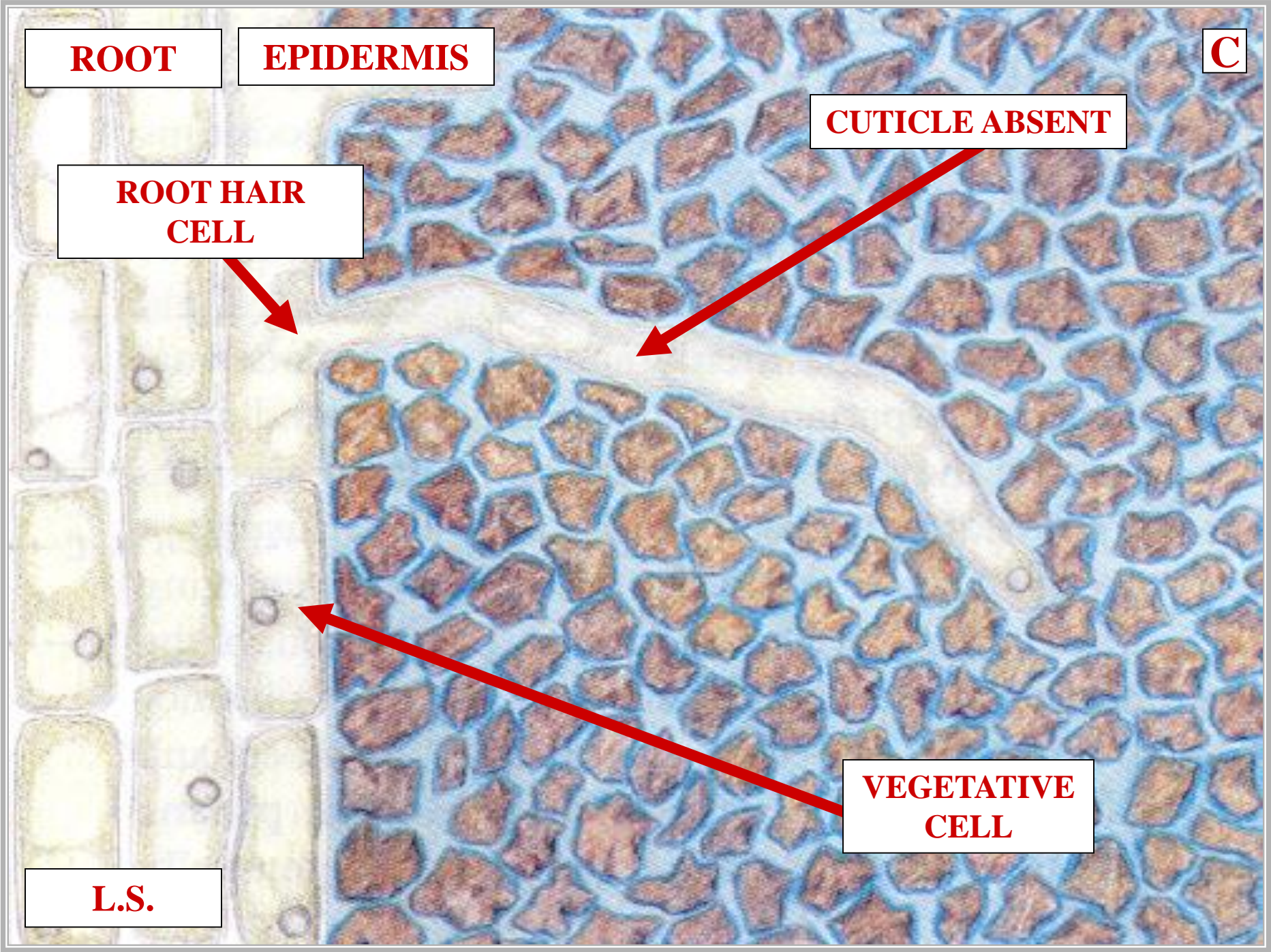
**C**

**CUTICLE ABSENT**

**ROOT HAIR  
CELL**

**VEGETATIVE  
CELL**

**L.S.**





**ROOT**

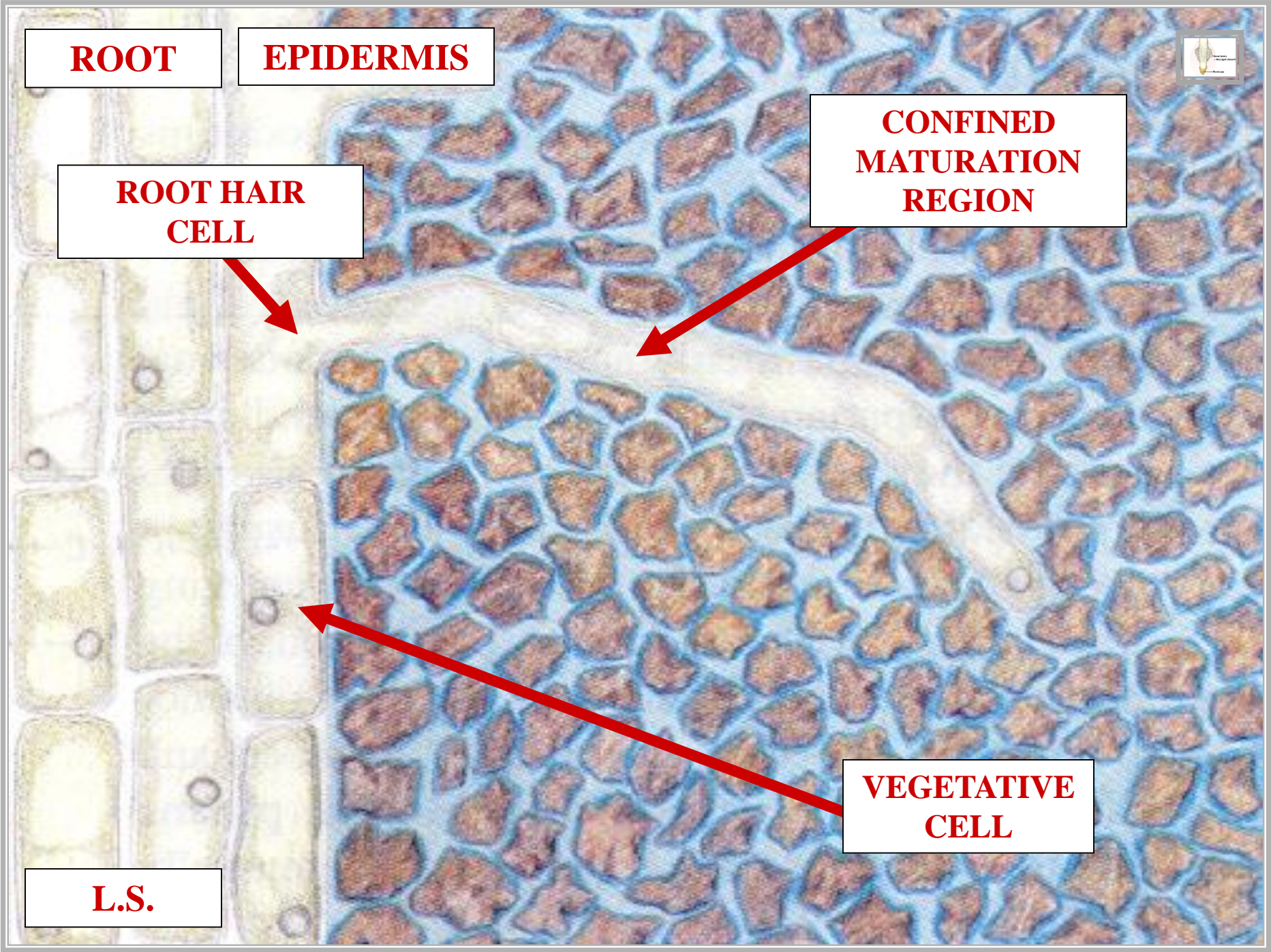
**EPIDERMIS**

**ROOT HAIR  
CELL**

**CONFINED  
MATURATION  
REGION**

**VEGETATIVE  
CELL**

**L.S.**





**ROOT**

**L.S**

**MATURATION  
REGION**

**ROOT  
DIFFERENTIATION  
REGIONS**

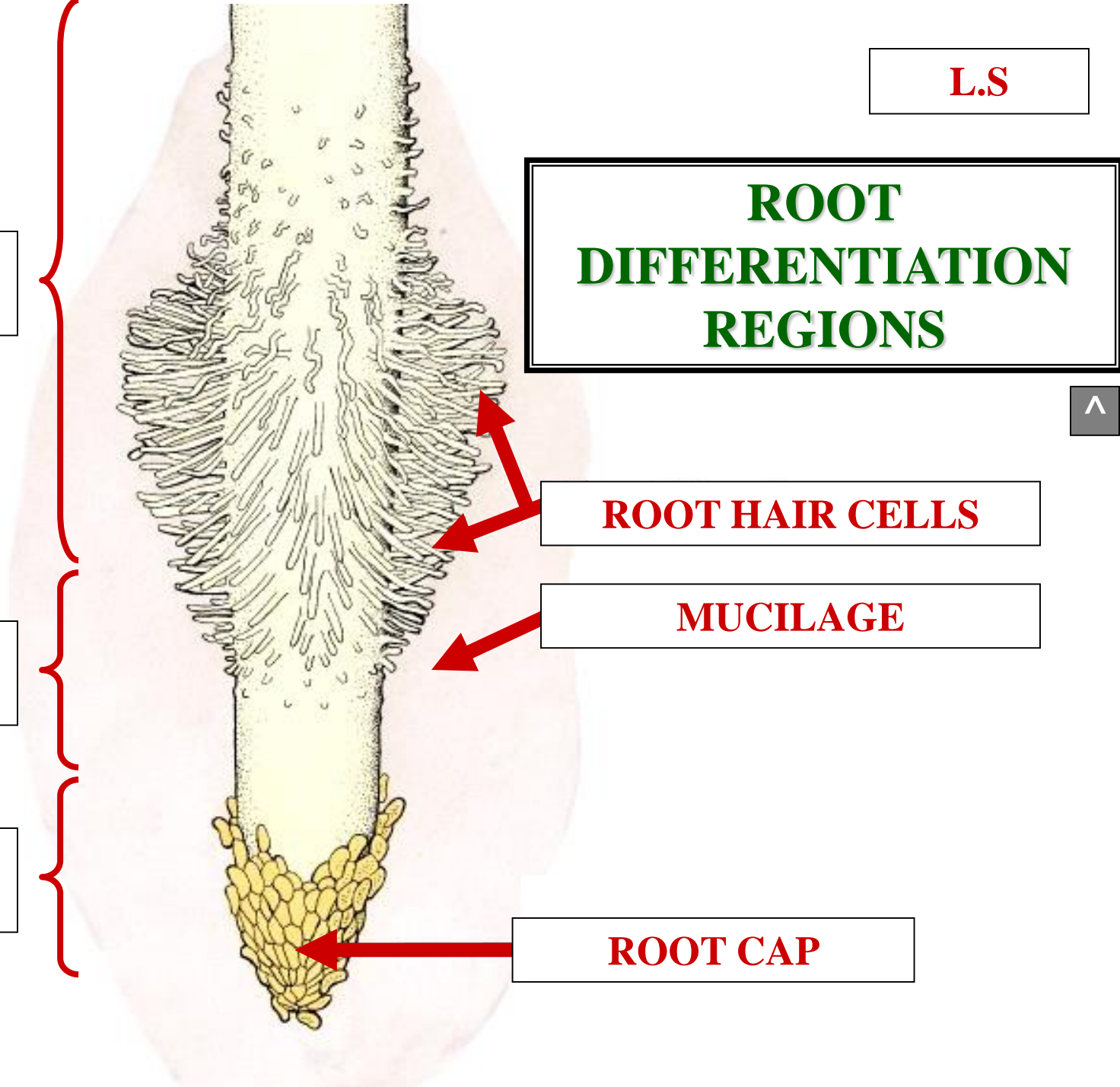
**ELONGATION  
REGION**

**ROOT HAIR CELLS**

**MUCILAGE**

**DIVISION  
REGION**

**ROOT CAP**

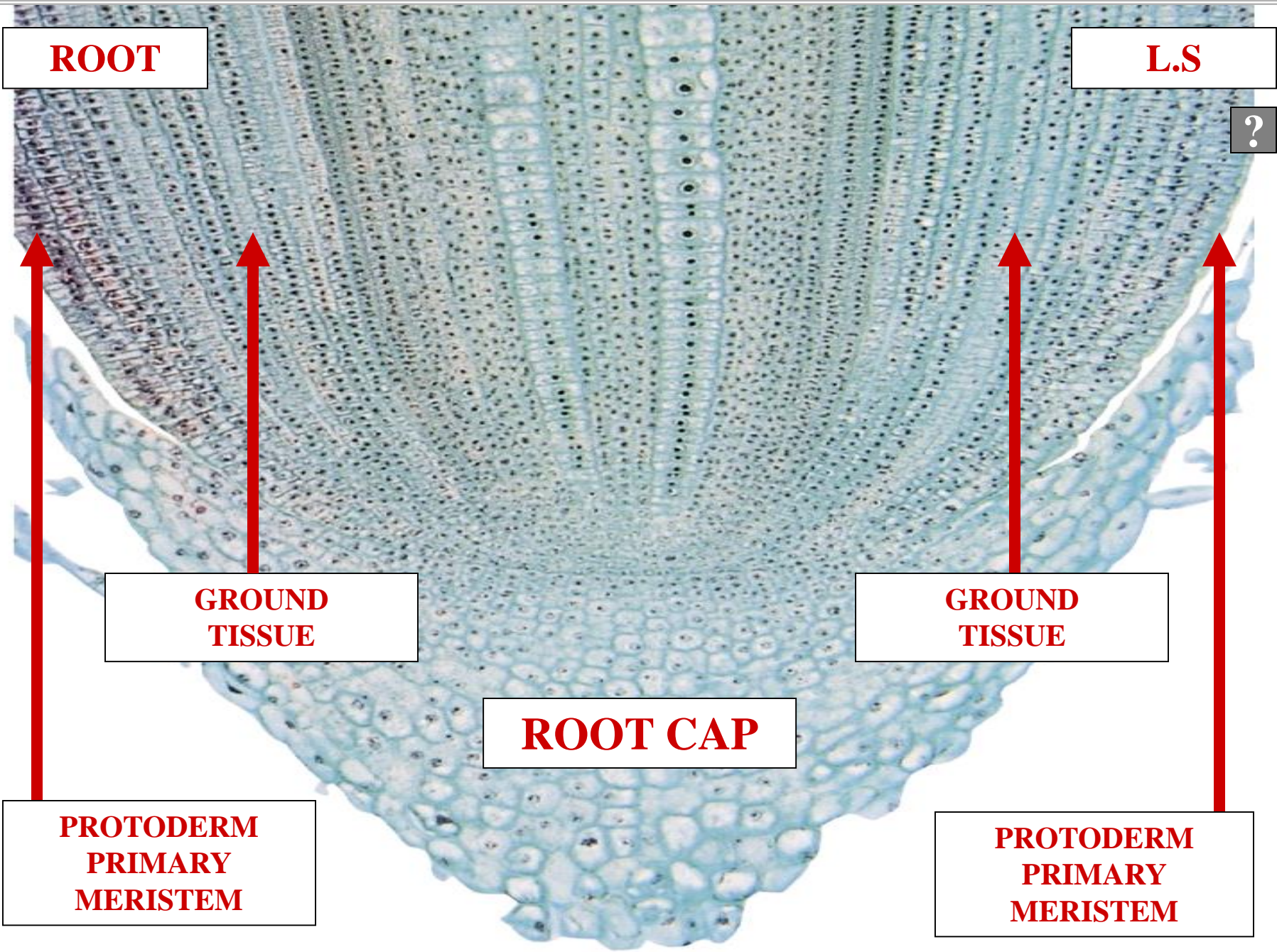




# ROOT GROUND TISSUE



**ROOT**  
**GROUND TISSUE**  
**PRIMARY**  
**MERISTEM**



**ROOT**

**L.S**

?

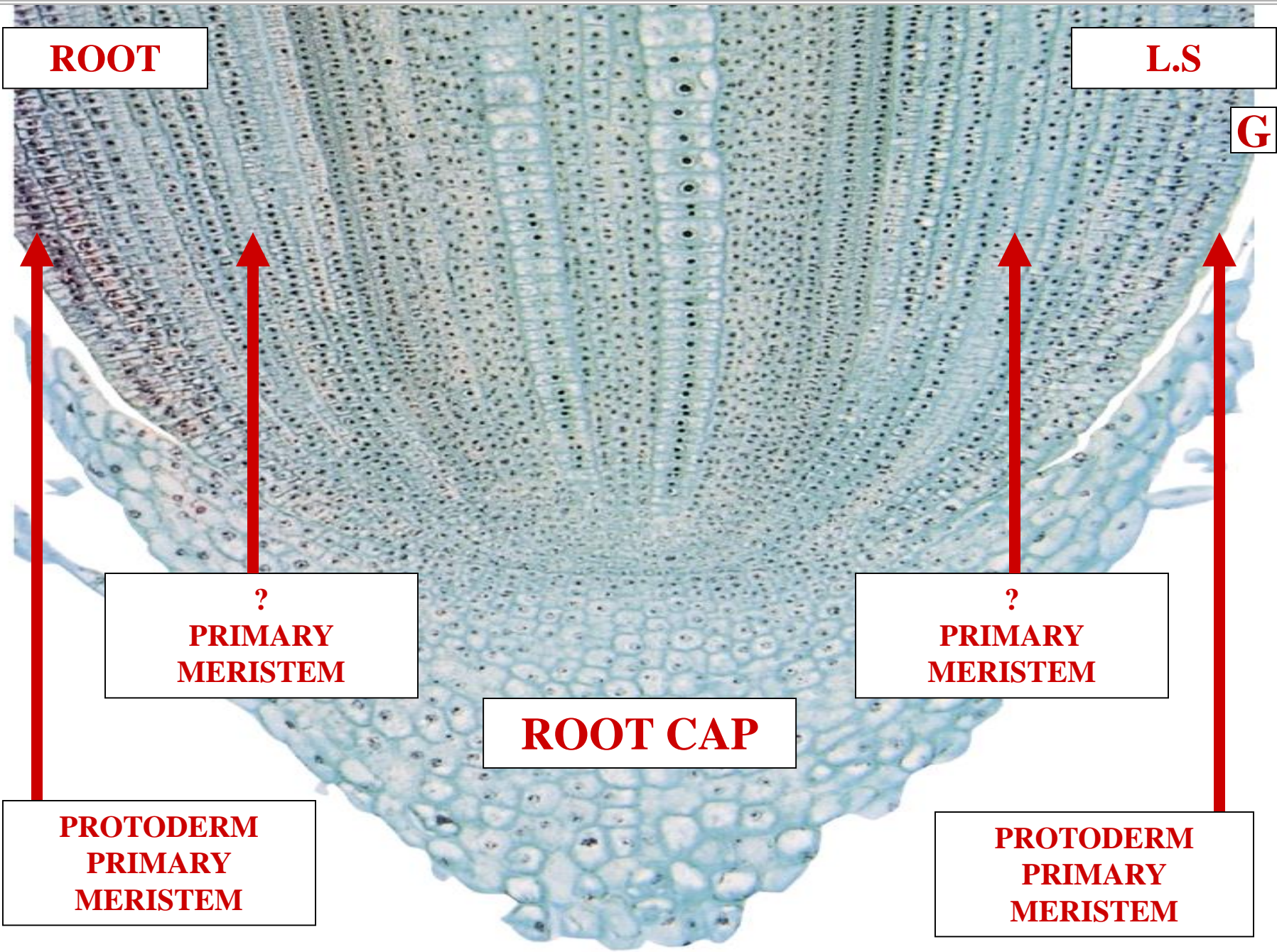
**GROUND  
TISSUE**

**GROUND  
TISSUE**

**ROOT CAP**

**PROTODERM  
PRIMARY  
MERISTEM**

**PROTODERM  
PRIMARY  
MERISTEM**



**ROOT**

**L.S**

**G**

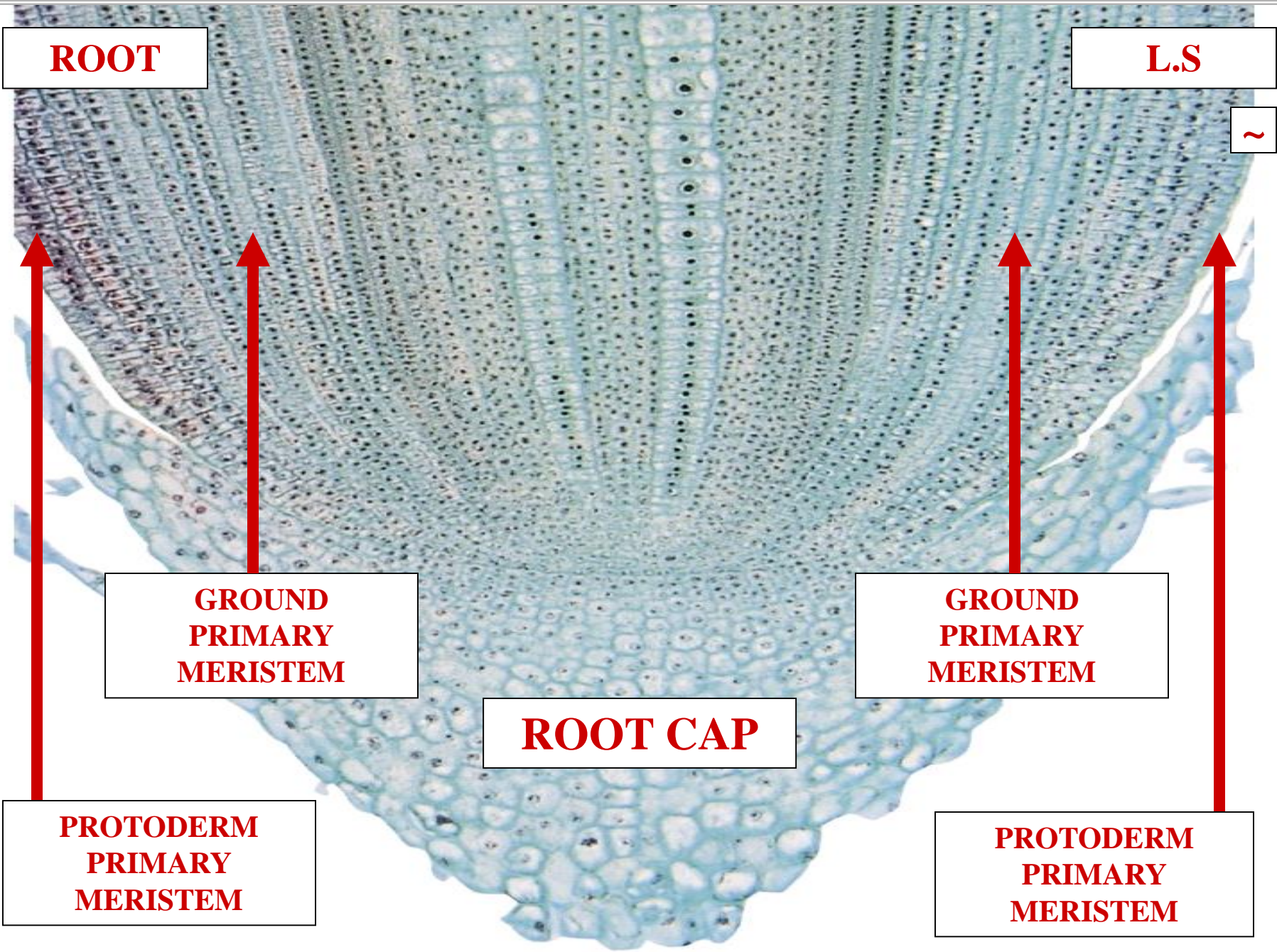
**?  
PRIMARY  
MERISTEM**

**?  
PRIMARY  
MERISTEM**

**ROOT CAP**

**PROTODERM  
PRIMARY  
MERISTEM**

**PROTODERM  
PRIMARY  
MERISTEM**



**ROOT**

**L.S.**

~

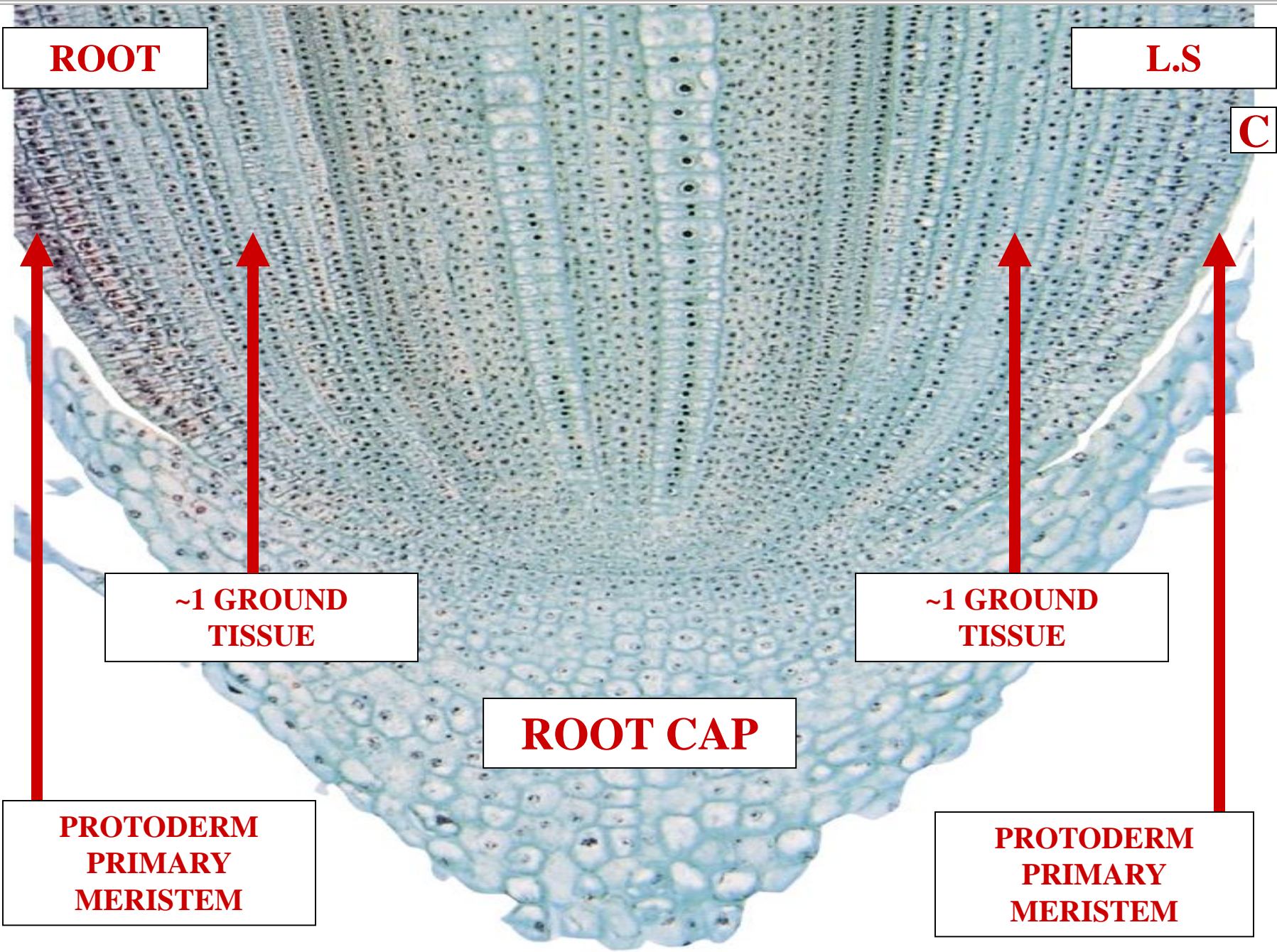
**GROUND  
PRIMARY  
MERISTEM**

**GROUND  
PRIMARY  
MERISTEM**

**ROOT CAP**

**PROTODERM  
PRIMARY  
MERISTEM**

**PROTODERM  
PRIMARY  
MERISTEM**



**ROOT**

**L.S**

**C**

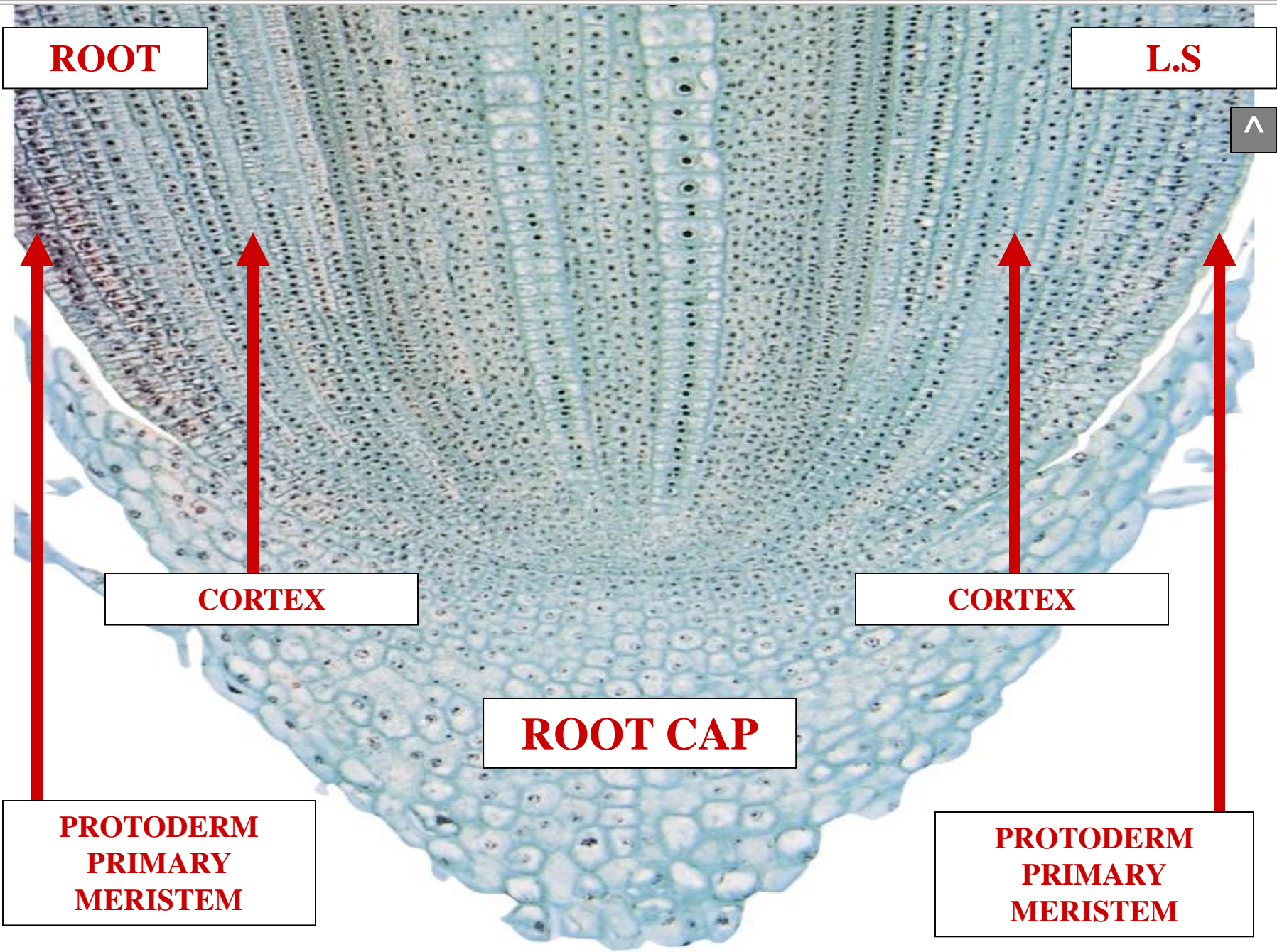
**~1 GROUND  
TISSUE**

**~1 GROUND  
TISSUE**

**ROOT CAP**

**PROTODERM  
PRIMARY  
MERISTEM**

**PROTODERM  
PRIMARY  
MERISTEM**



**ROOT**

**L.S**

**CORTEX**

**CORTEX**

**ROOT CAP**

**PROTODERM  
PRIMARY  
MERISTEM**

**PROTODERM  
PRIMARY  
MERISTEM**



# ROOT CORTEX

**CORTEX**

**ROOT ANATOMY**

**ROOT CORTEX**

**TISSUE REGION**

**BETWEEN**

**EPIDERMIS AND STELE**

**ROOT ANATOMY**

**ROOT CORTEX**



