

FISIOLOGIA DO CRESCIMENTO E DESENVOLVIMENTO VEGETAL

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UNIVERSIDADE FEDERAL DO PARANÁ



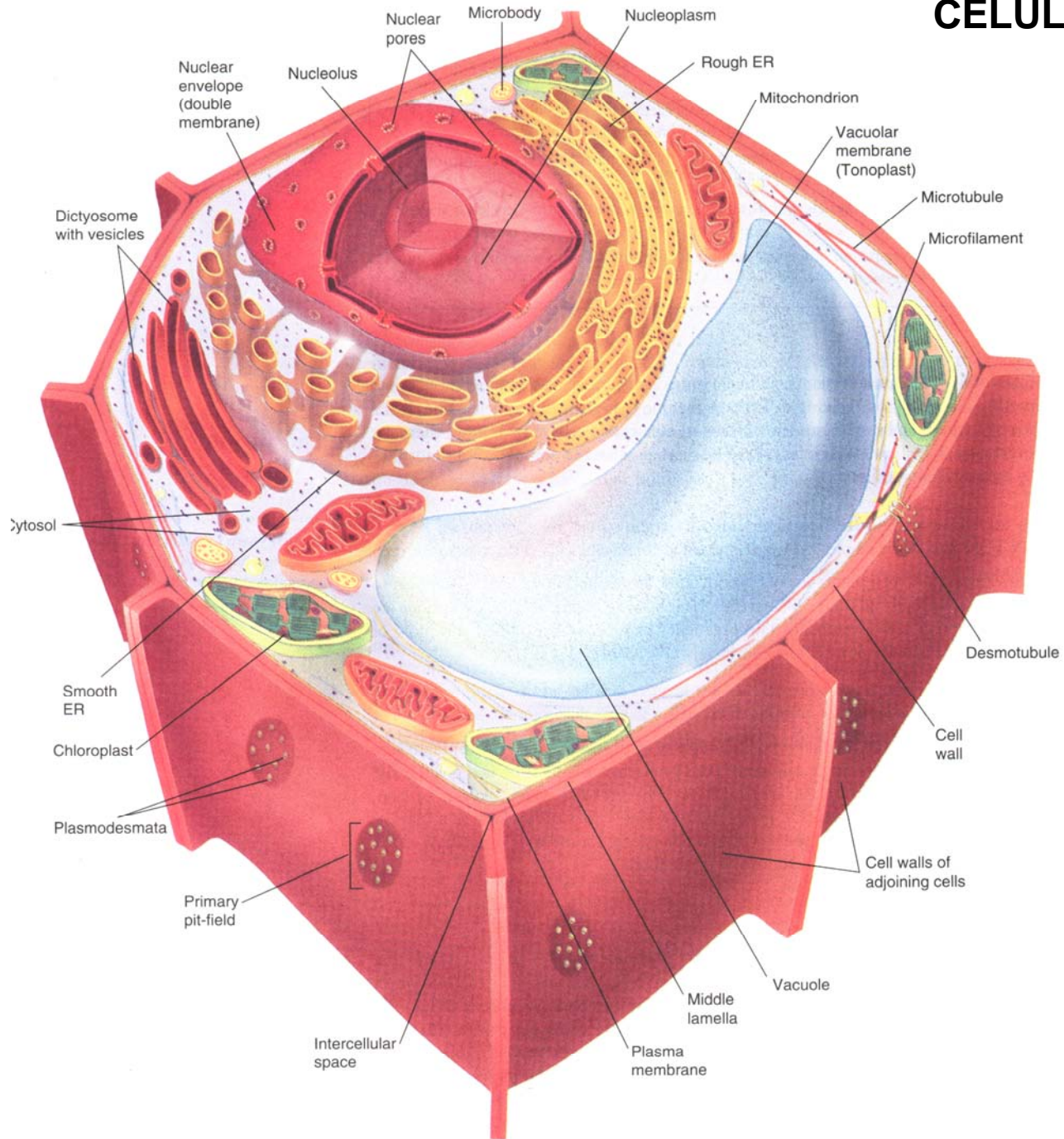
kazu@ufpr.br



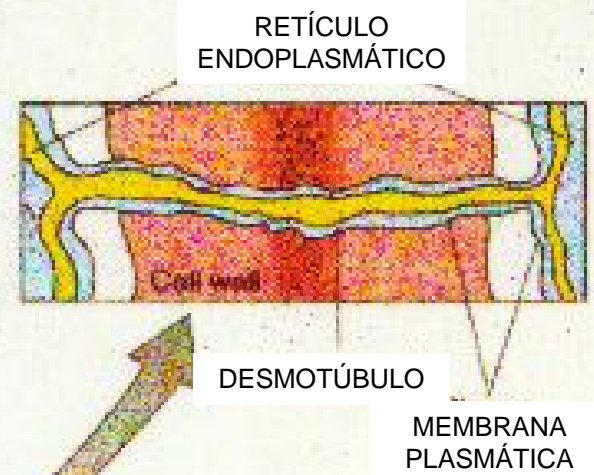
FISIOLOGIA CELULAR

Katia Christina Zuffellato-Ribas

CÉLULA VEGETAL



CÉLULA VEGETAL



PAREDE CELULAR

PLASMODESMOS

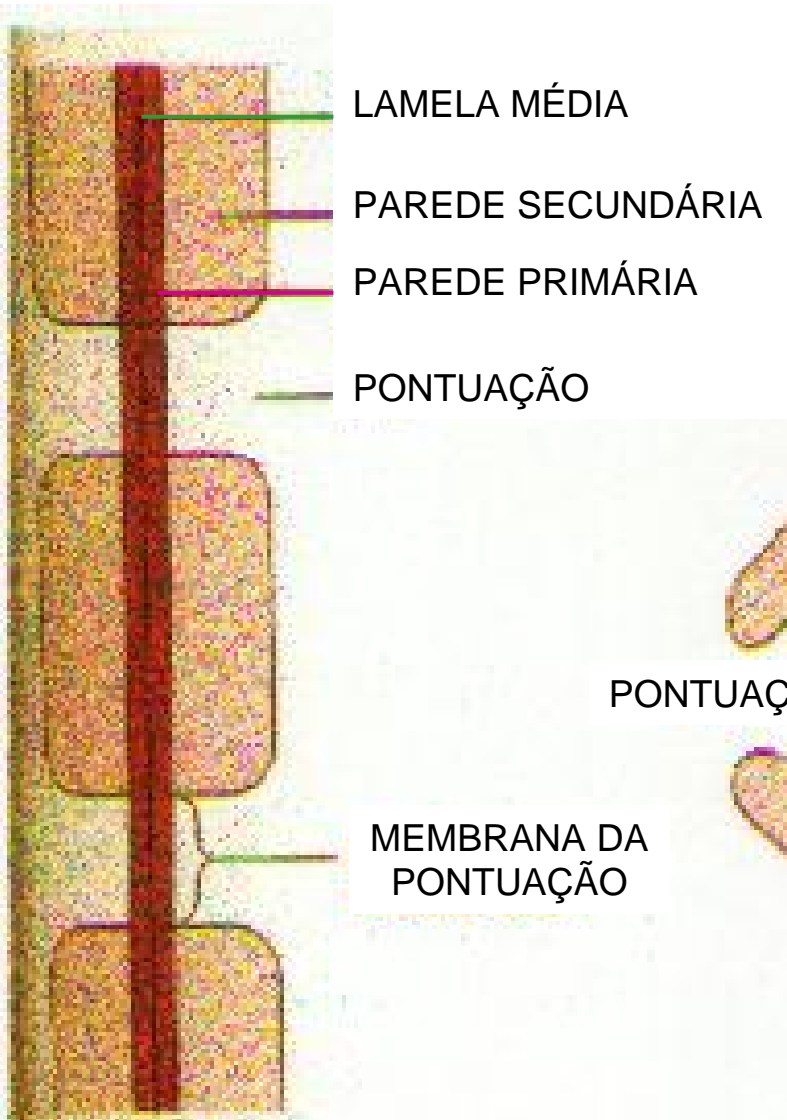
MEMBRANA PLASMÁTICA

RETÍCULO ENDOPLASMÁTICO

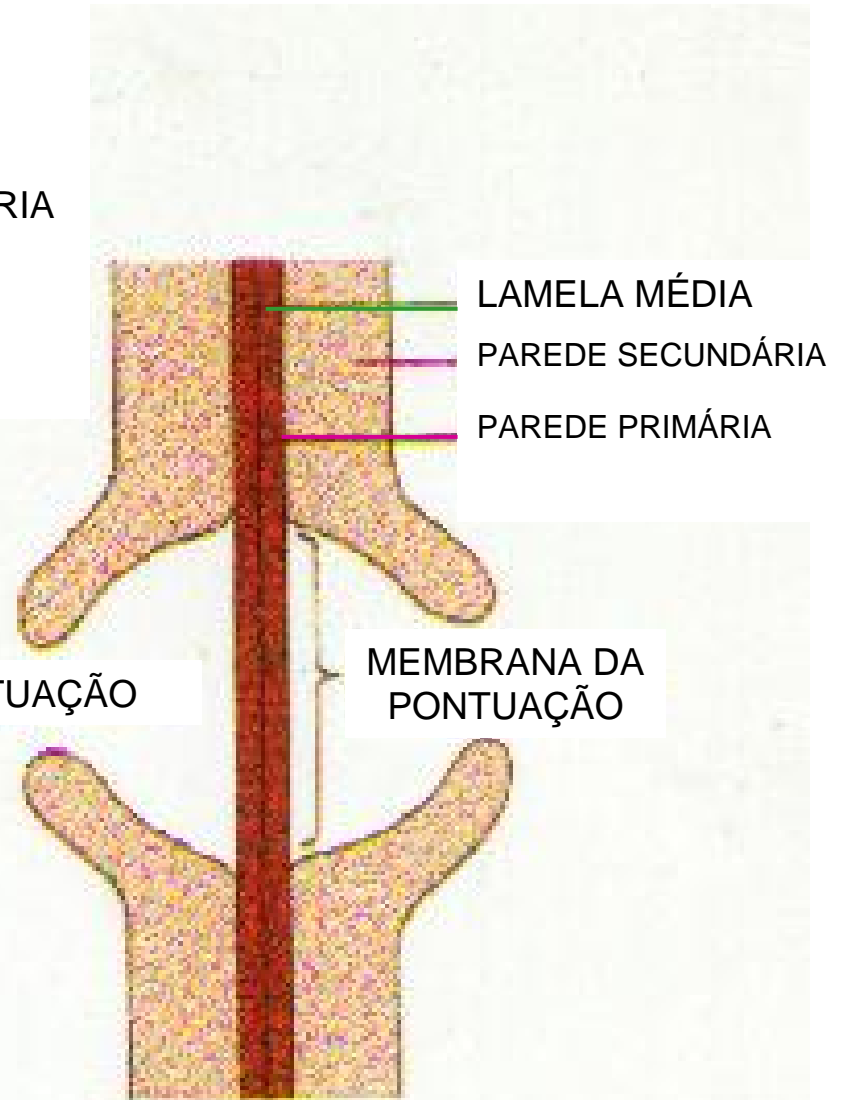
DESMOTÚBULO

MEMBRANA PLASMÁTICA

CÉLULA VEGETAL

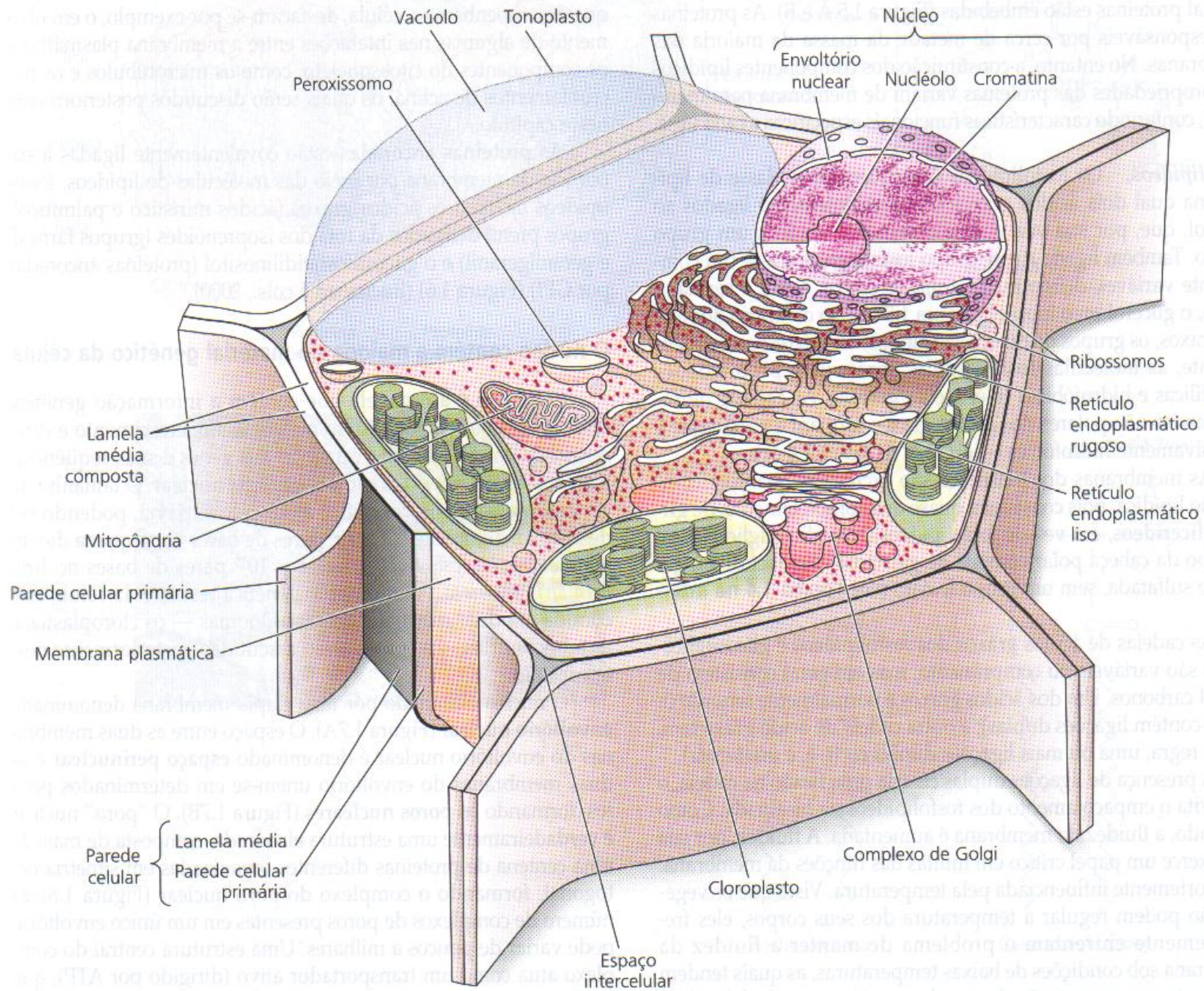


PONTUAÇÃO SIMPLES

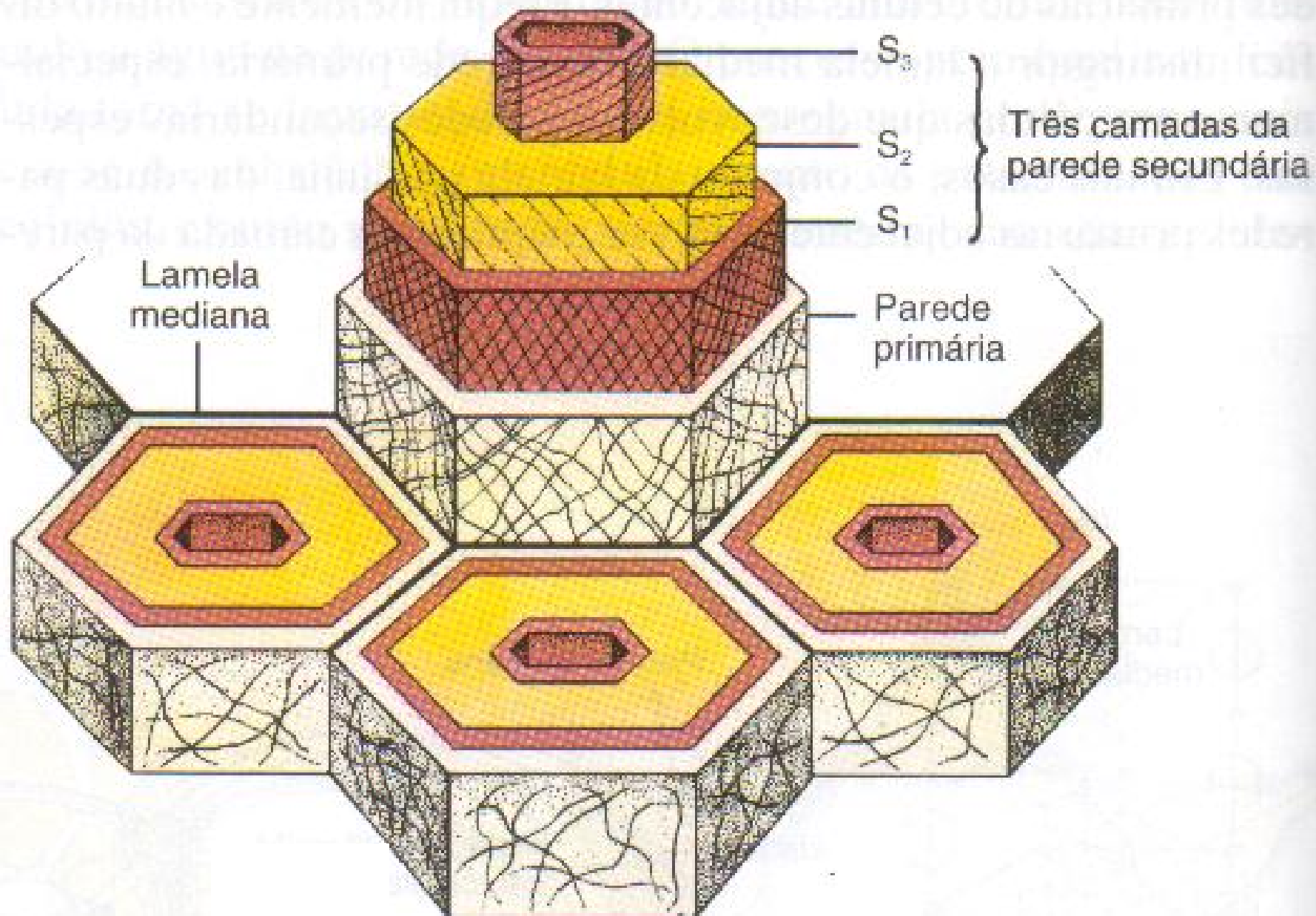


PONTUAÇÃO AREOLADA

CÉLULA VEGETAL



PAREDE CELULAR



PAREDE CELULAR PRIMÁRIA:

10% DE FIBRILAS DE CELULOSE

HEMICELULOSE

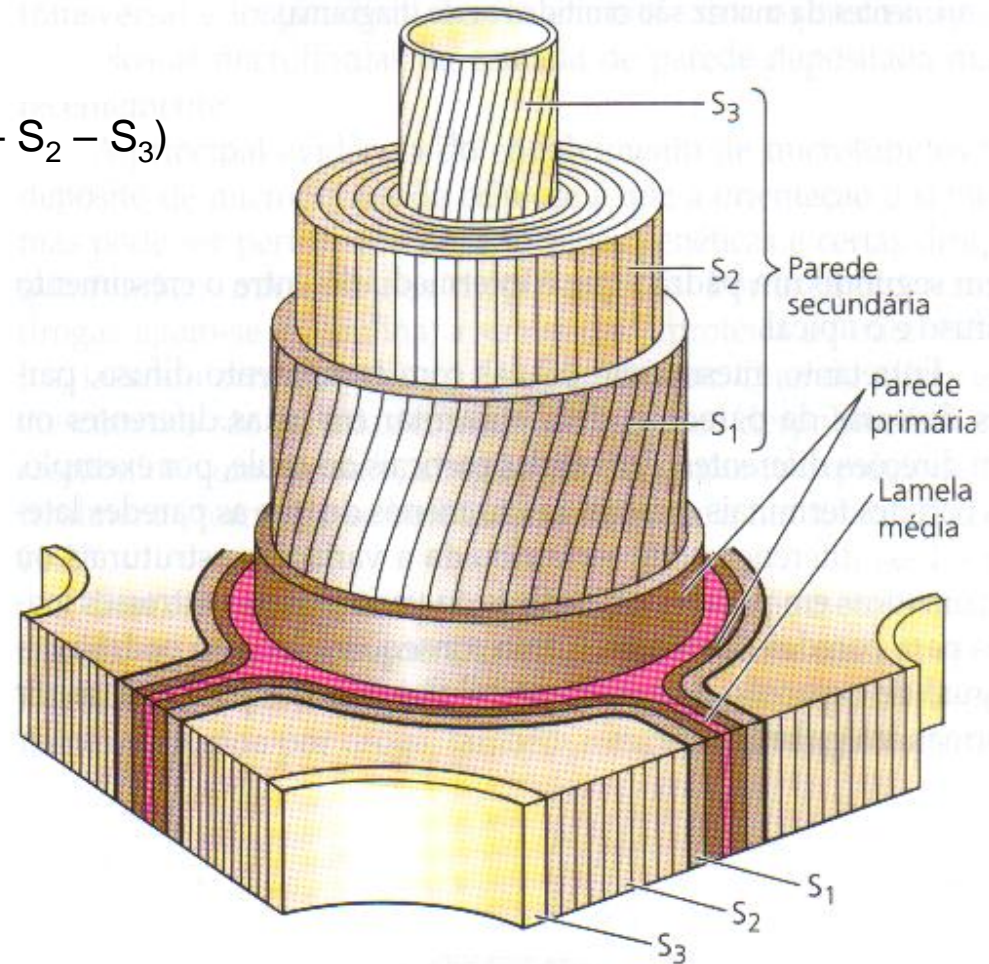
COMPOSTOS PÉCTICOS

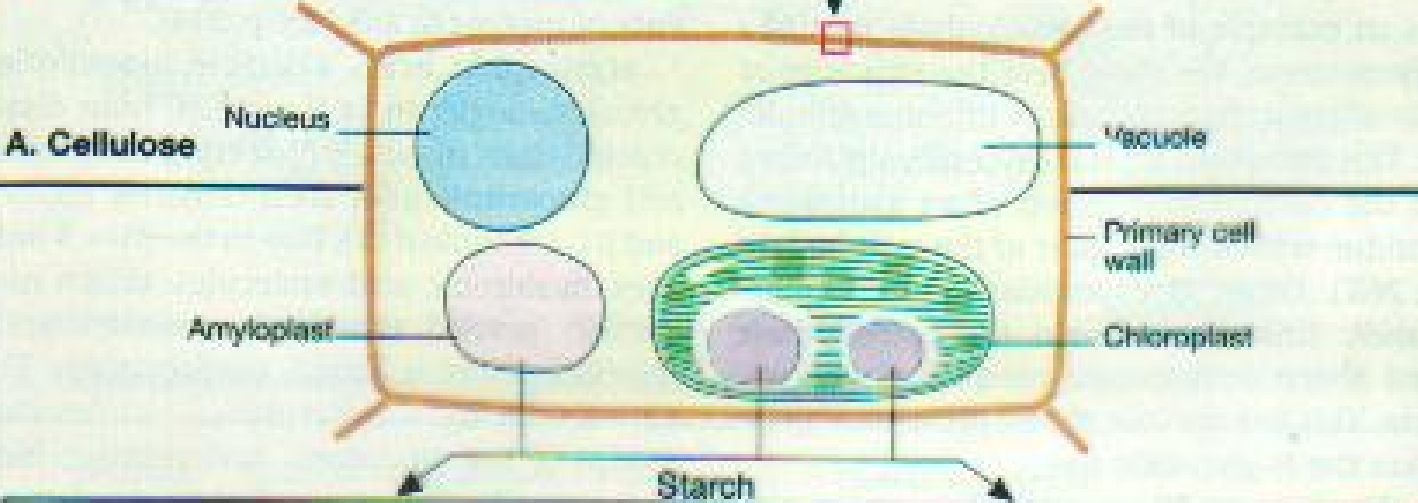
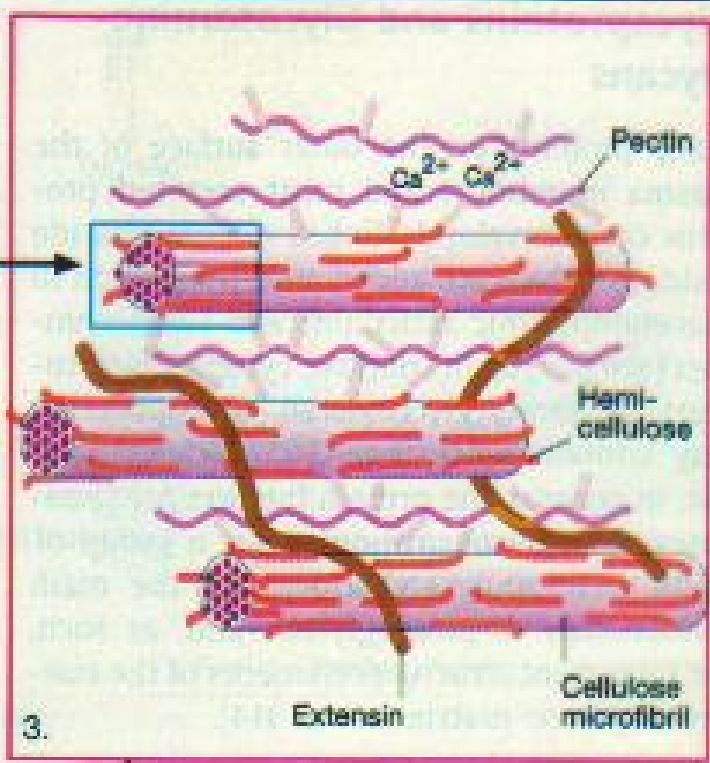
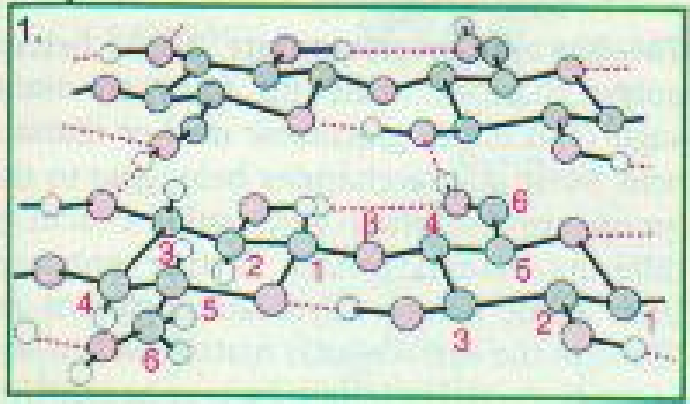
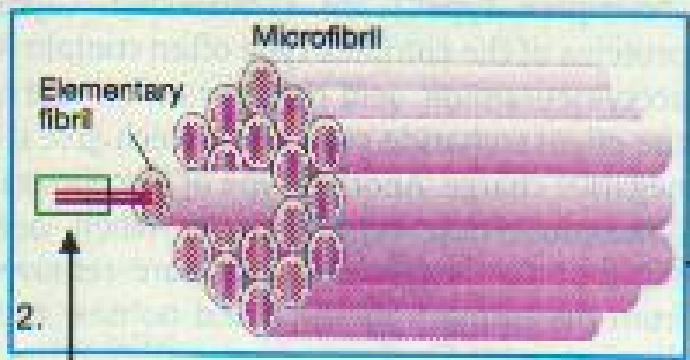
PAREDE CELULAR SECUNDÁRIA:

50% DE FIBRILAS DE CELULOSE ($S_1 - S_2 - S_3$)

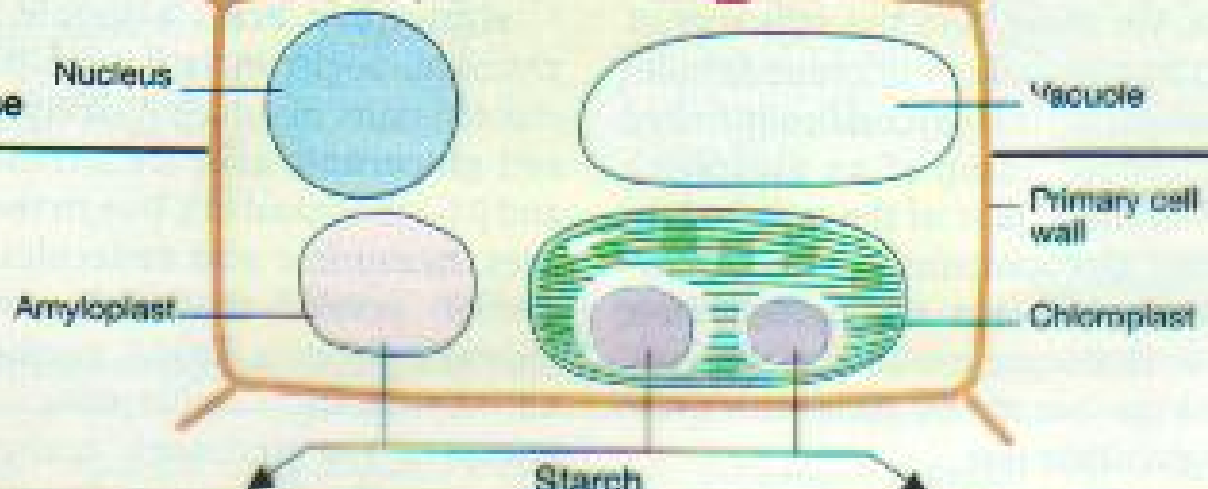
HEMICELULOSE

COMPOSTOS PÉCTICOS

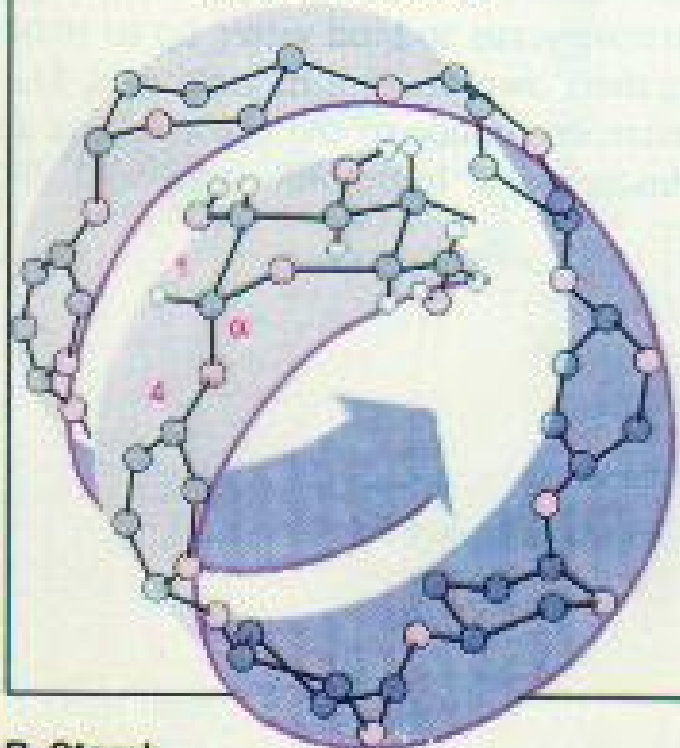




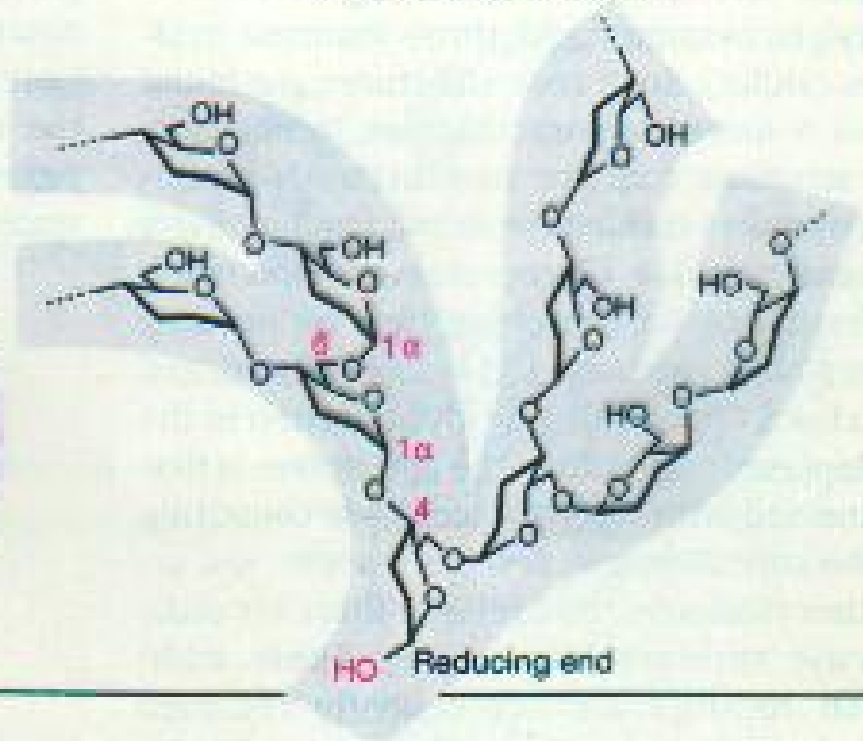
A. Cellulose



1. Amylose 20%

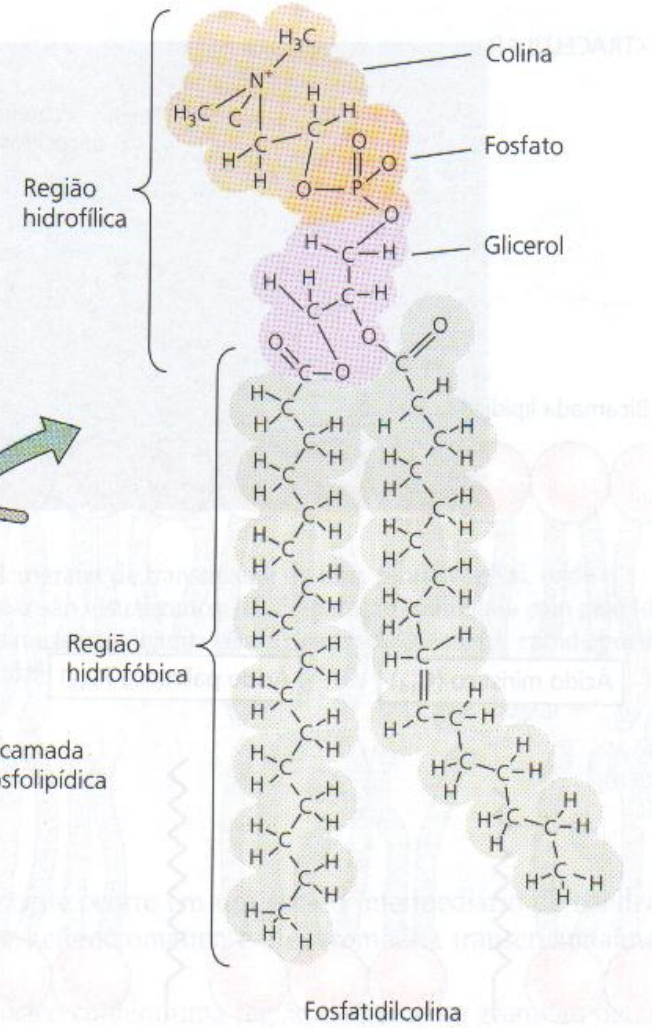
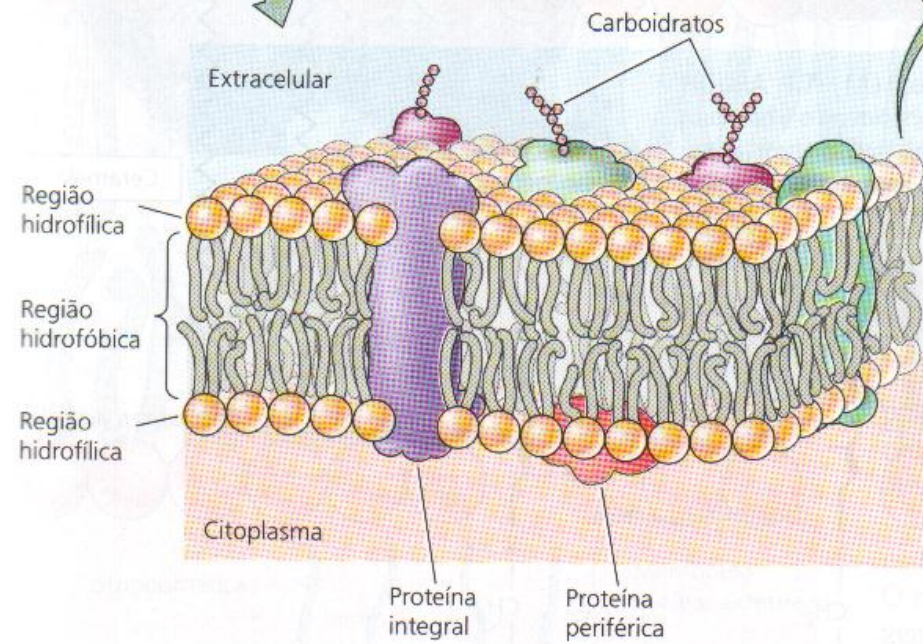
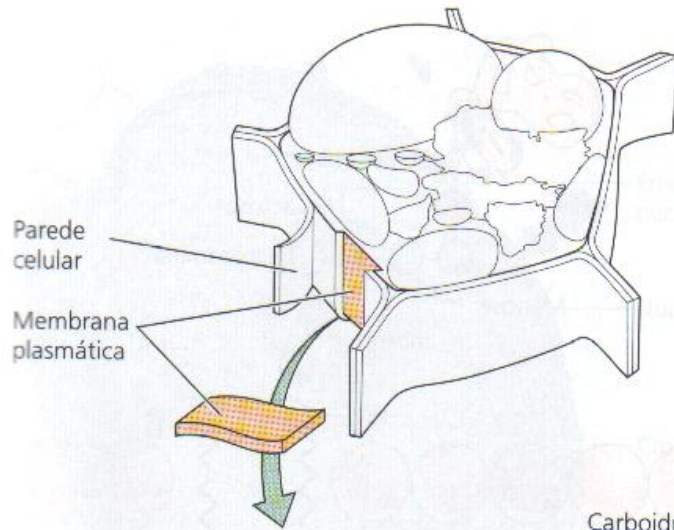


2. Amylopectin 80%

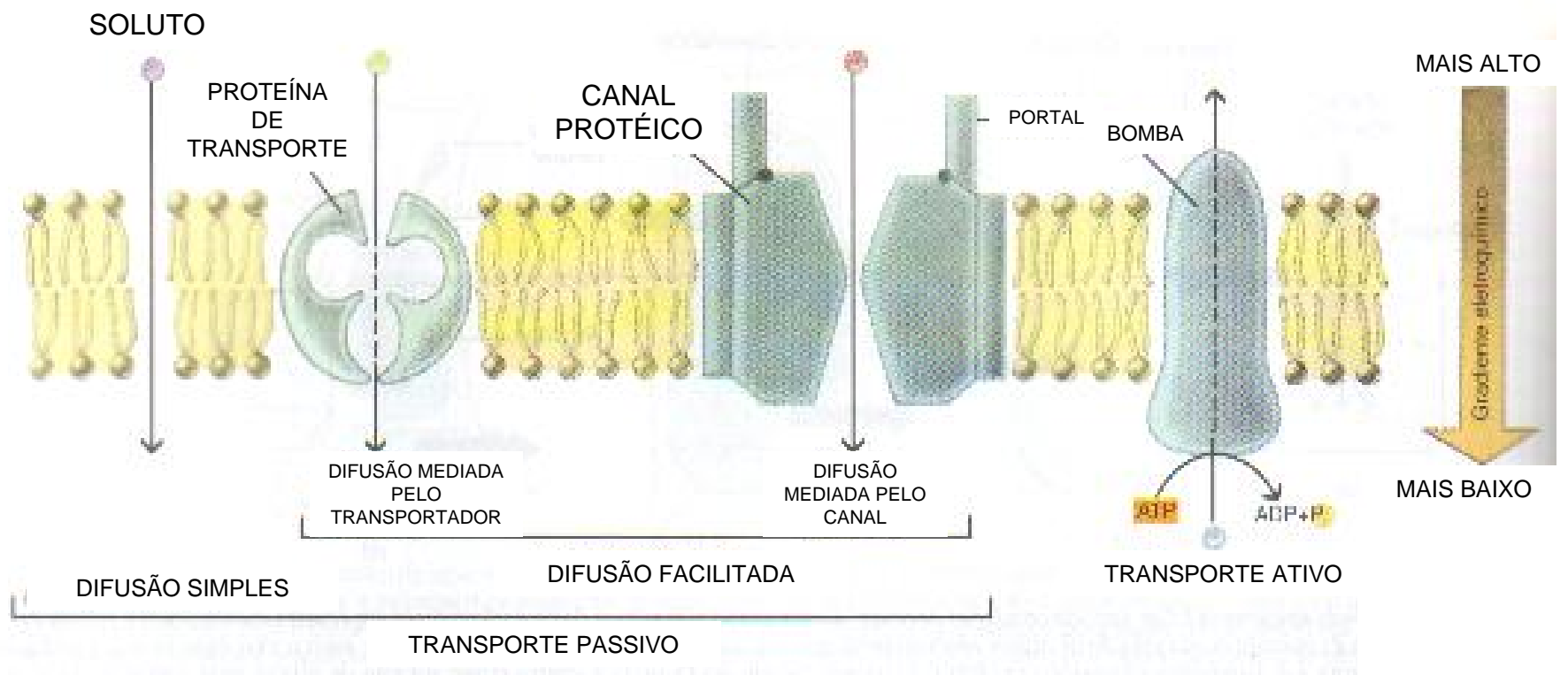


B. Starch

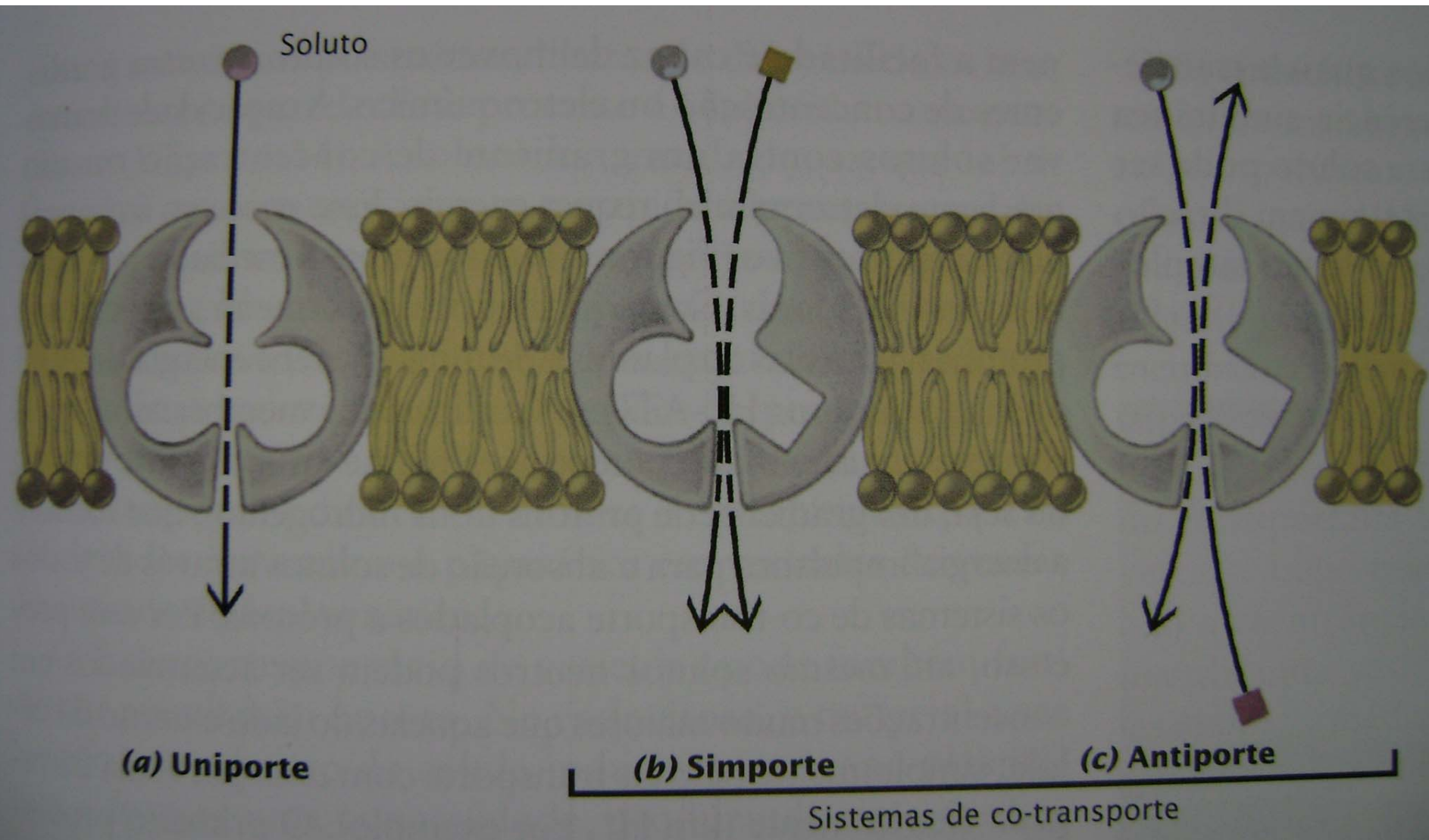
MEMBRANA PLASMÁTICA

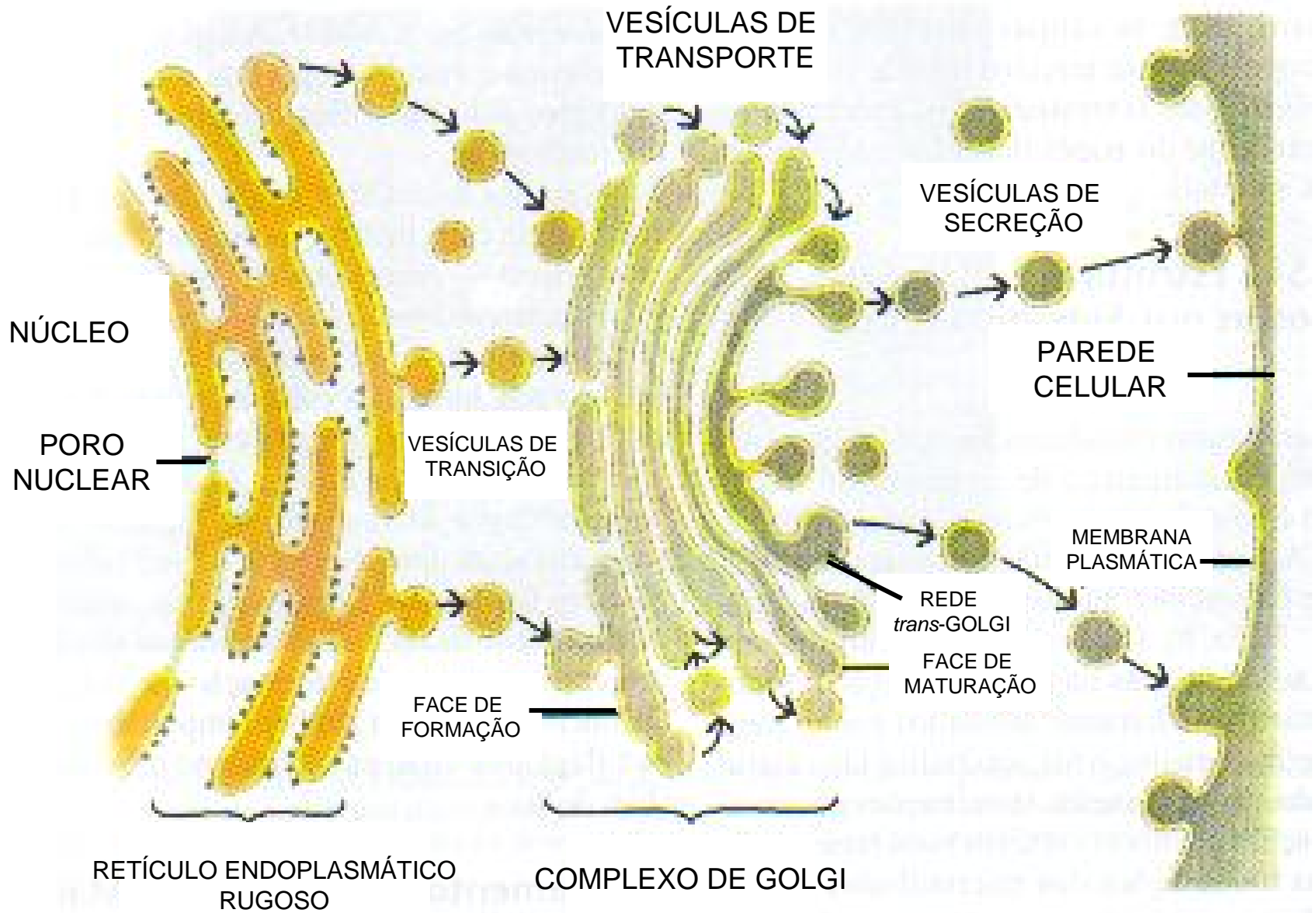


PROTEÍNAS TRANSPORTADORAS



PROTEÍNAS TRANSPORTADORAS





(a)

Recepção

(b)

Transdução

(c)

Indução

Receptor

Hormônio

Reações que produzem

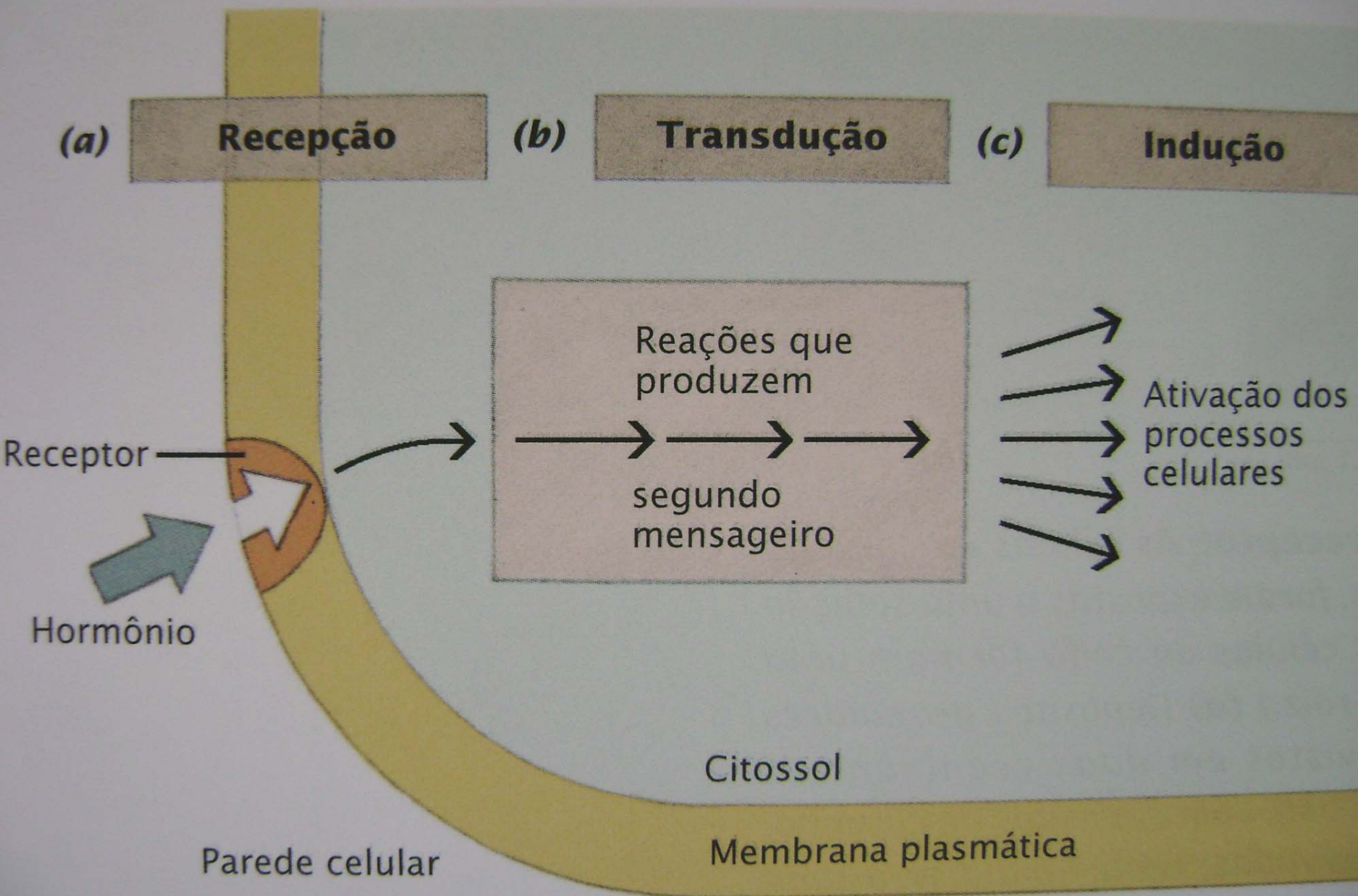
segundo mensageiro

Ativação dos processos celulares

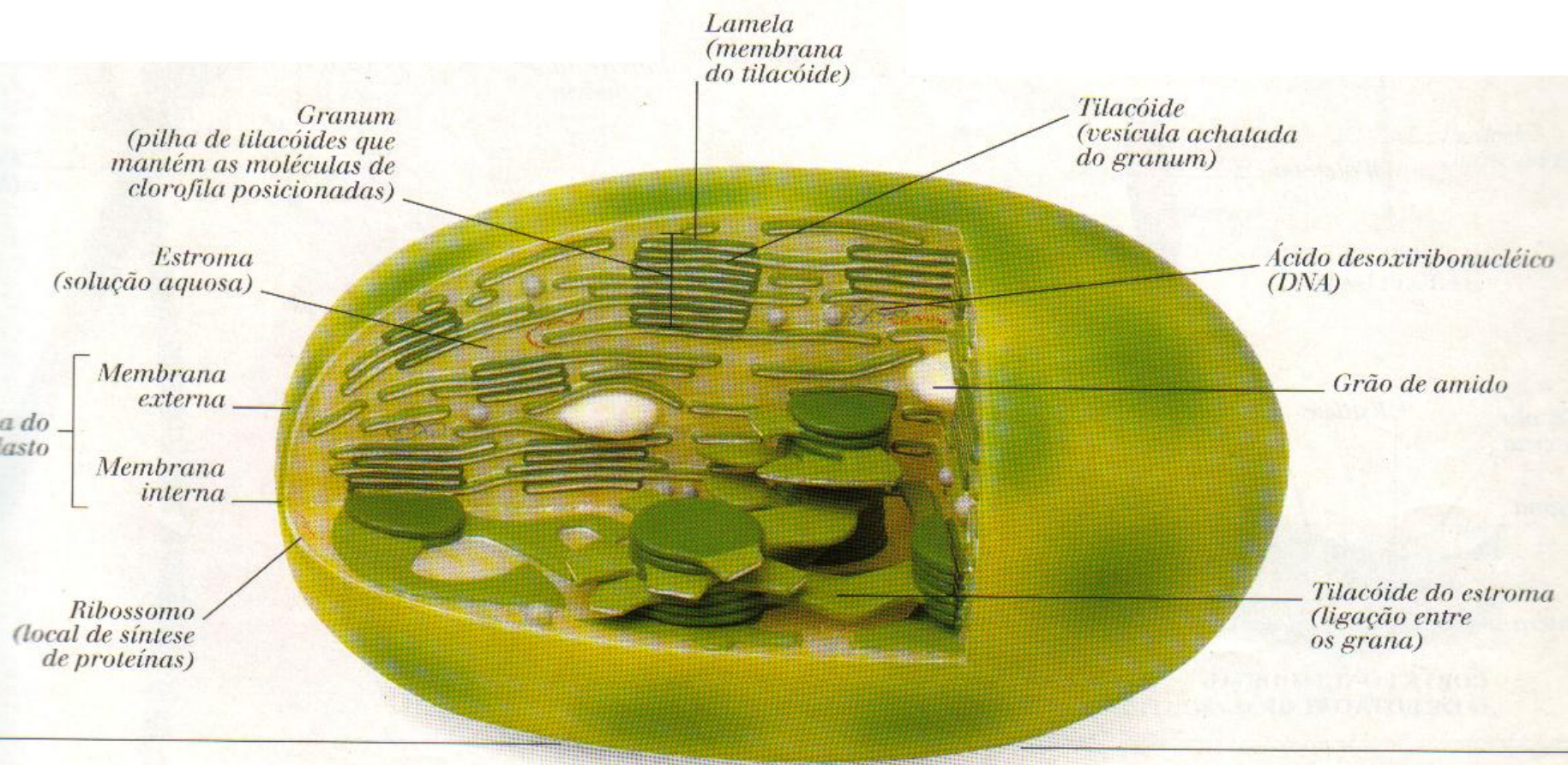
Citossol

Parede celular

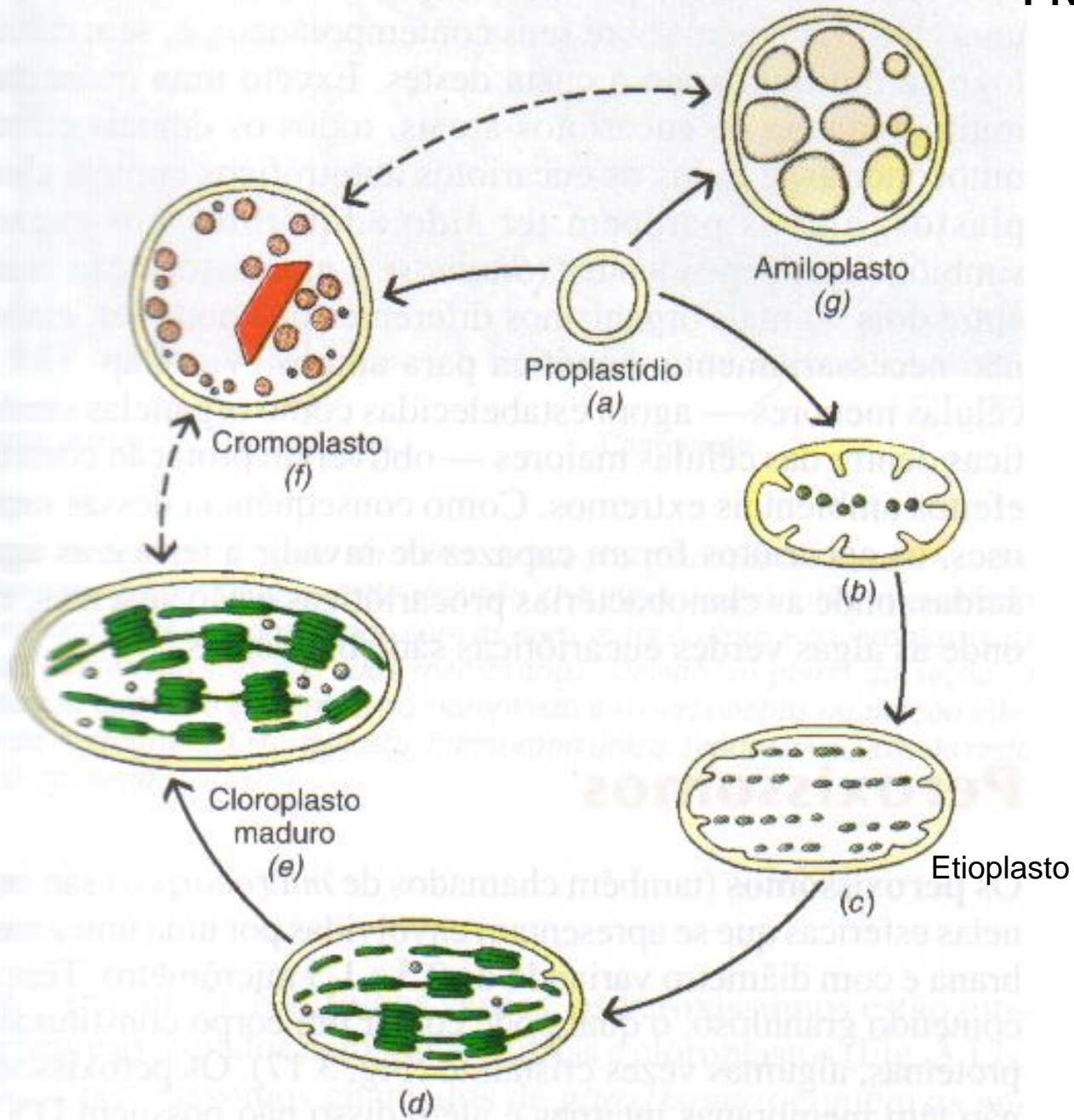
Membrana plasmática

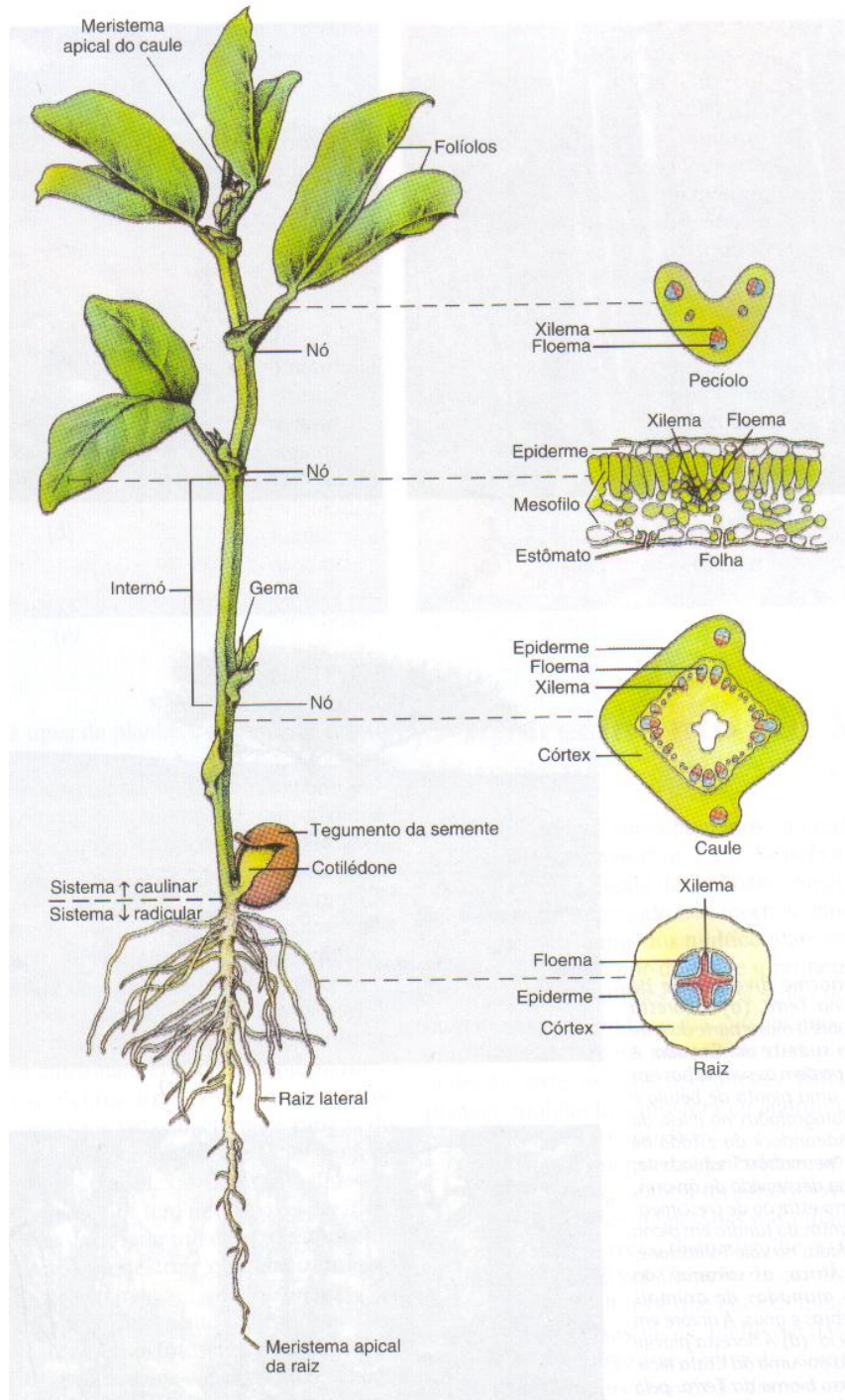


COLORPLASTO



PROPLASTÍDIO





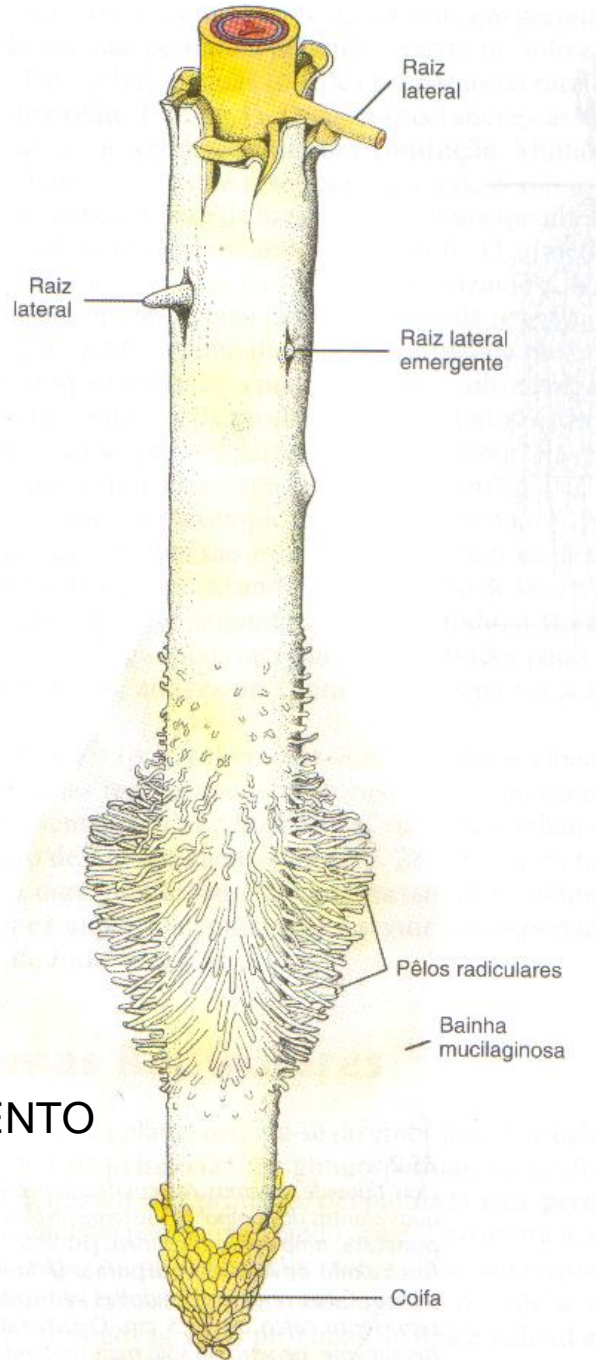
COLO

ZONA DE RAMIFICAÇÃO

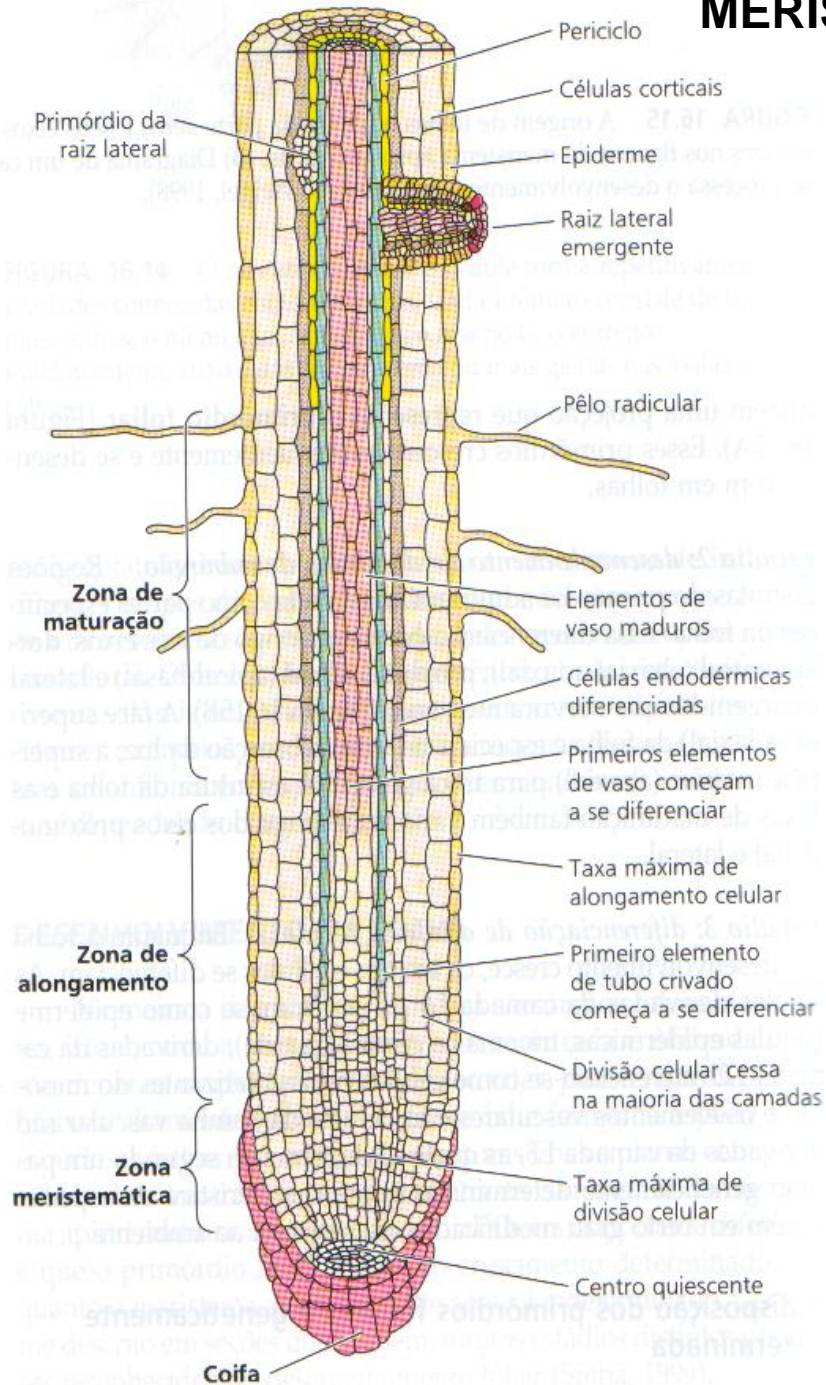
ZONA PILÍFERA

ZONA LISA OU DE ALONGAMENTO

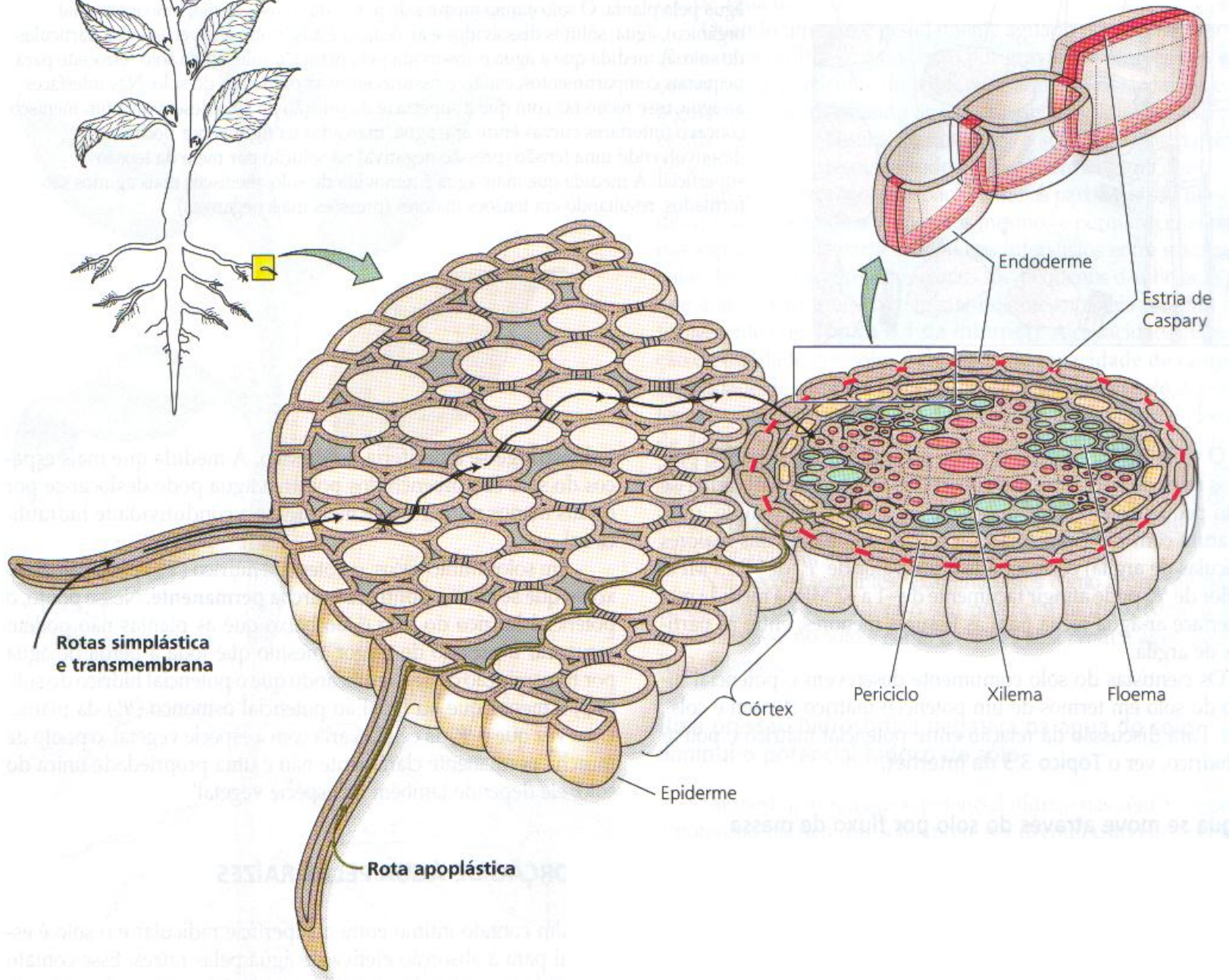
ZONA MERISTEMÁTICA



MERISTEMA SUB-APICAL DE RAIZ

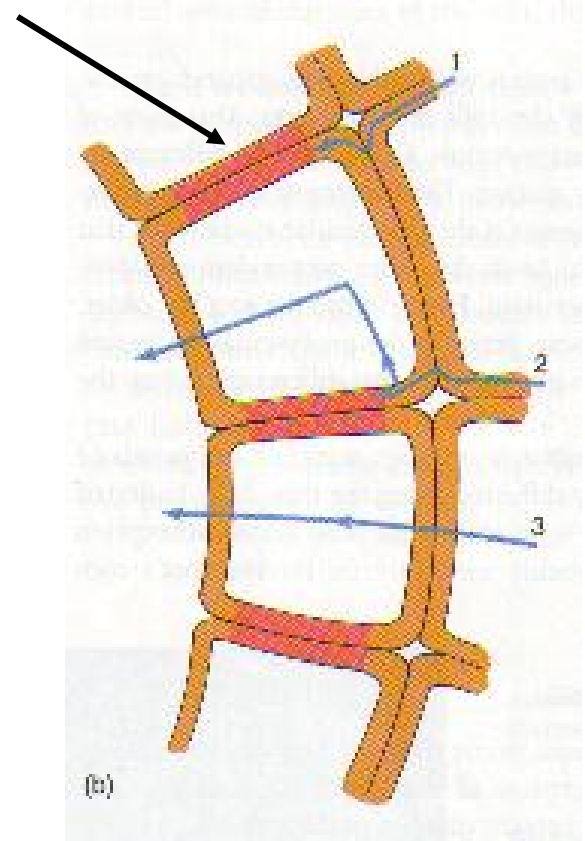
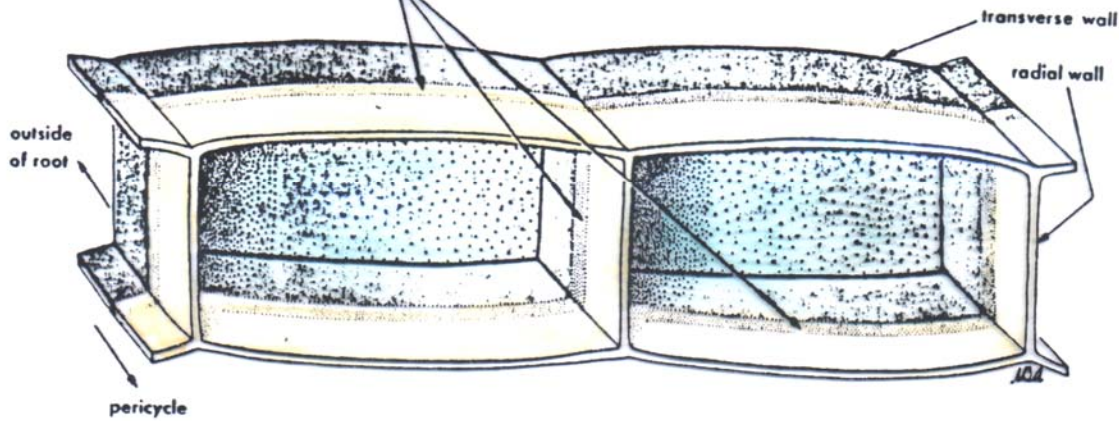


ABSORÇÃO DE ÁGUA E DE SAIS MINERAIS



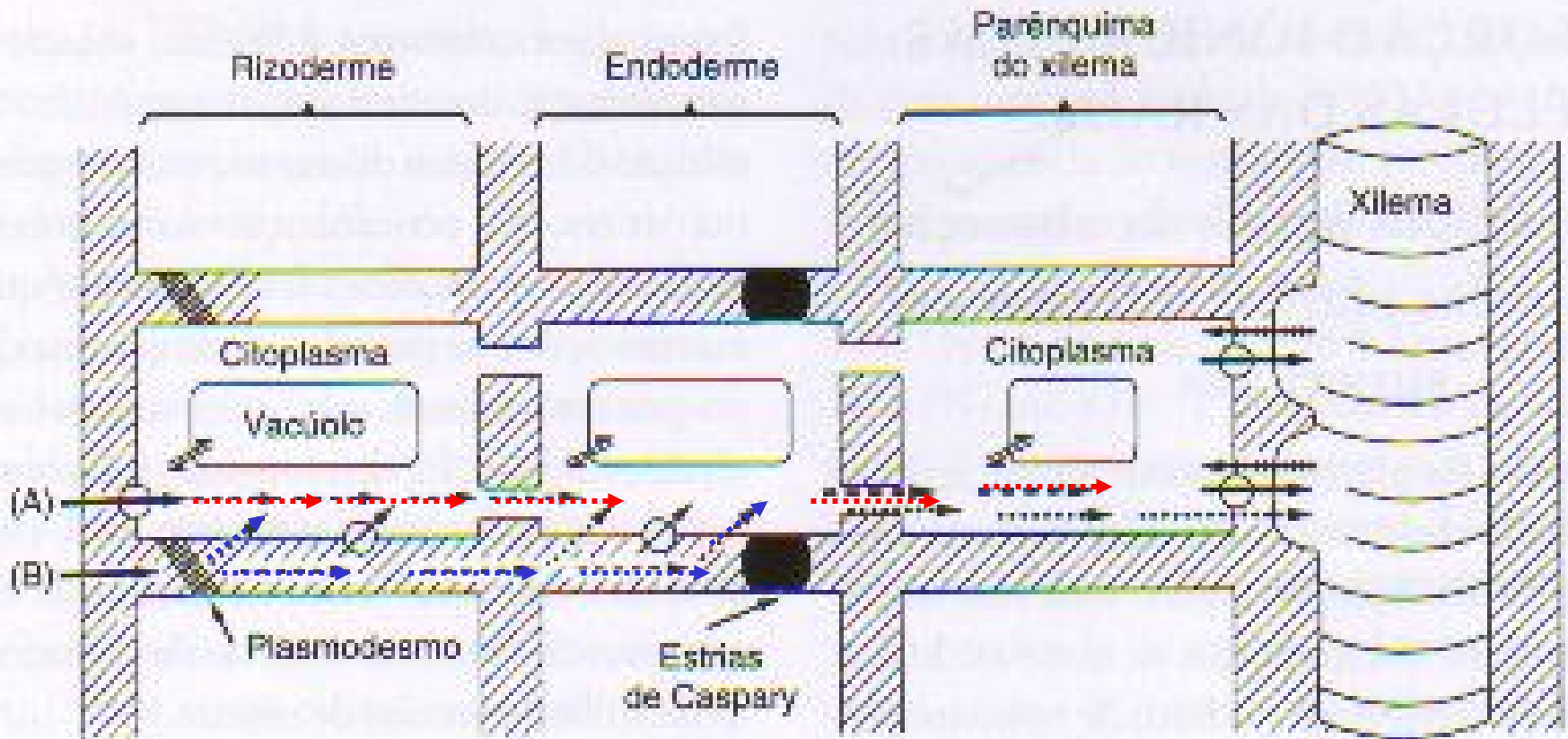
ESTRIAS DE CASPARY

ESTRIAS DE CASPARY



CÉLULAS DA ENDODERME COM ESTRIAS DE CASPARY

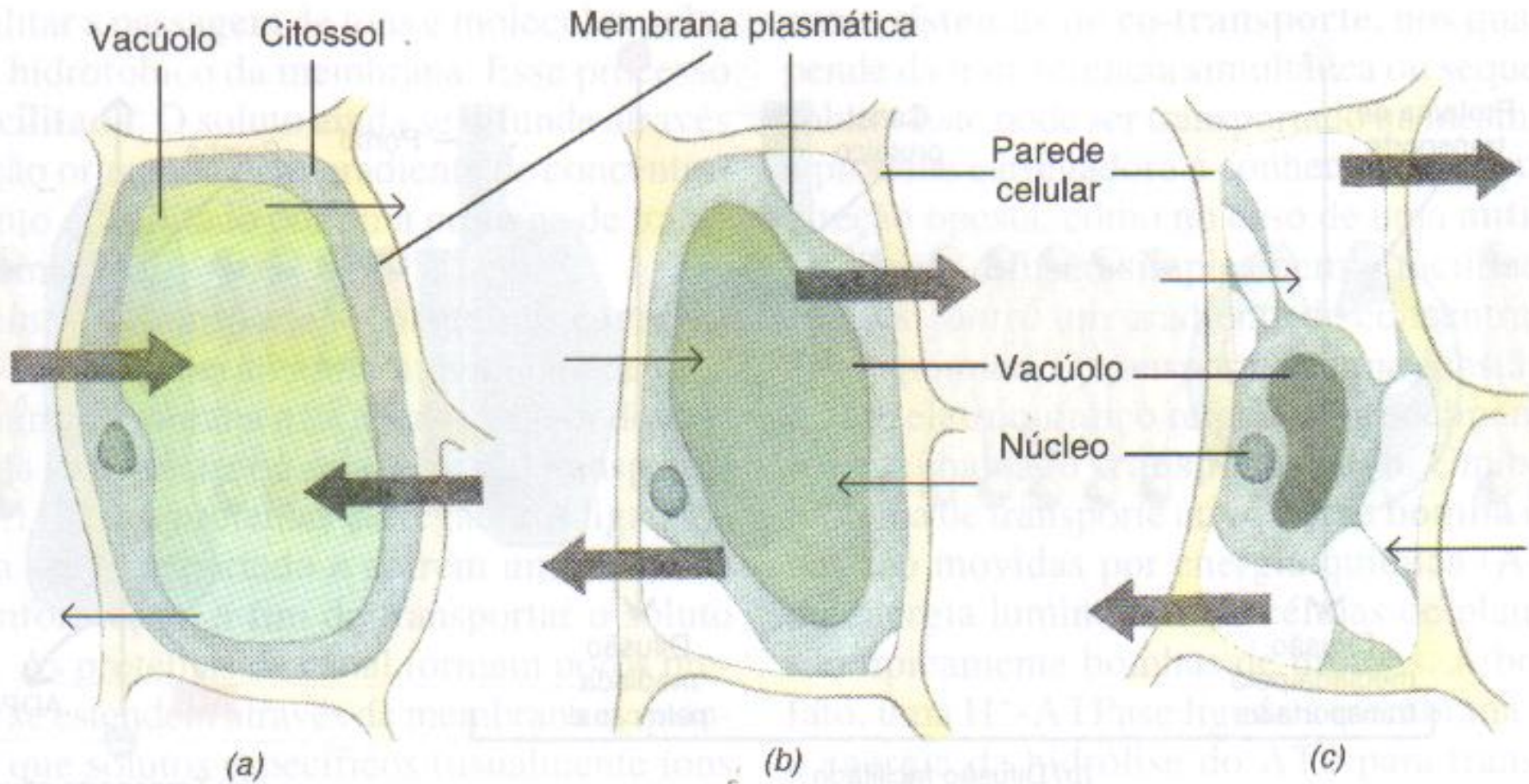
ABSORÇÃO DE ÁGUA E DE SAIS MINERAIS



A: VIA SIMPLÁSTICA→

B: VIA APOPLÁSTICA→

PLASMÓLISE



CÉLULA TÚRGIDA

**CÉLULA
PLASMOLISADA**

**PLASMÓLISE
SEVERA**

Plasmólise é a saída de água da célula vegetal.

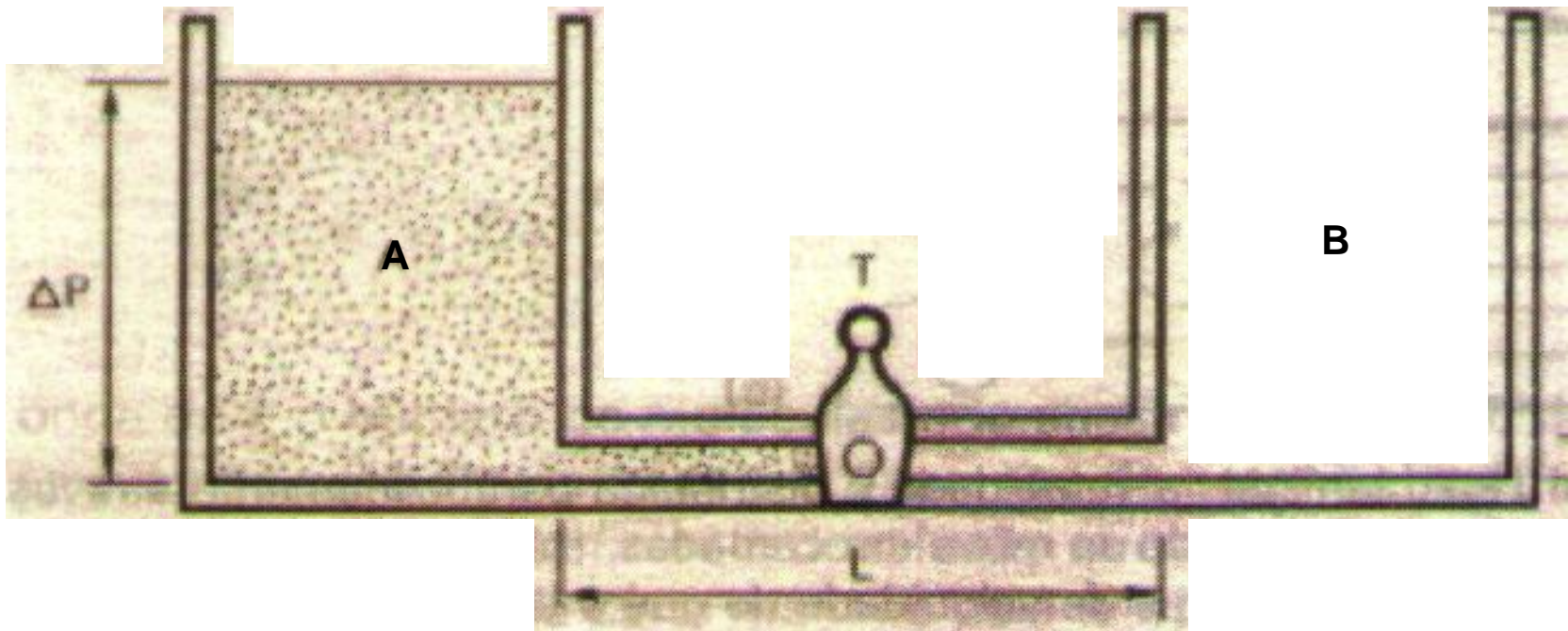
Deplasmólise é o inverso.

- **FLUXO DE MASSA**
- **DIFUSÃO**
- **OSMOSE**

- **FLUXO DE MASSA**

MOVIMENTO TOTAL DA ÁGUA (OU DE OUTROS LÍQUIDOS) QUE OCORRE EM RESPOSTA A DIFERENÇAS DE ENERGIA POTENCIAL DA ÁGUA, USUALMENTE DESIGNADA DE POTENCIAL HÍDRICO (ψ_w)

- FLUXO DE MASSA



VAI DO MAIOR ψ_w PARA O MENOR ψ_w

- **FLUXO DE MASSA**

NUTRIENTES CARREGADOS PELA ÁGUA DO SOLO ATÉ AS RAÍZES

DEPENDENTE:

- . FLUXO DE ÁGUA

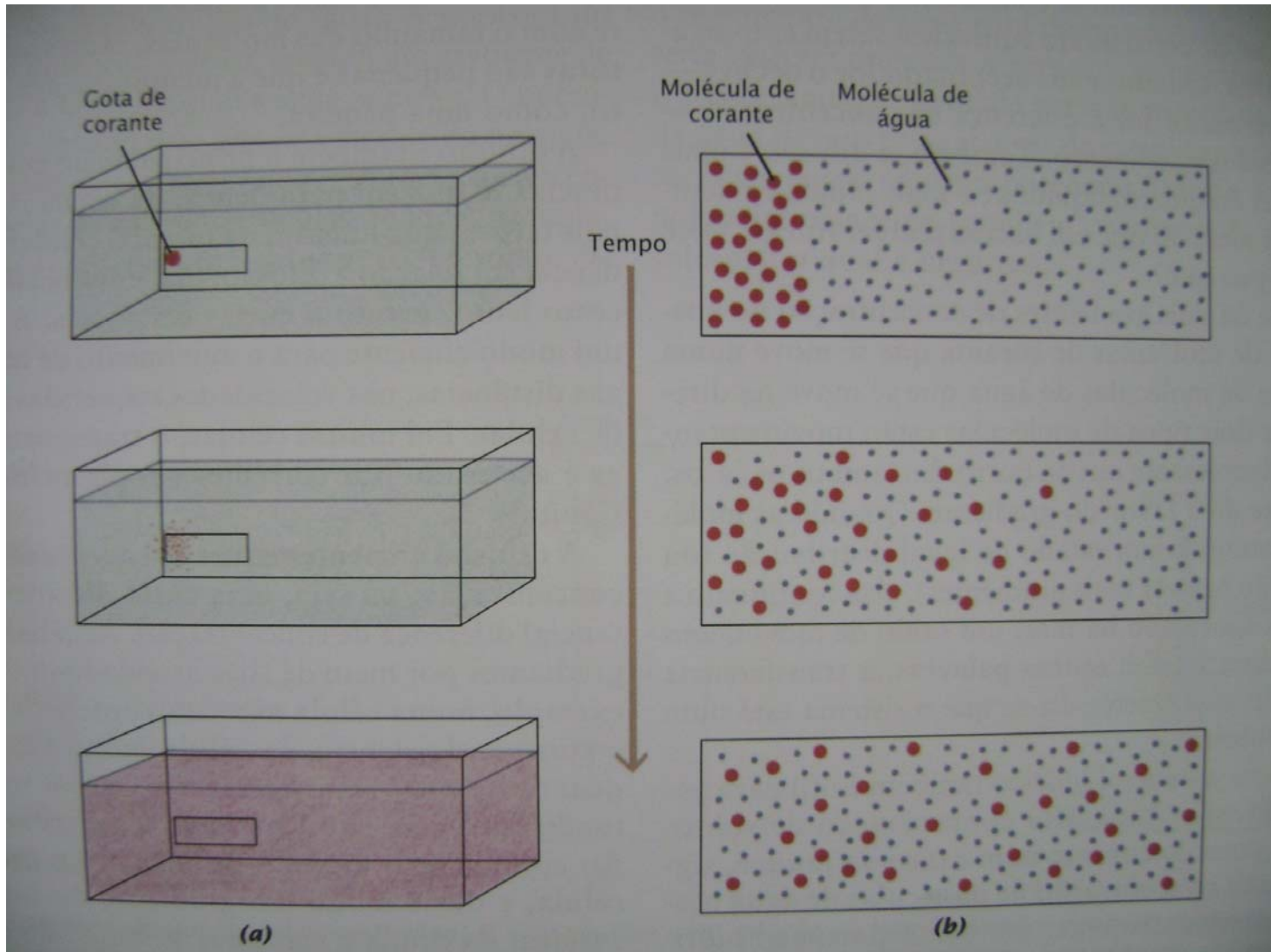
- . TRANSPIRAÇÃO

- . NÍVEIS DE NUTRIENTES NO SOLO

- **DIFUSÃO**

MOVIMENTO DE SOLUTOS DE UMA REGIÃO DE MAIOR CONCENTRAÇÃO PARA OUTRA DE MENOR CONCENTRAÇÃO, A FAVOR DE UM GRADIENTE DE CONCENTRAÇÃO, A FIM DE EQUILIBRAR AS CONCENTRAÇÕES DE TODO O SISTEMA

- DIFUSÃO



- **DIFUSÃO**

PROCESSO LENTO

NUTRIENTES MOVEM-SE EM FUNÇÃO DA DIFERENÇA DE
CONCENTRAÇÃO

- **OSMOSE**

DIFUSÃO DA ÁGUA ATRAVÉS DE MEMBRANA SEMIPERMEÁVEL

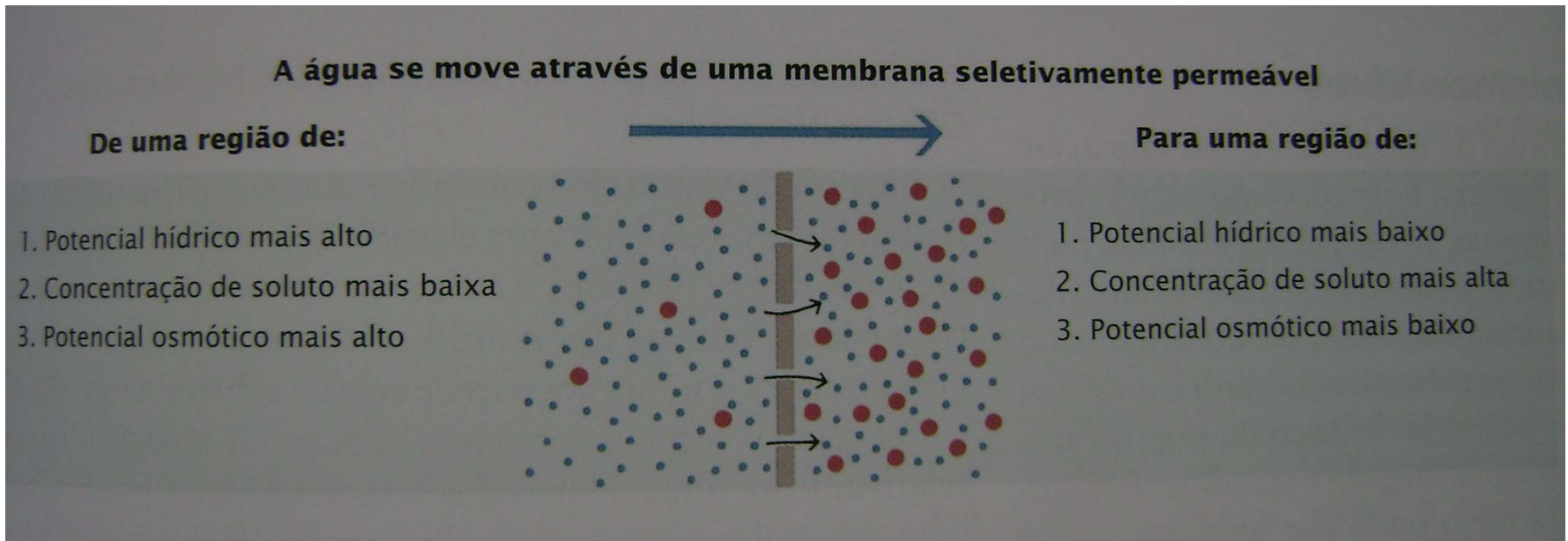
O MOVIMENTO DE OSMOSE SE DÁ:

MAIOR ψ_w → MENOR ψ_w

MAIOR [ÁGUA] → MENOR [ÁGUA]

MENOR [SOLUTOS] → MAIOR [SOLUTOS]

- **OSMOSE**



- **MECANISMOS DE CONTATO ÍON-RAIZ**
 - INTERCEPTAÇÃO RADICULAR
 - FLUXO DE MASSA
 - DIFUSÃO

ABSORÇÃO DE ÁGUA E DE SAIS MINERAIS

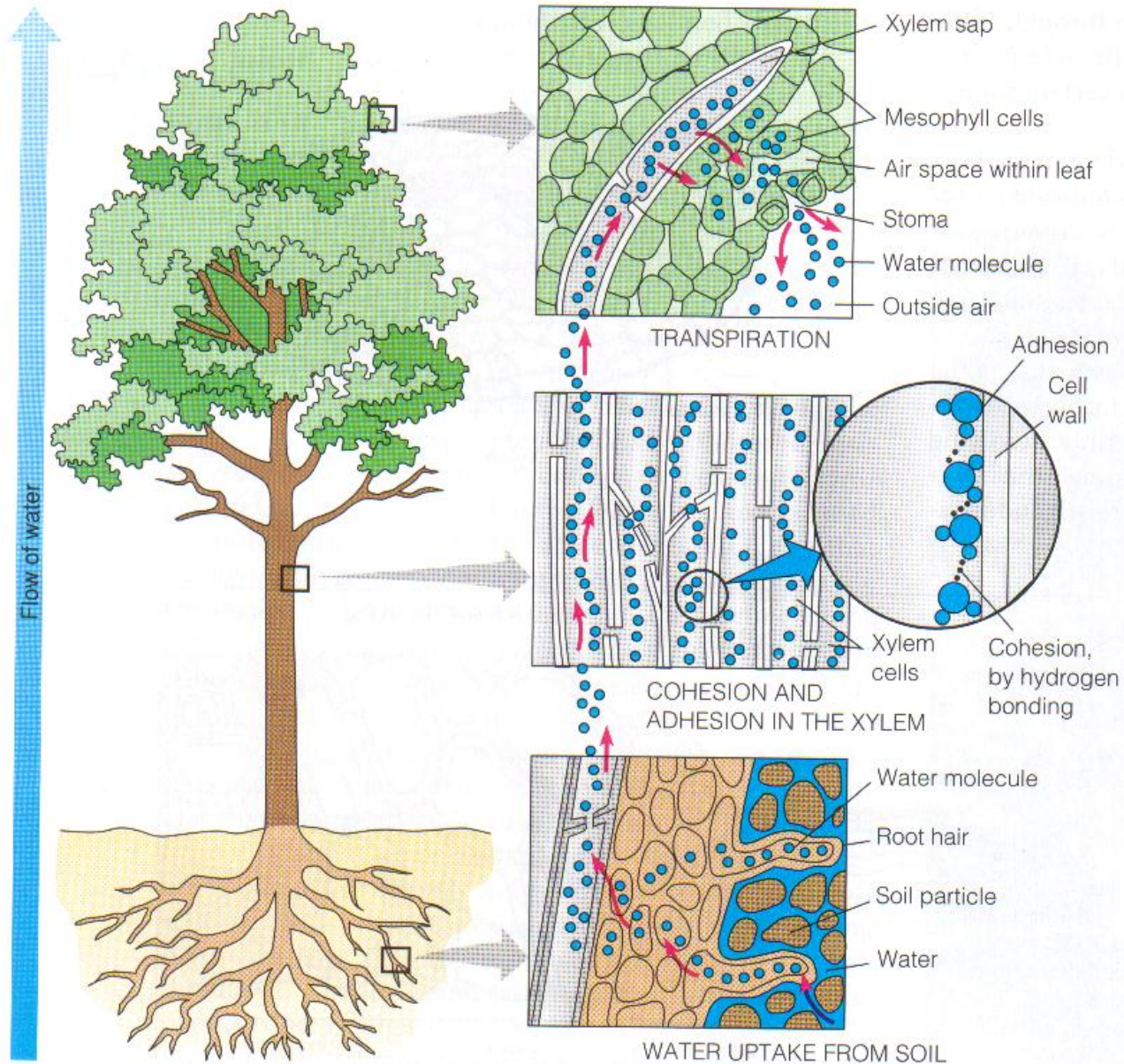


Figure 32.3 The flow of water up a tree

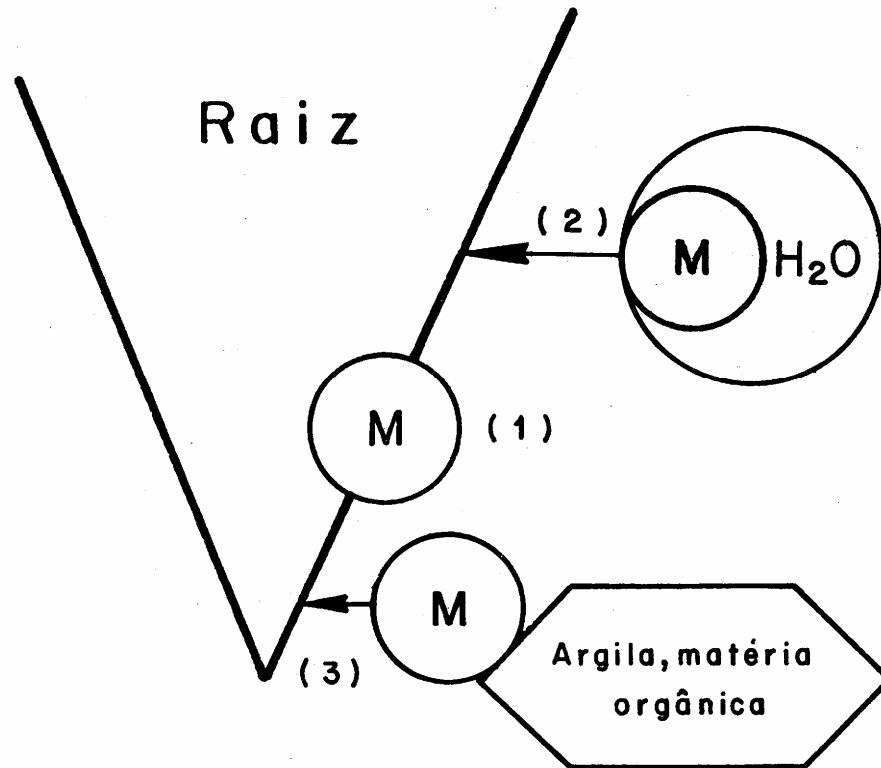
- **INTERCEPTAÇÃO RADICULAR**

ENCONTRO DA RAIZ ABSORVENTE COM OS NUTRIENTES,
NA FORMA DISPONÍVEL NO SOLO

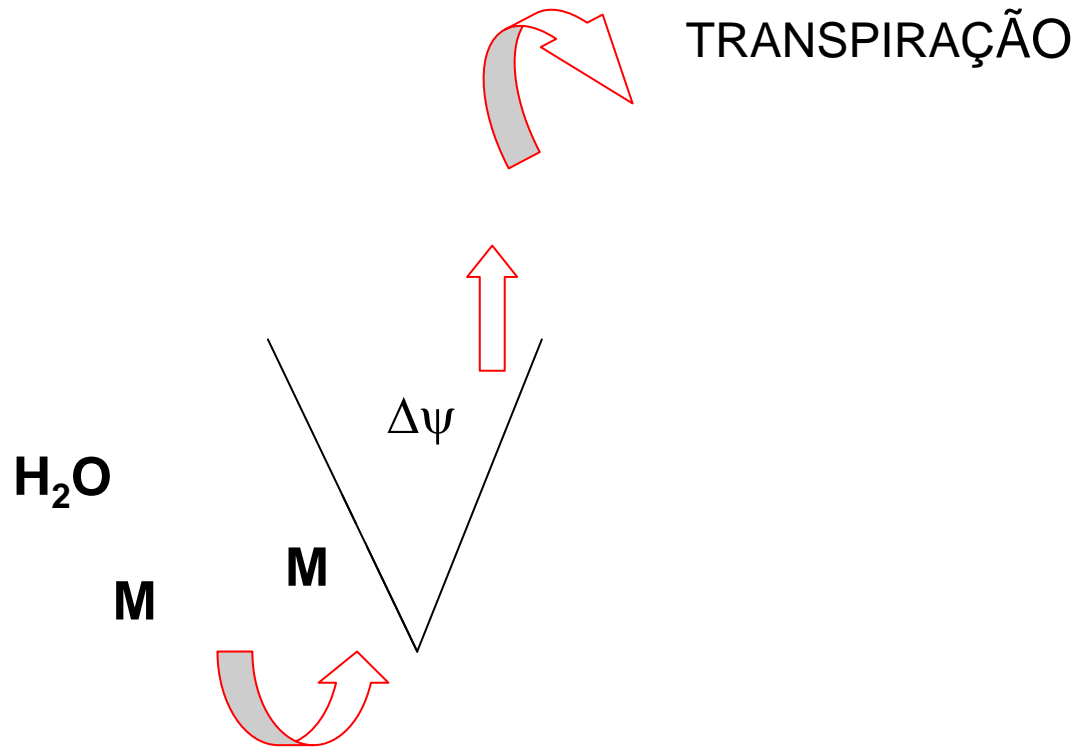
PROCESSO DECORRENTE DO DESENVOLVIMENTO DAS RAÍZES

$$\text{RELAÇÃO} = \frac{\text{SUPERFÍCIE DA RAIZ}}{\text{SUPERFÍCIE DO SOLO}}$$

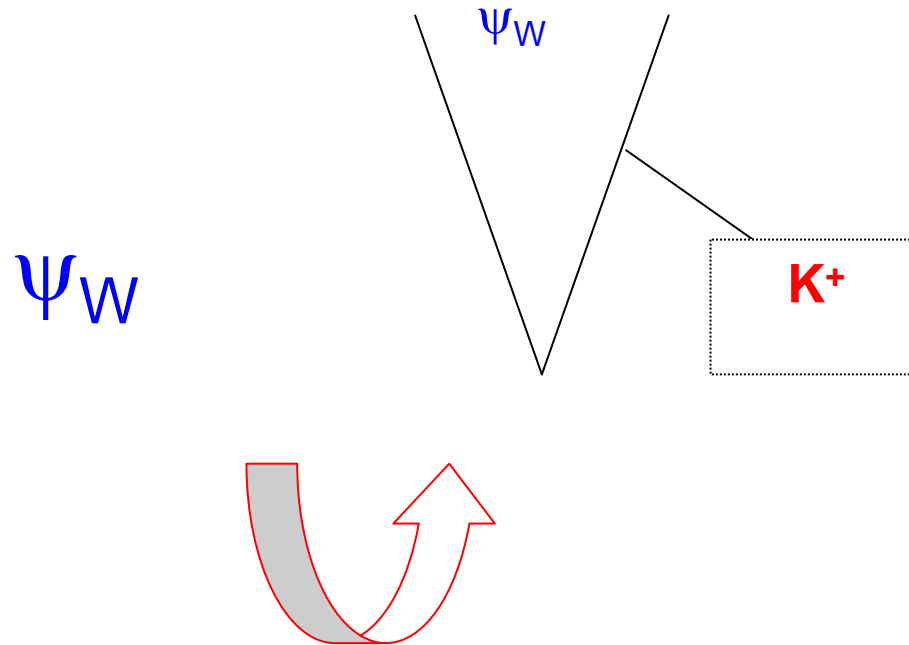
- INTERCEPTAÇÃO RADICULAR



- FLUXO DE MASSA



- DIFUSÃO



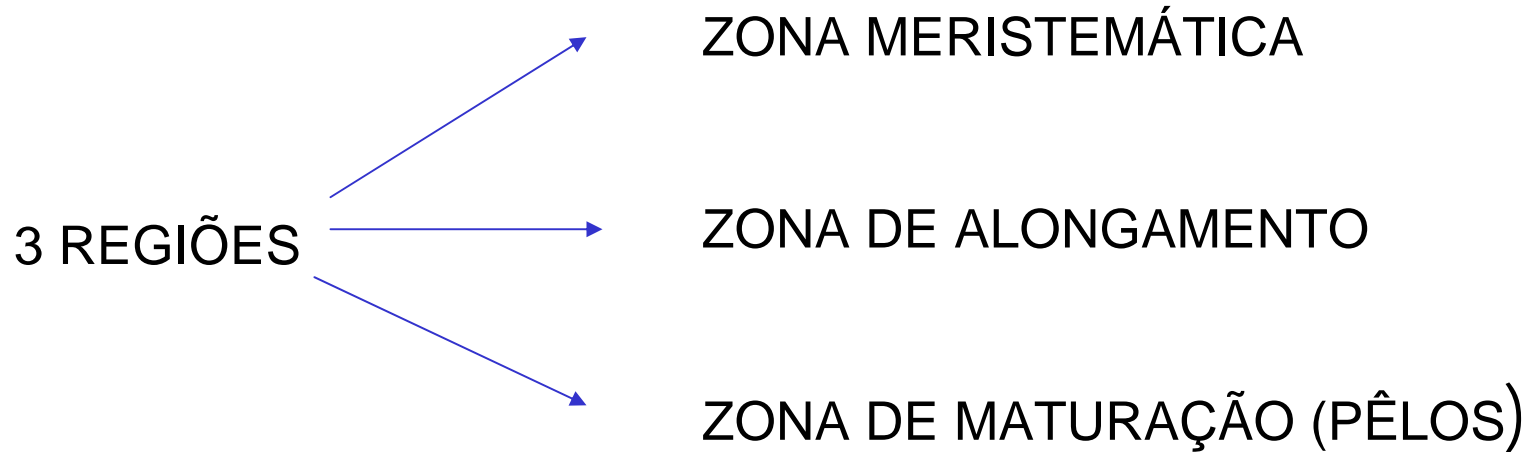
TIPOS DE CONTATO DE NUTRIENTES

Elemento	Interceptação Radicular	Fluxo de massa	Difusão
N	1	99	0
P	2	4	94
K	3	25	72
Ca	27	73	0
Mg	13	87	0
S	5	95	0
B	3	97	0
Cu	70	20	10
Fe	50	10	40
Mn	15	5	80
Mo	5	95	0
Zn	20	20	60

* dados em % do total

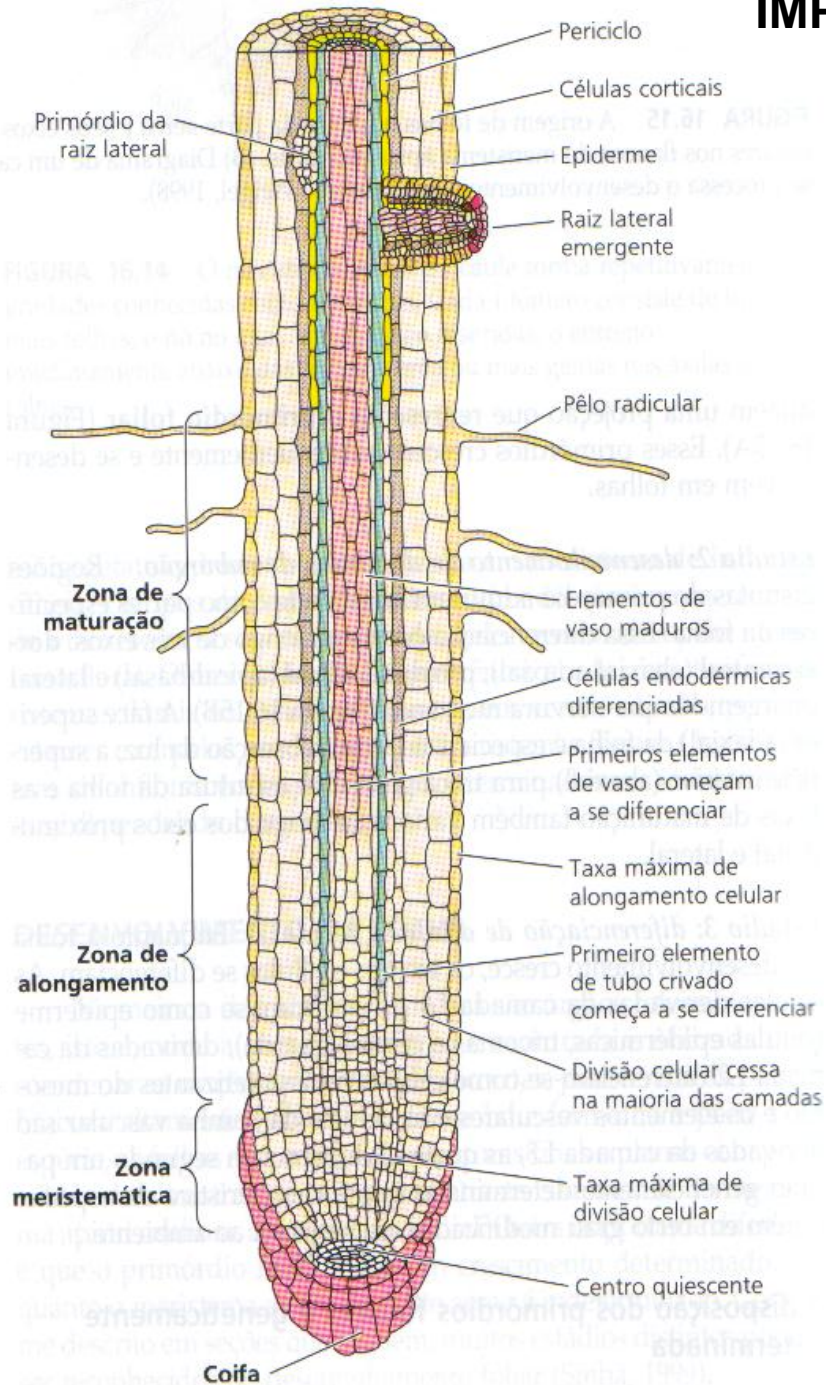
Malavolta et al. (1989)

IMPORTÂNCIA DAS RADICELAS



ABSORÇÃO EM TODAS AS ZONAS → DEPENDENTE DO NUTRIENTE

IMPORTÂNCIA DAS RADICELAS





Tratamento 2



Tratamento 3



Ca → ZONA MERISTEMÁTICA

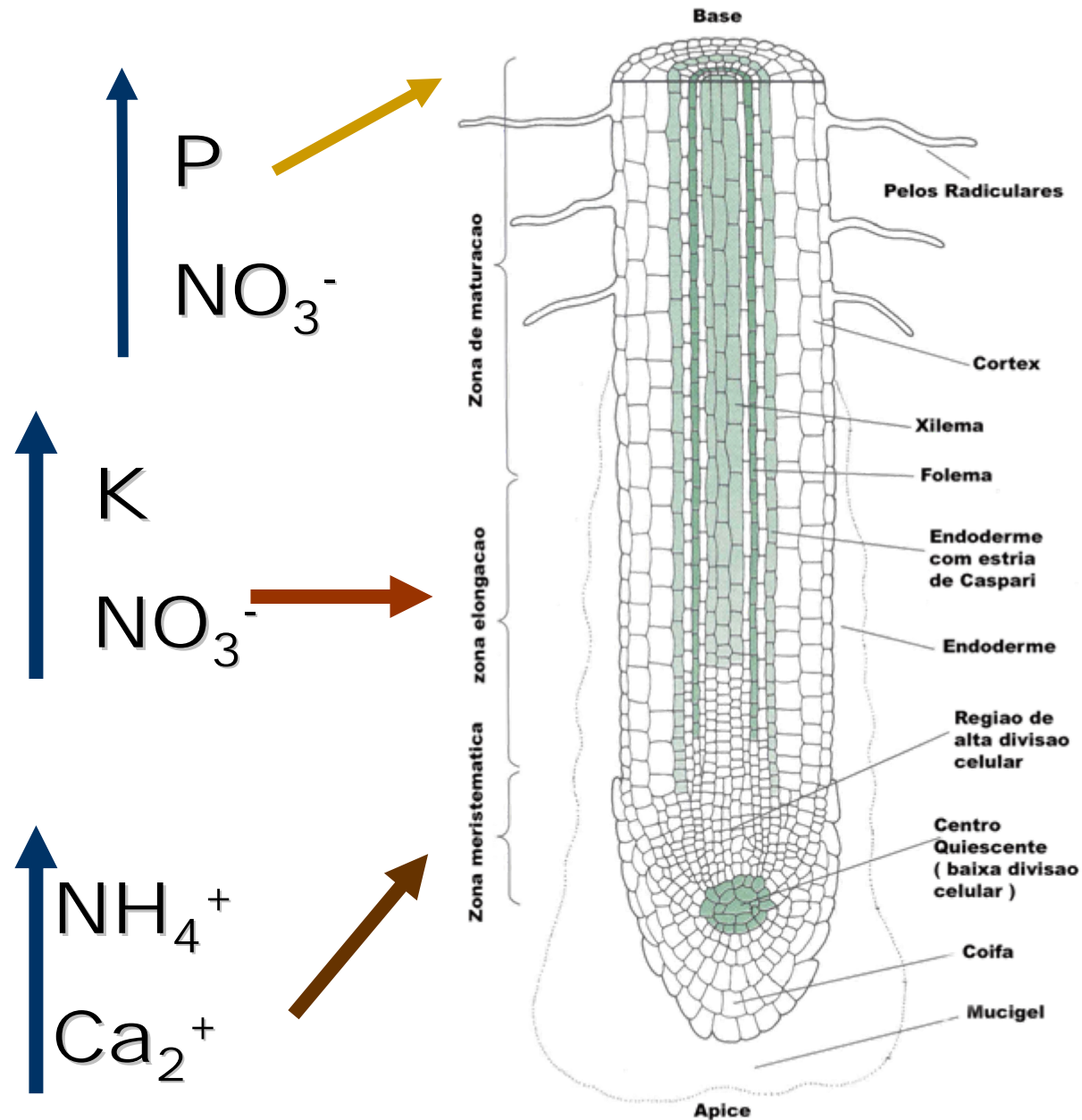
N, P, K e NH₄ → NAS TRÊS ZONAS

N e P → MAIOR NA ZONA DE ALONGAMENTO

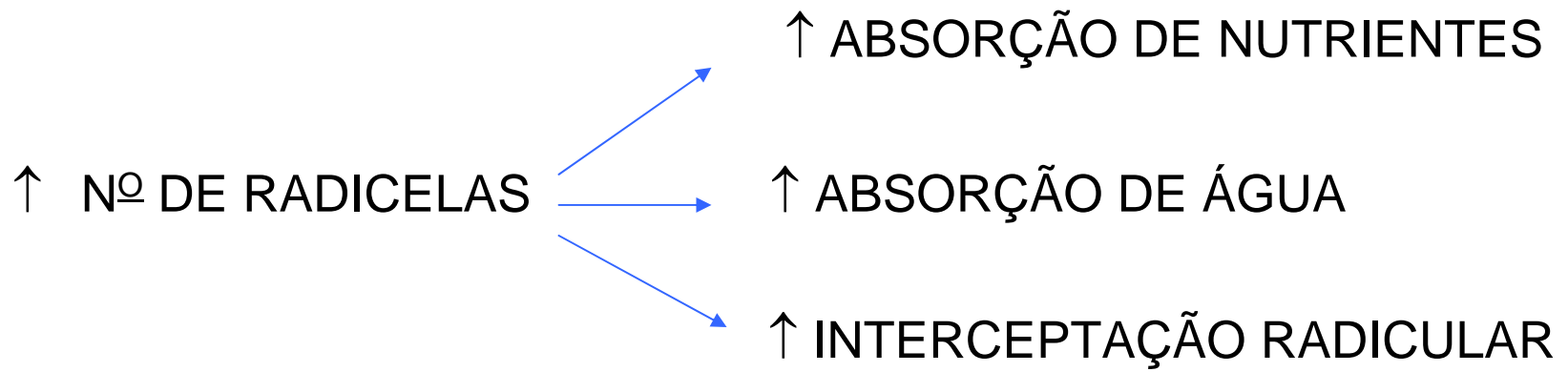
NH₄ → MAIOR NA ZONA MERISTEMÁTICA

MAIOR ABSORÇÃO → ZONA DE MATURAÇÃO

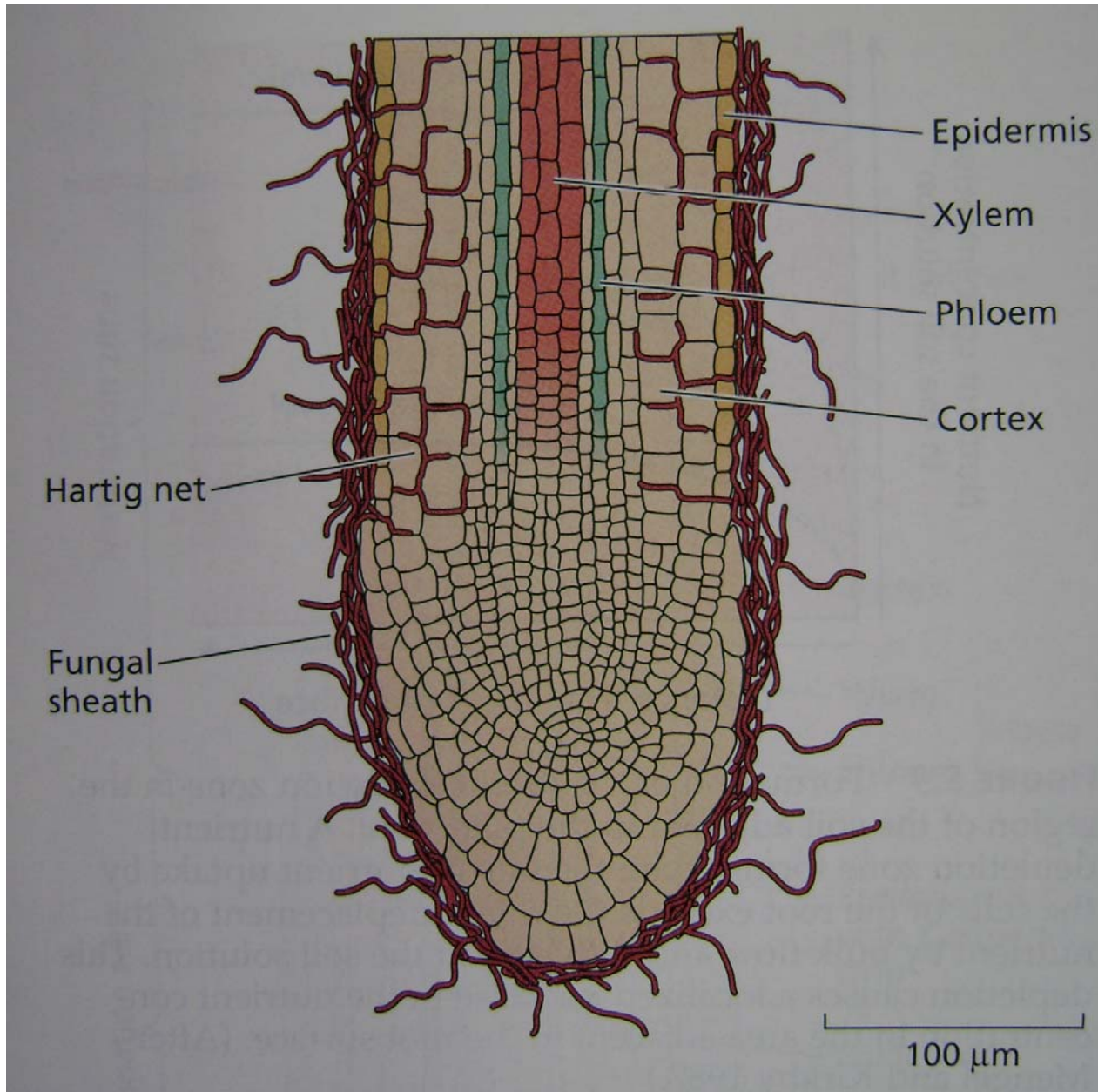
IMPORTÂNCIA DAS RADICELAS



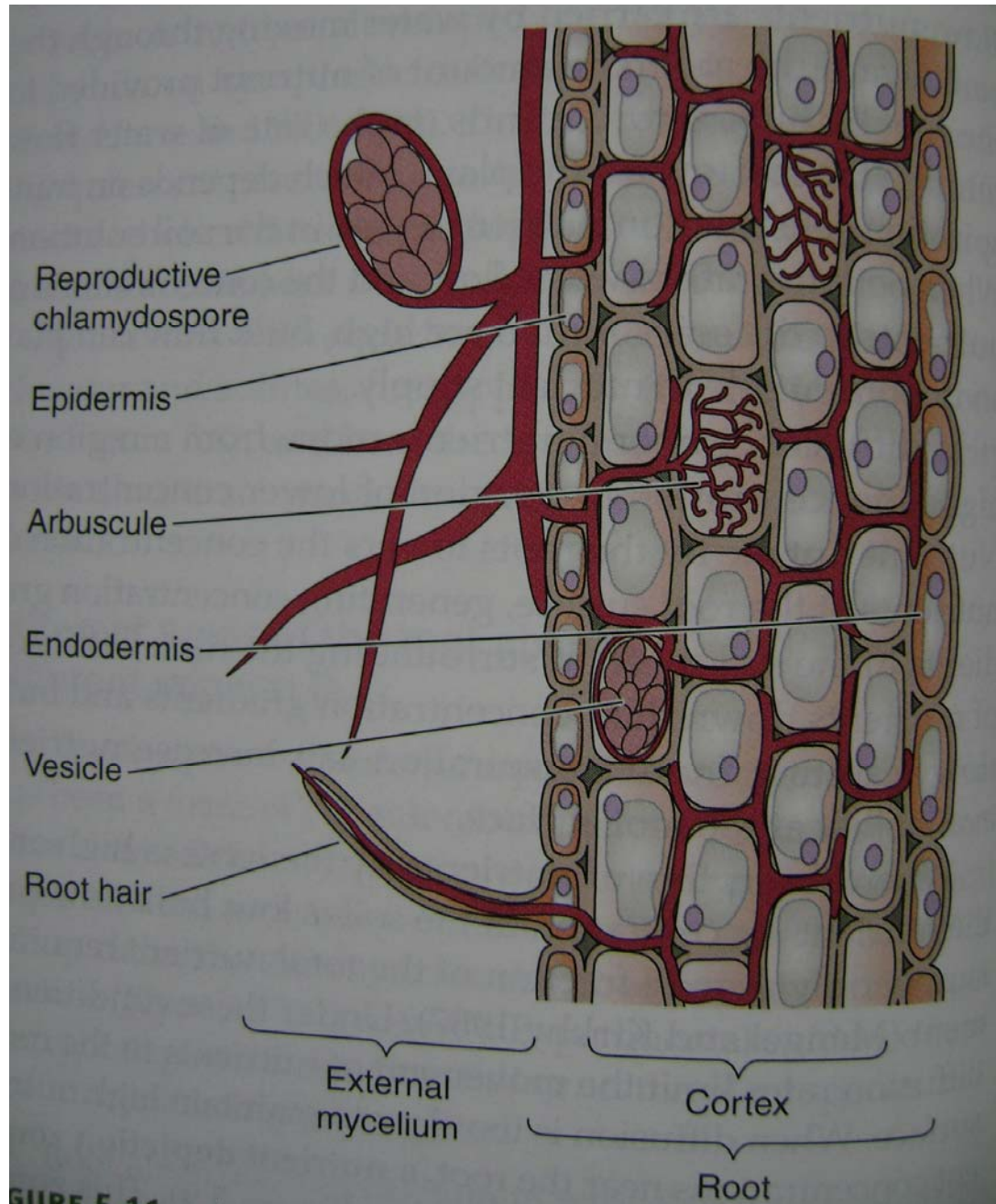
IMPORTÂNCIA DAS RADICELAS

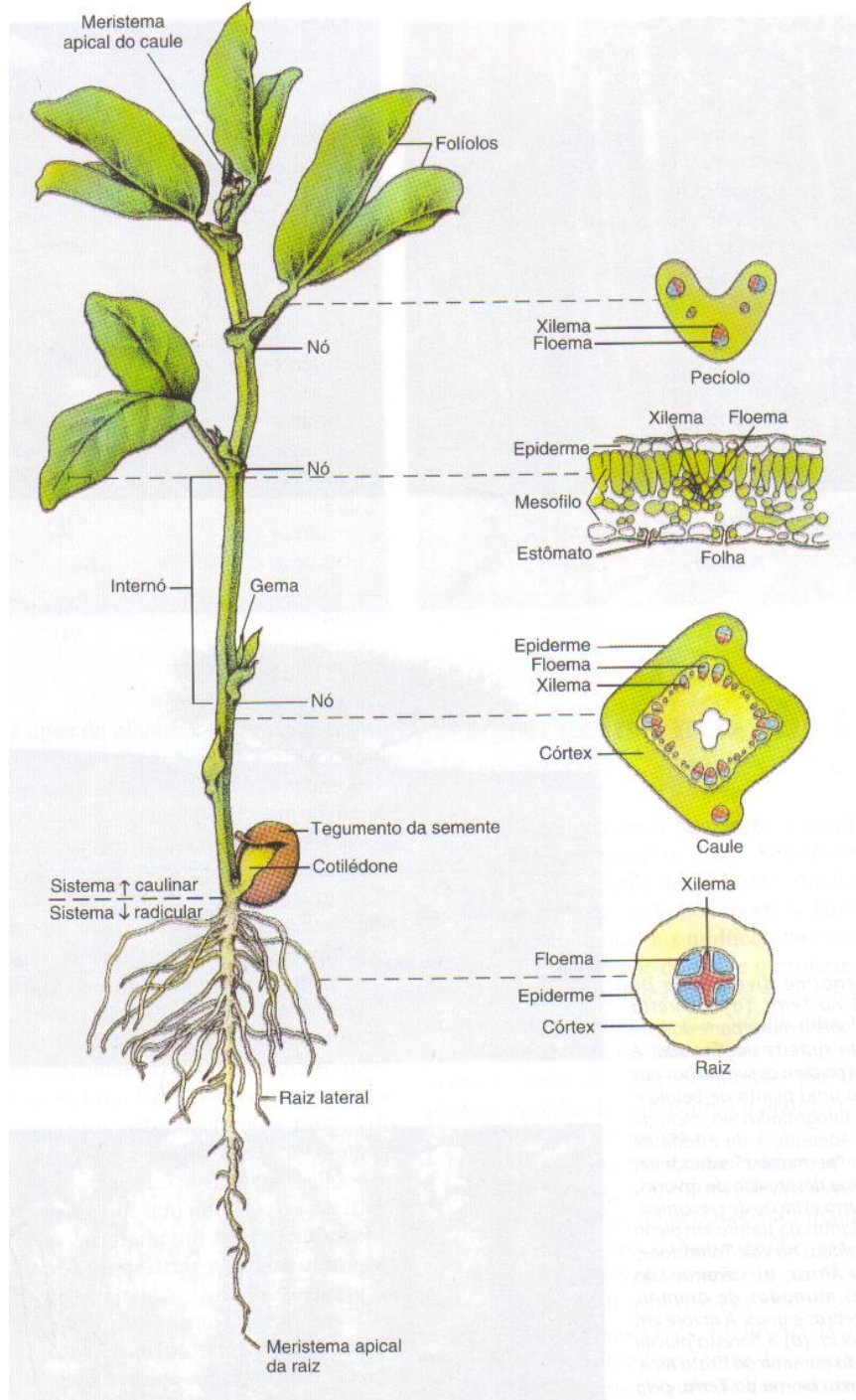


RAIZ INFECTADA COM FUNGO MICORRÍZICO ECTOTRÓFICO



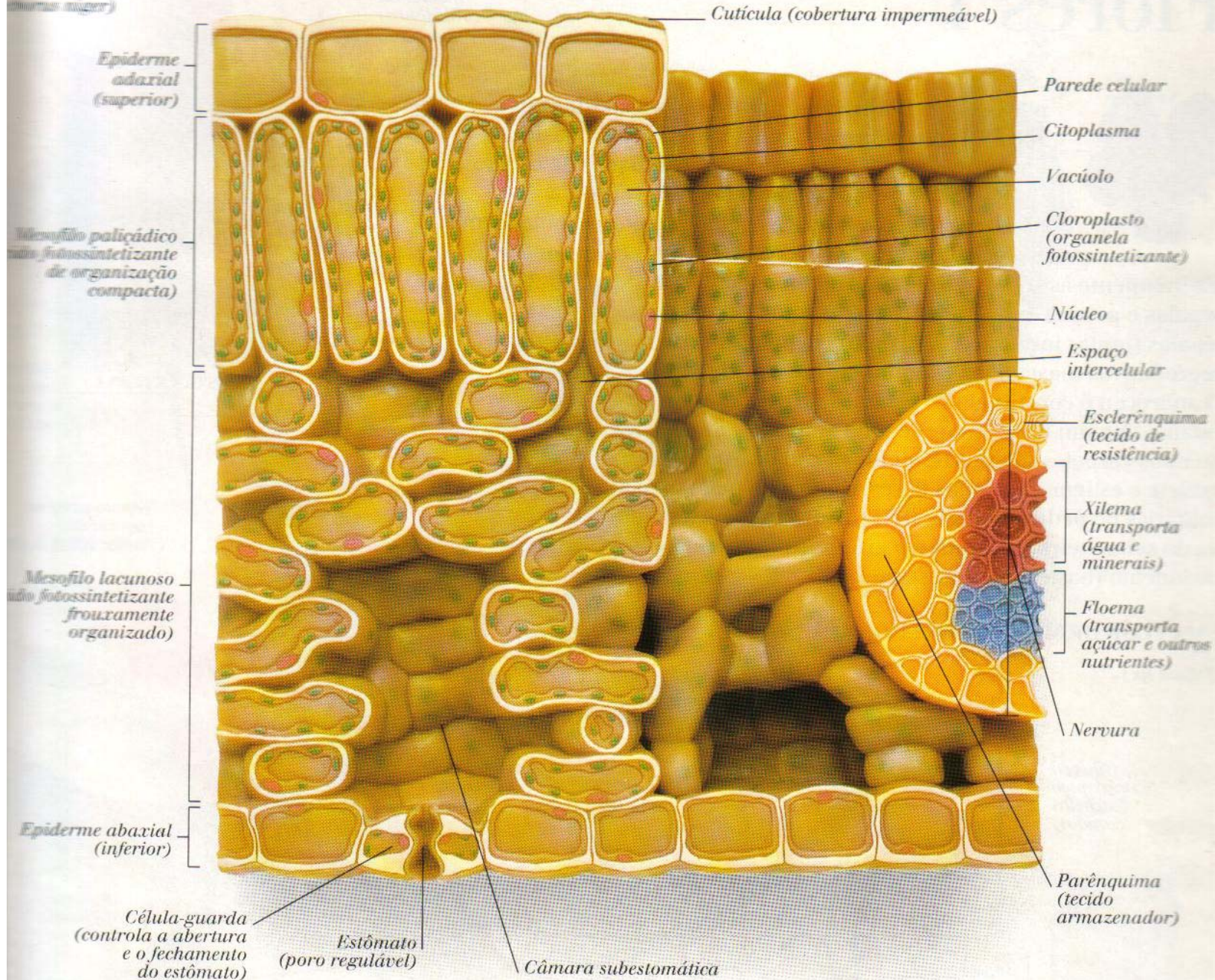
ASSOCIAÇÃO DE FUNGO MICORRÍZICO VESÍCULO-ARBUSCULAR

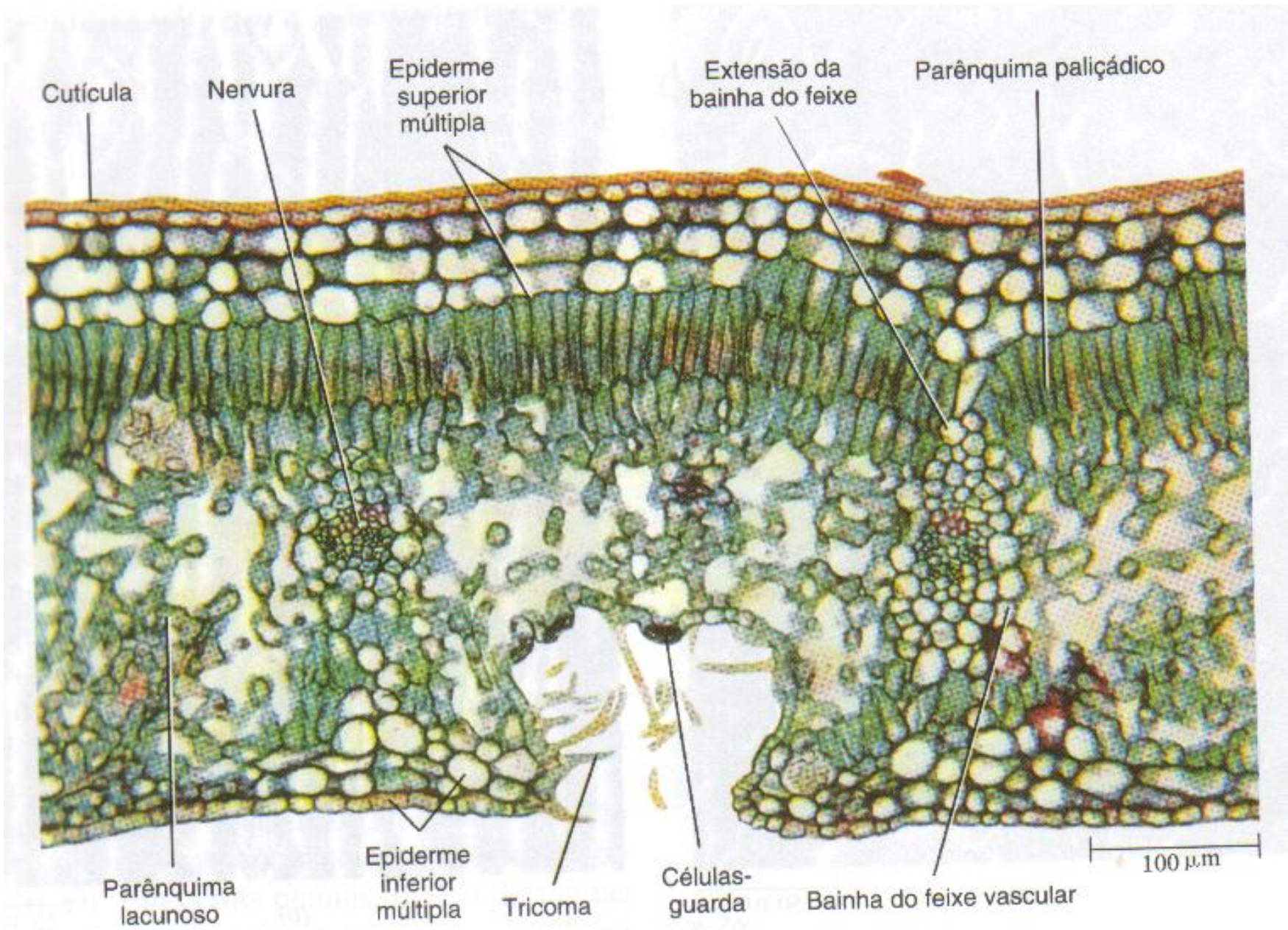




TRANSVERSAL DE UMA FOLHA

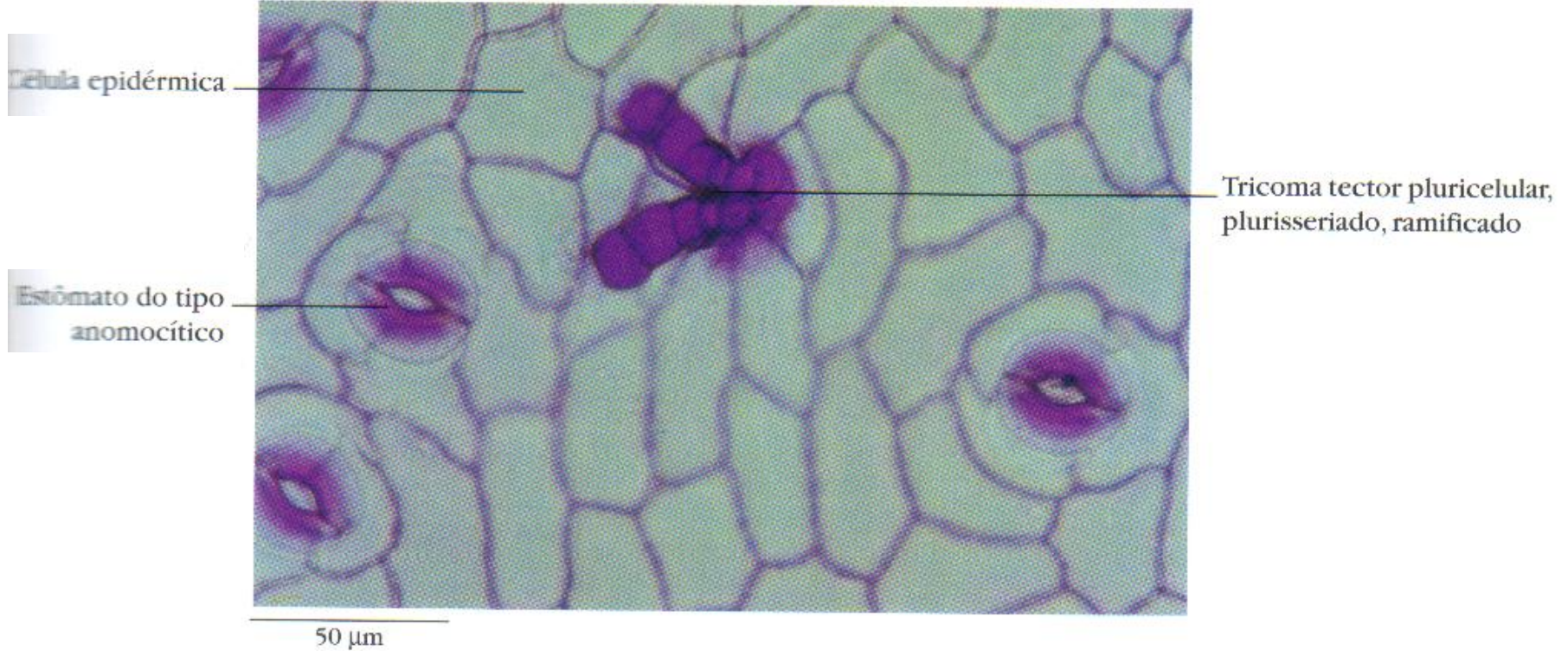
(*Phaseolus vulgaris*)

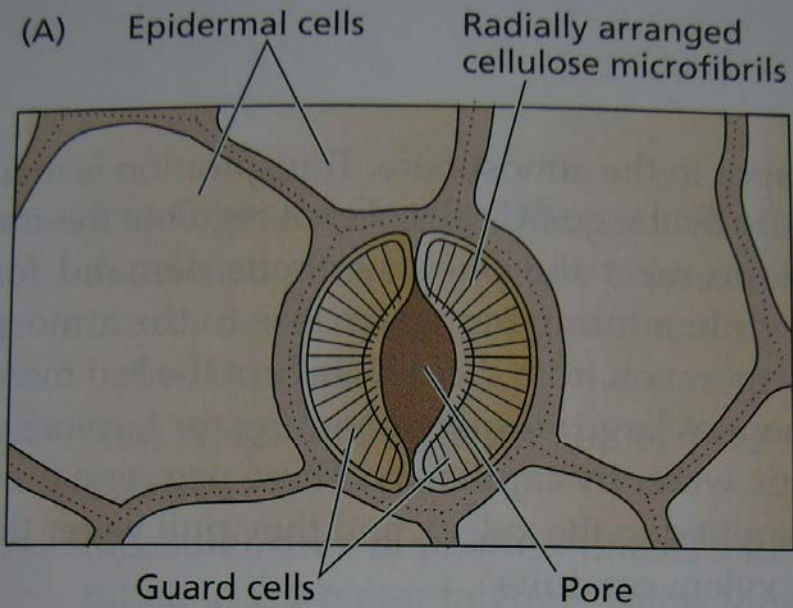




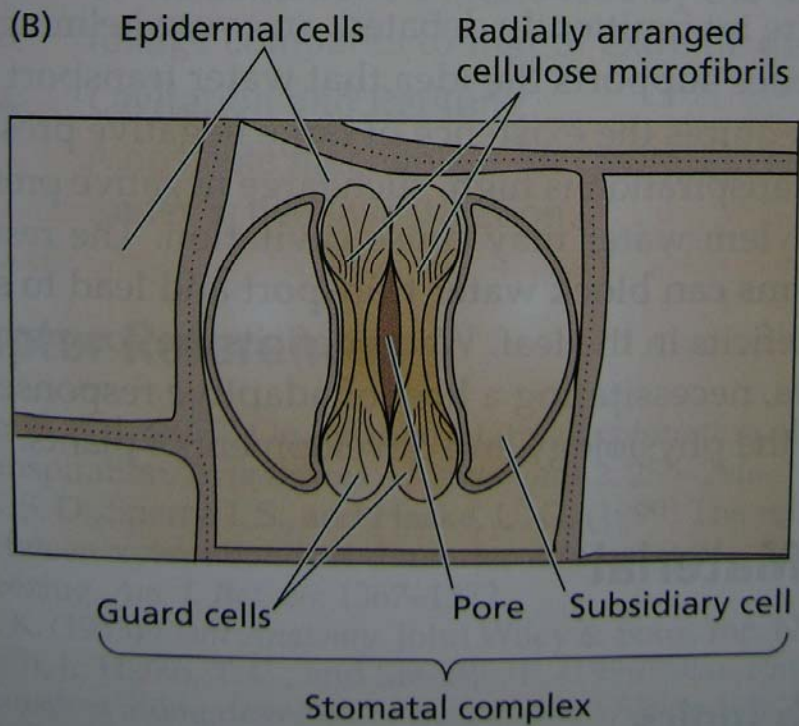
ESTÔMATO

FOTO 11

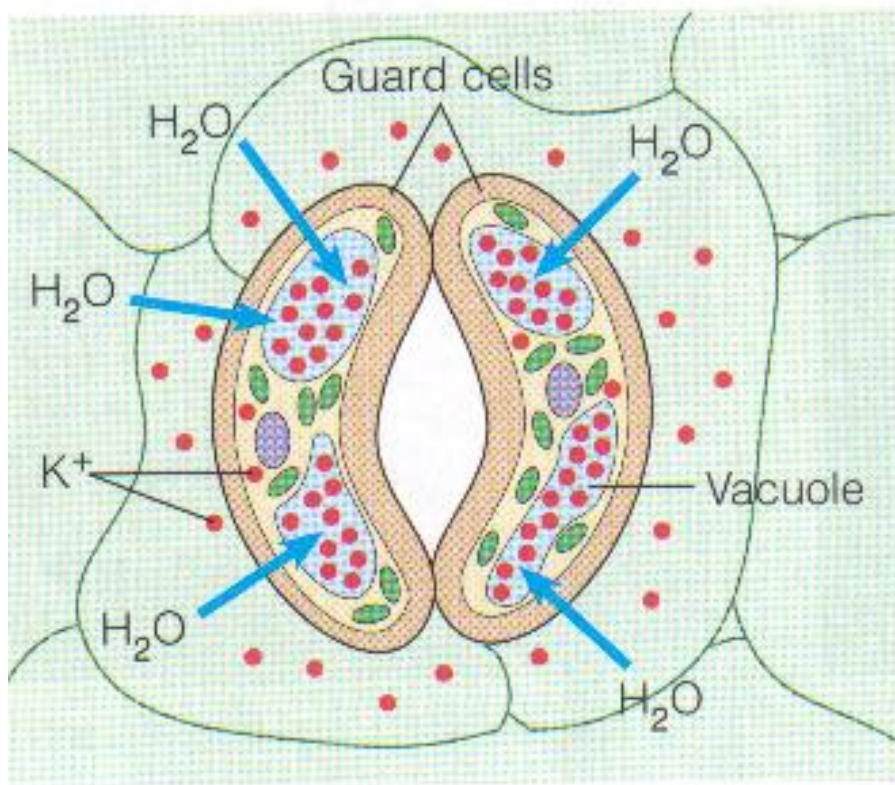




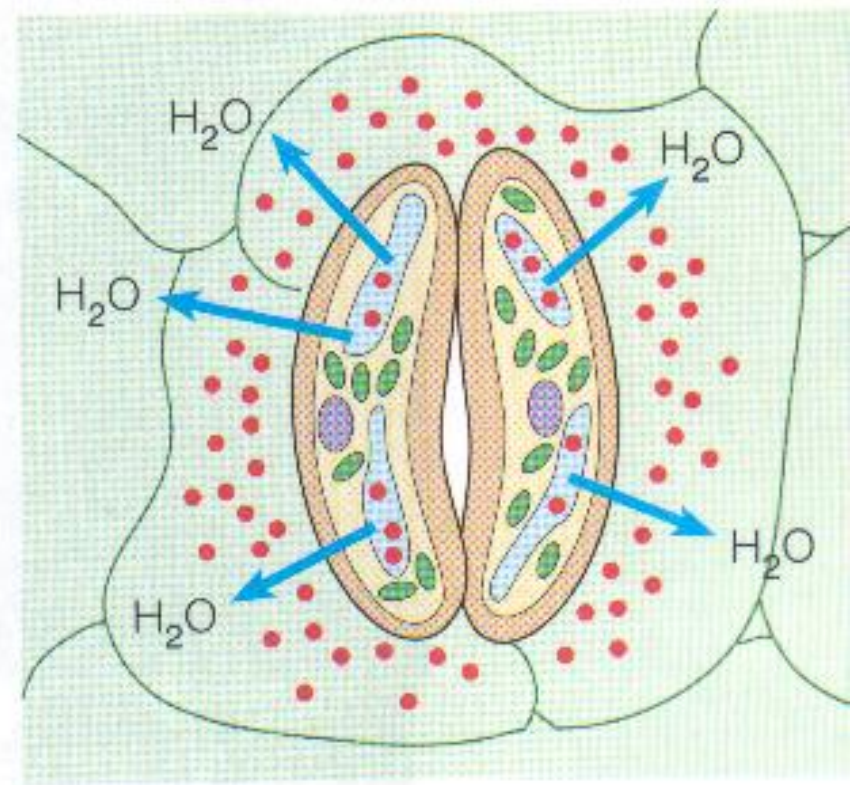
ESTÔMATO DE EUDICOTILEDÔNEA



ESTÔMATO DE MONOCOTILEDÔNEA



Stoma opening



Stoma closing

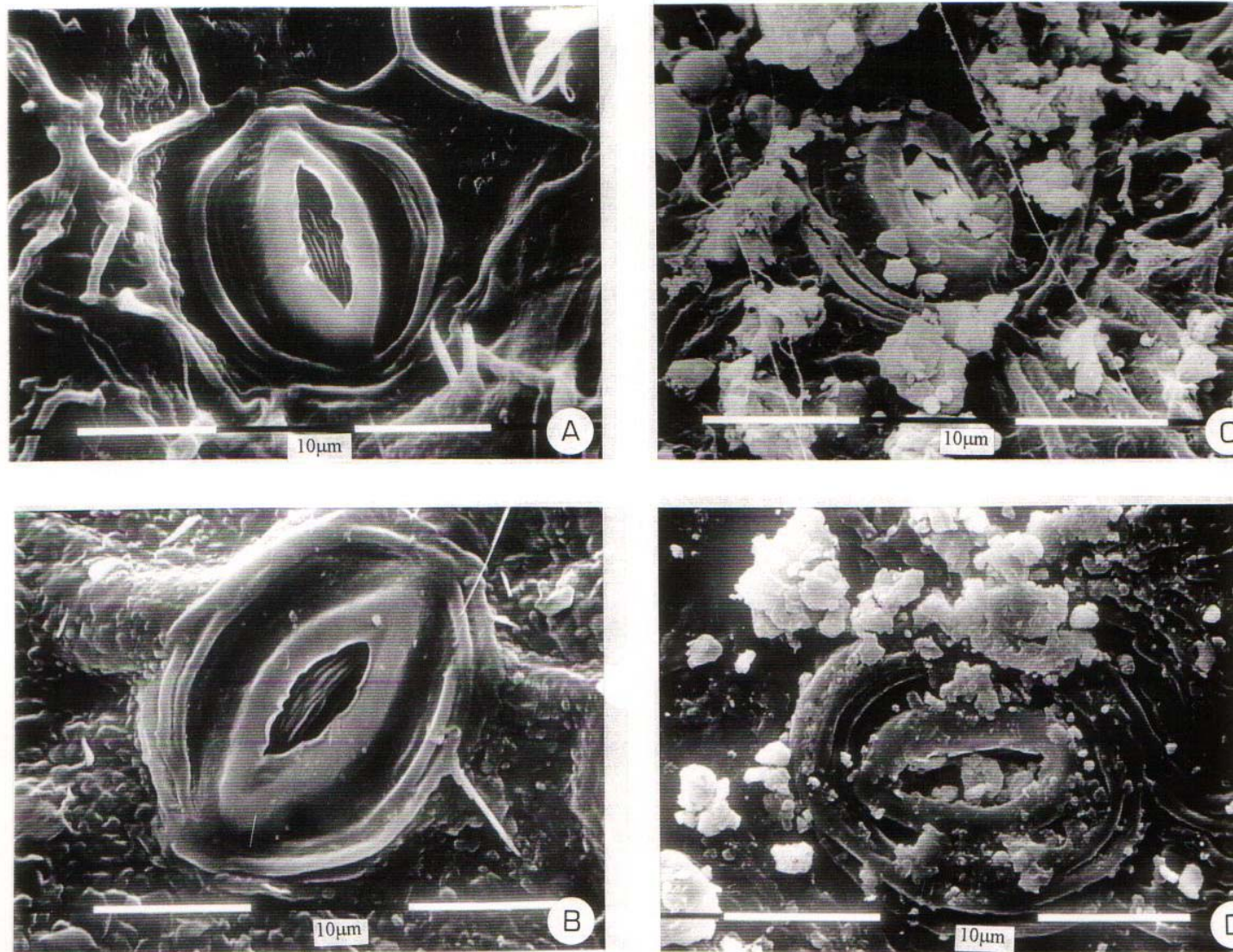
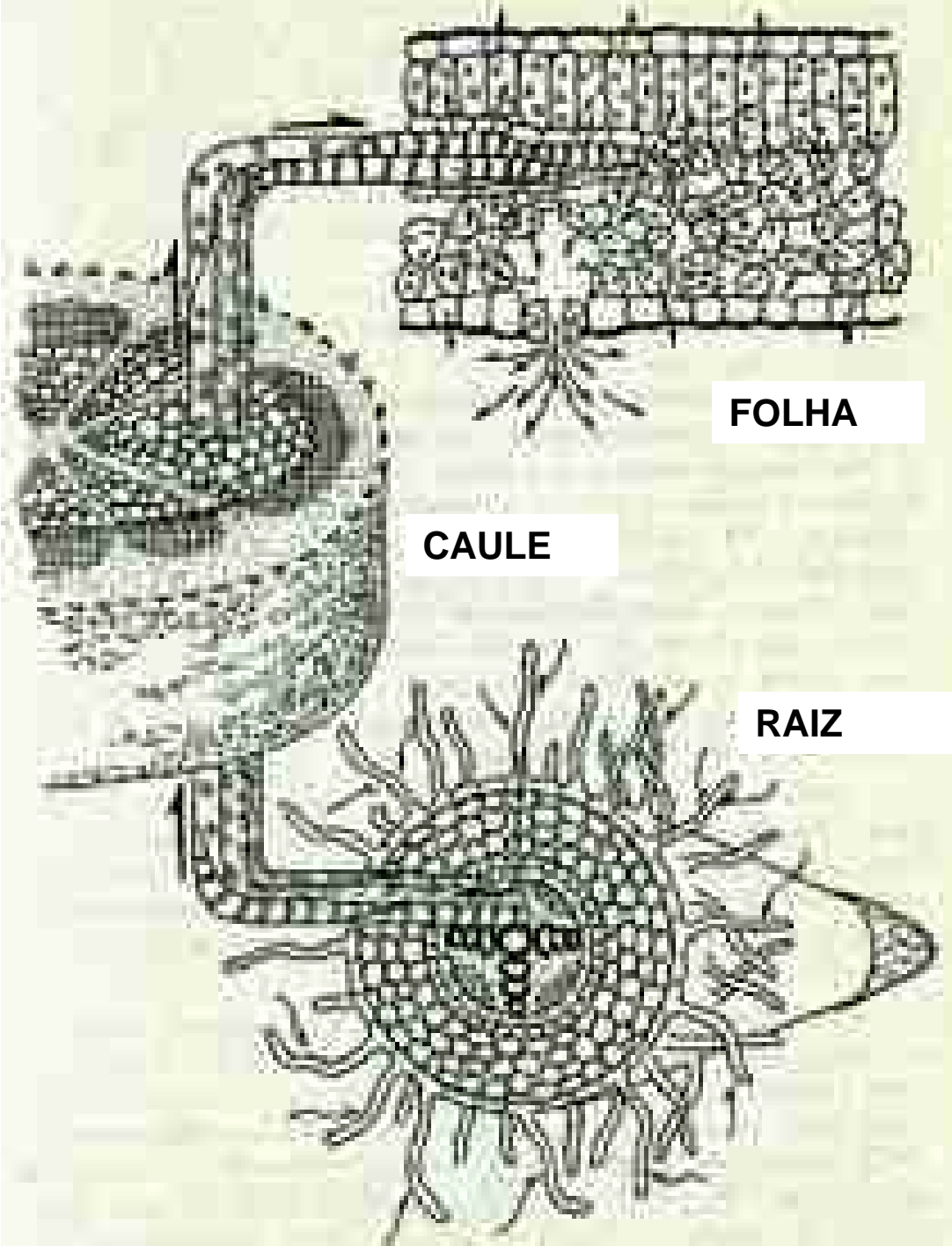


Figura 11- Detalhe de estômatos na superfície abaxial das folhas de *Schinus terebinthifolius* Raddi. Indivíduo adulto controle (A e B); Indivíduo adulto da fábrica (C e D).

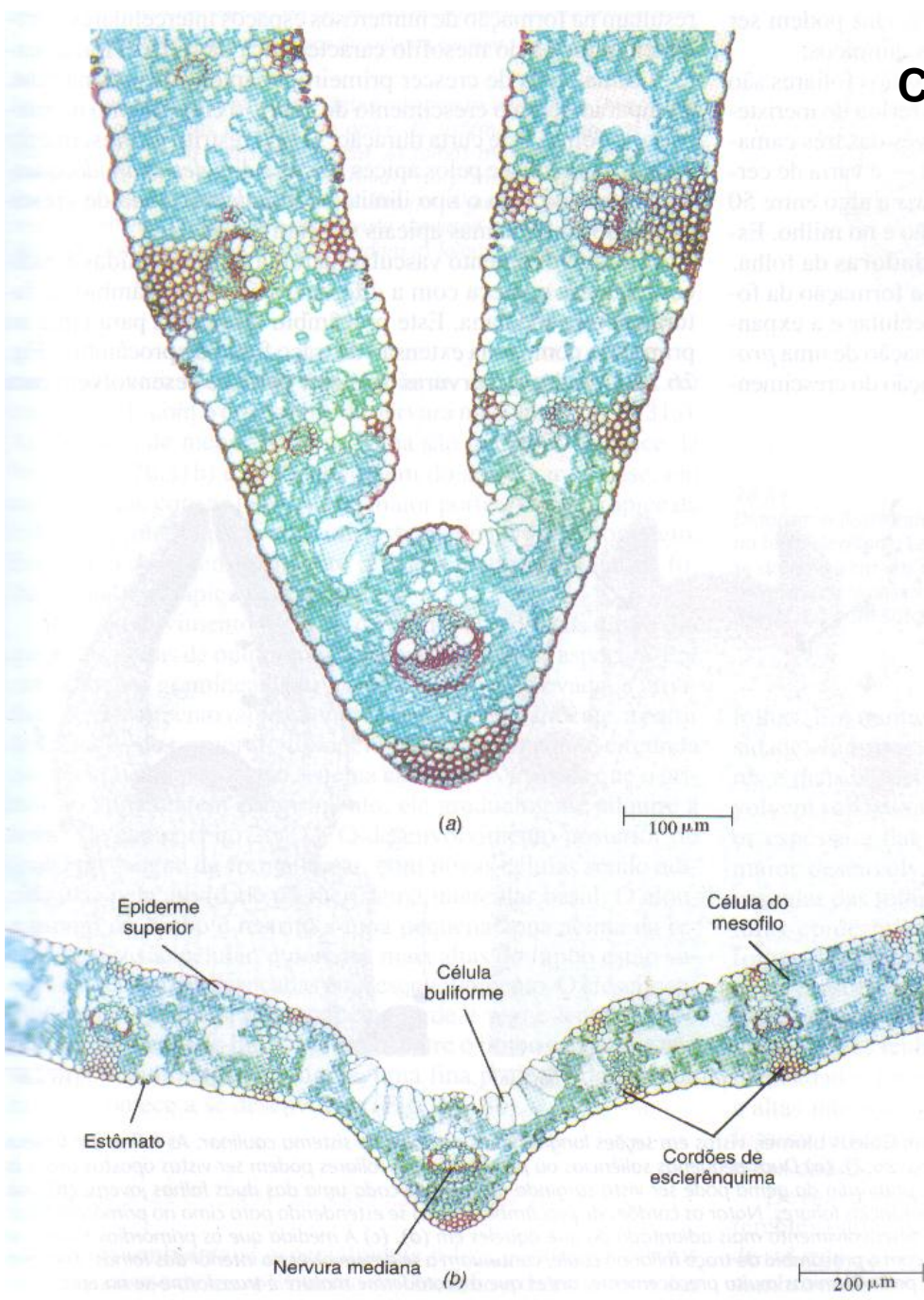


GUTAÇÃO

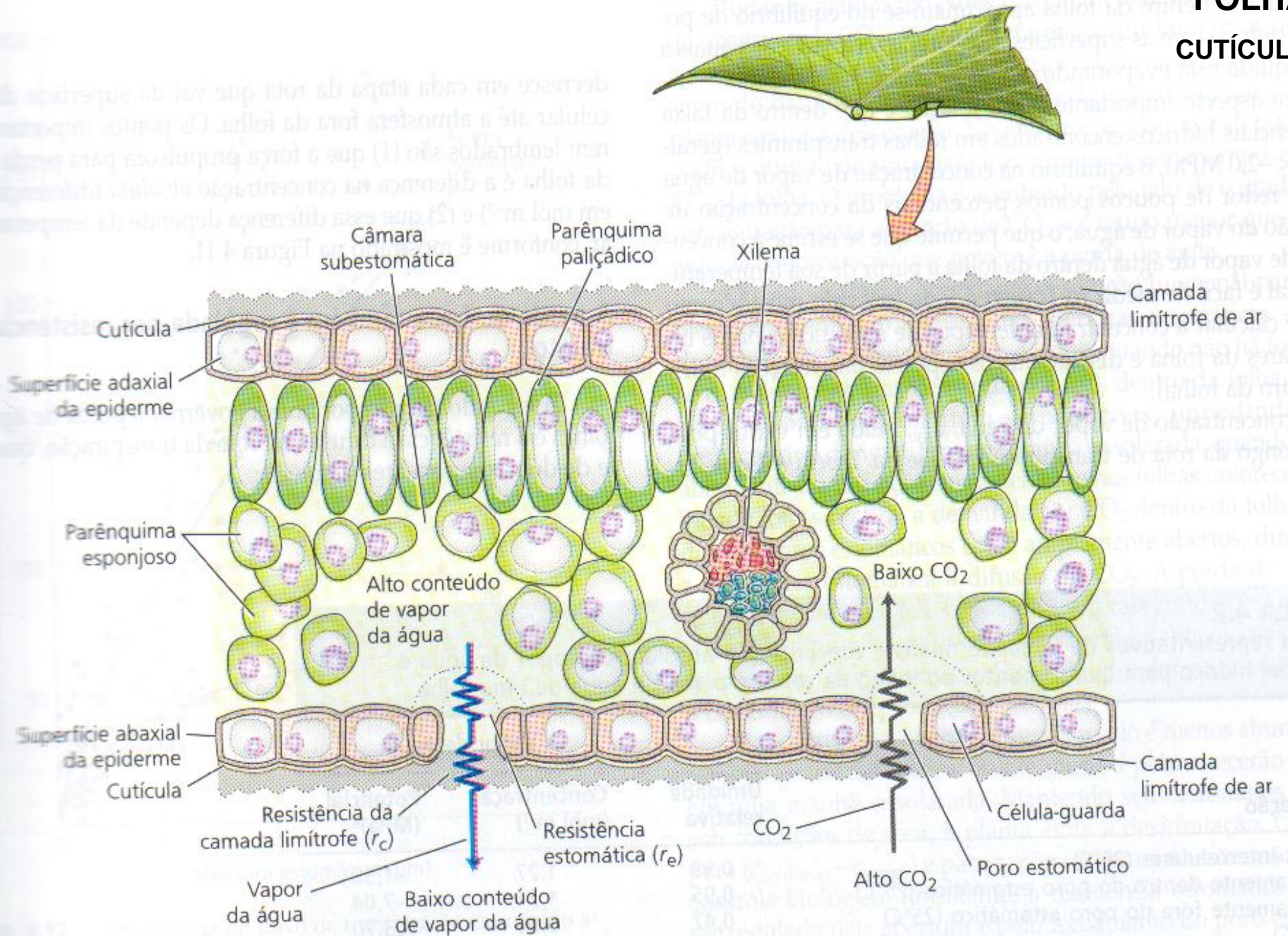
HIDATÓDIOS



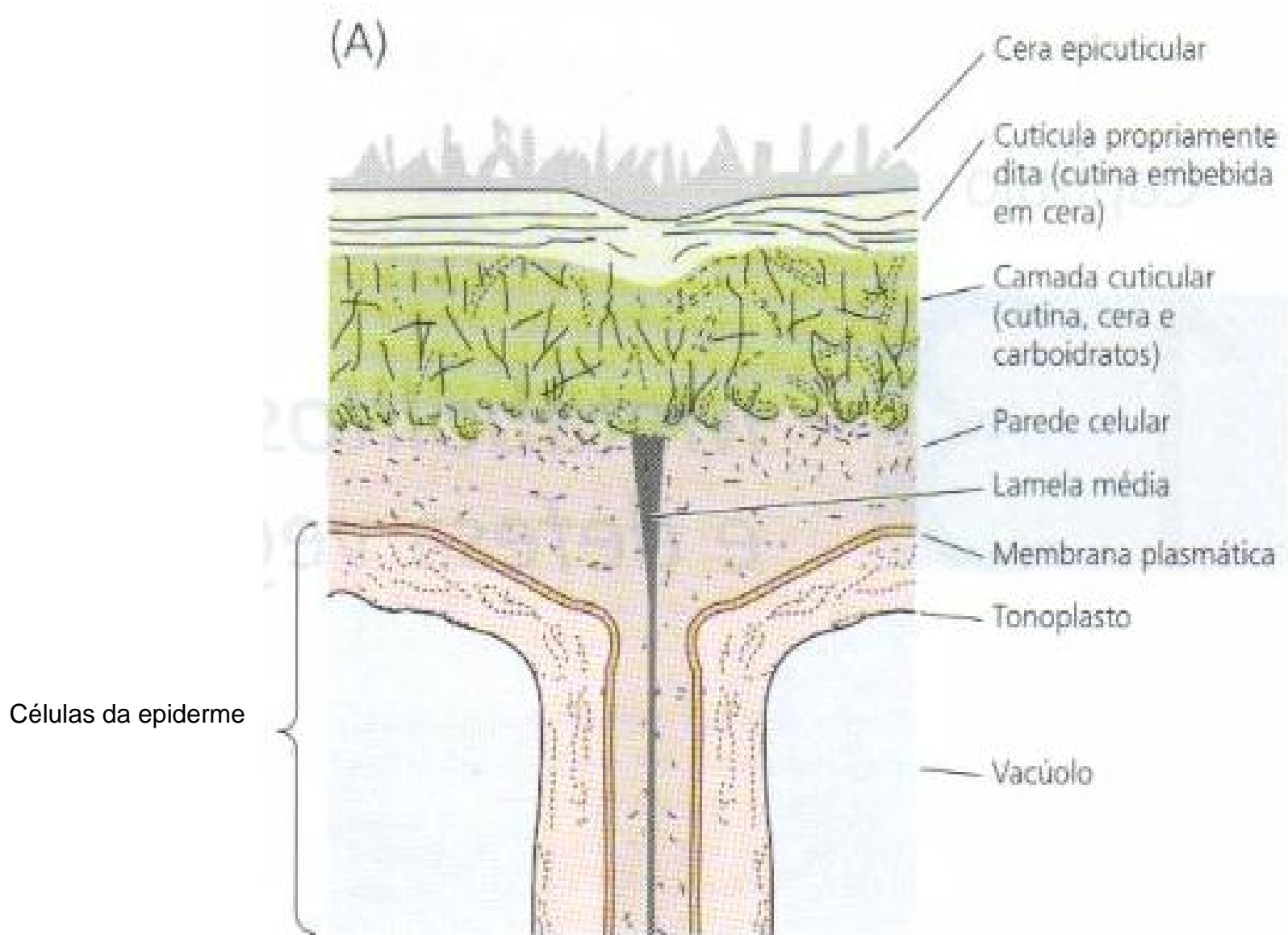
CÉLULAS BULIFORMES



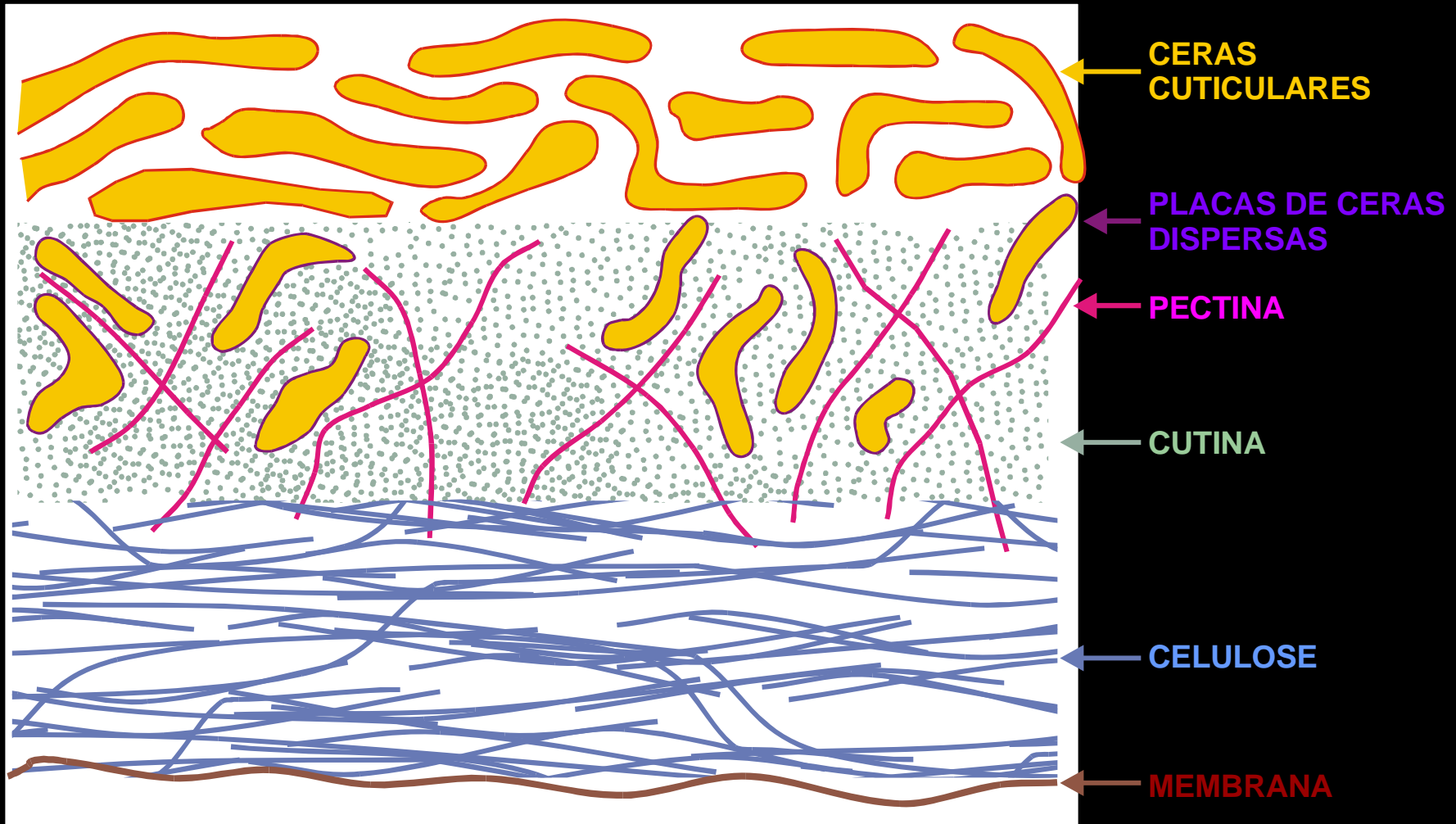
FOLHA CUTÍCULA



Esquema da estrutura da cutícula de folhas e de caules jovens

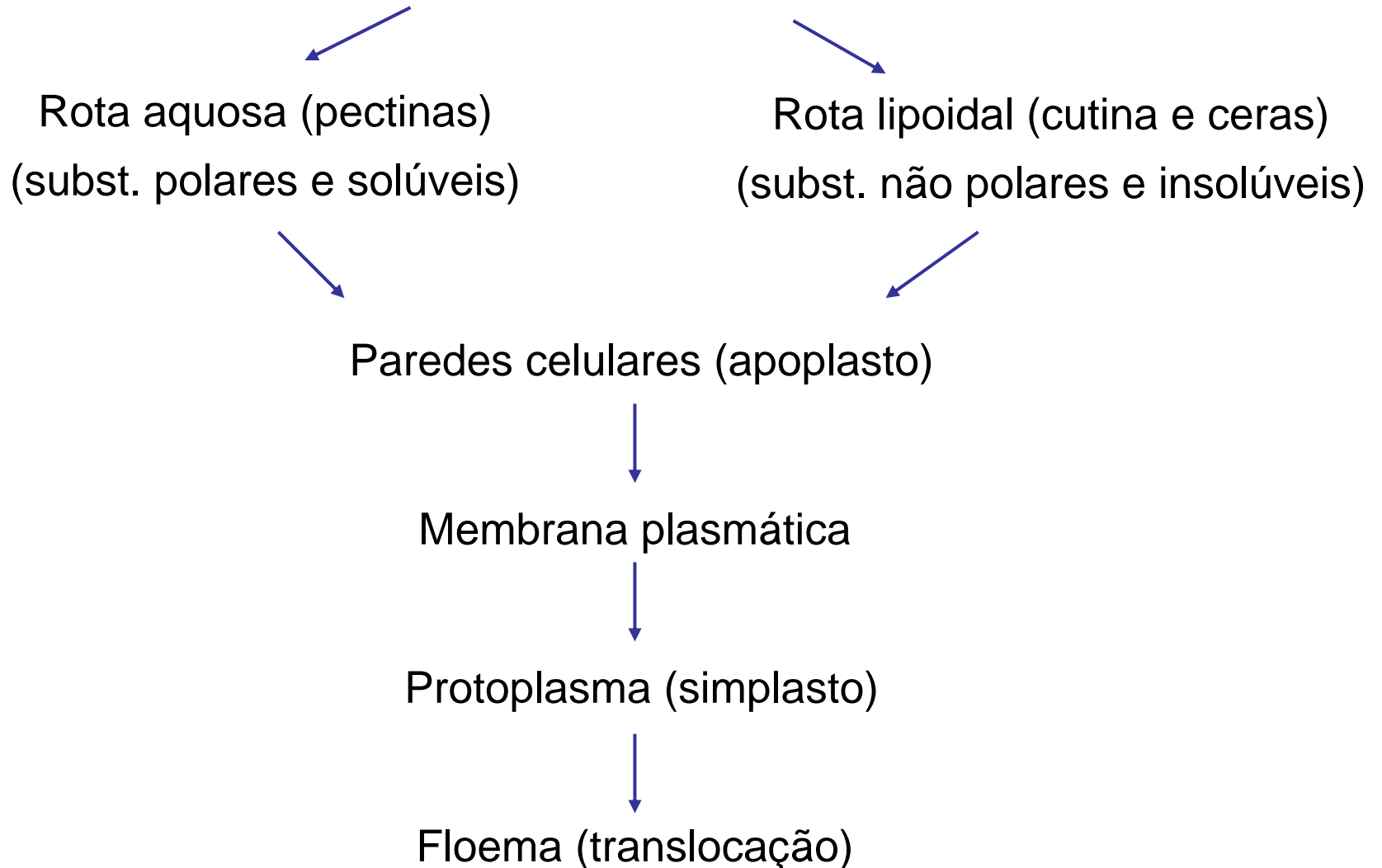


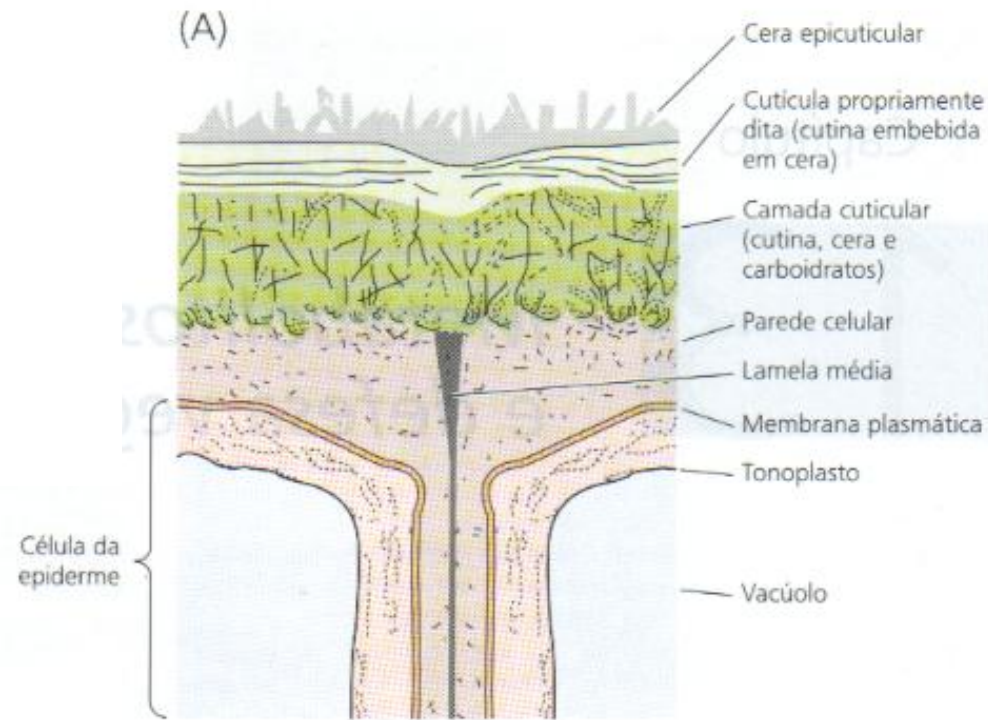
COMPOSIÇÃO DA CUTÍCULA



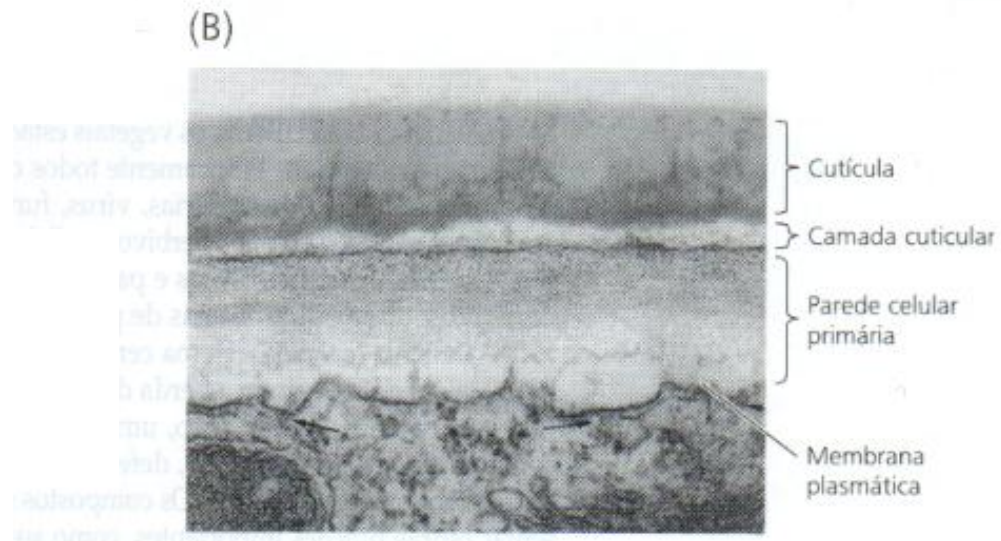
ROTAS DE ABSORÇÃO FOLIAR

Cutícula externa





Esquema da estrutura da cutícula de folhas e de caules jovens



Electromicrografia de célula glandular da cutícula de uma folha jovem de *Laminum* sp.

ROTAS DE ABSORÇÃO FOLIAR

Estômatos



Câmara sub-estomática (gases)



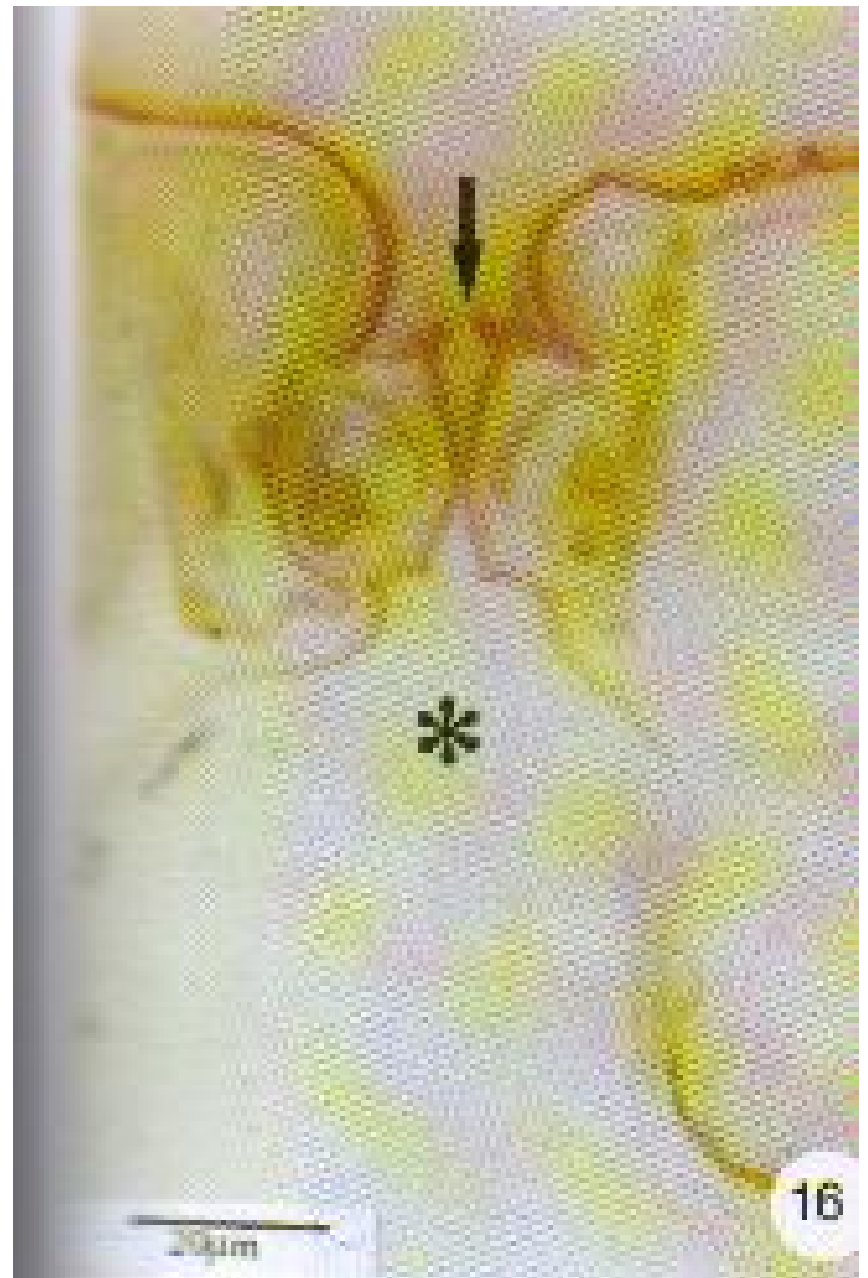
Cutícula delgada



Parede celular



Membrana plasmática



ROTAS DE ABSORÇÃO FOLIAR

Estômatos



Câmara sub-estomática (gases)



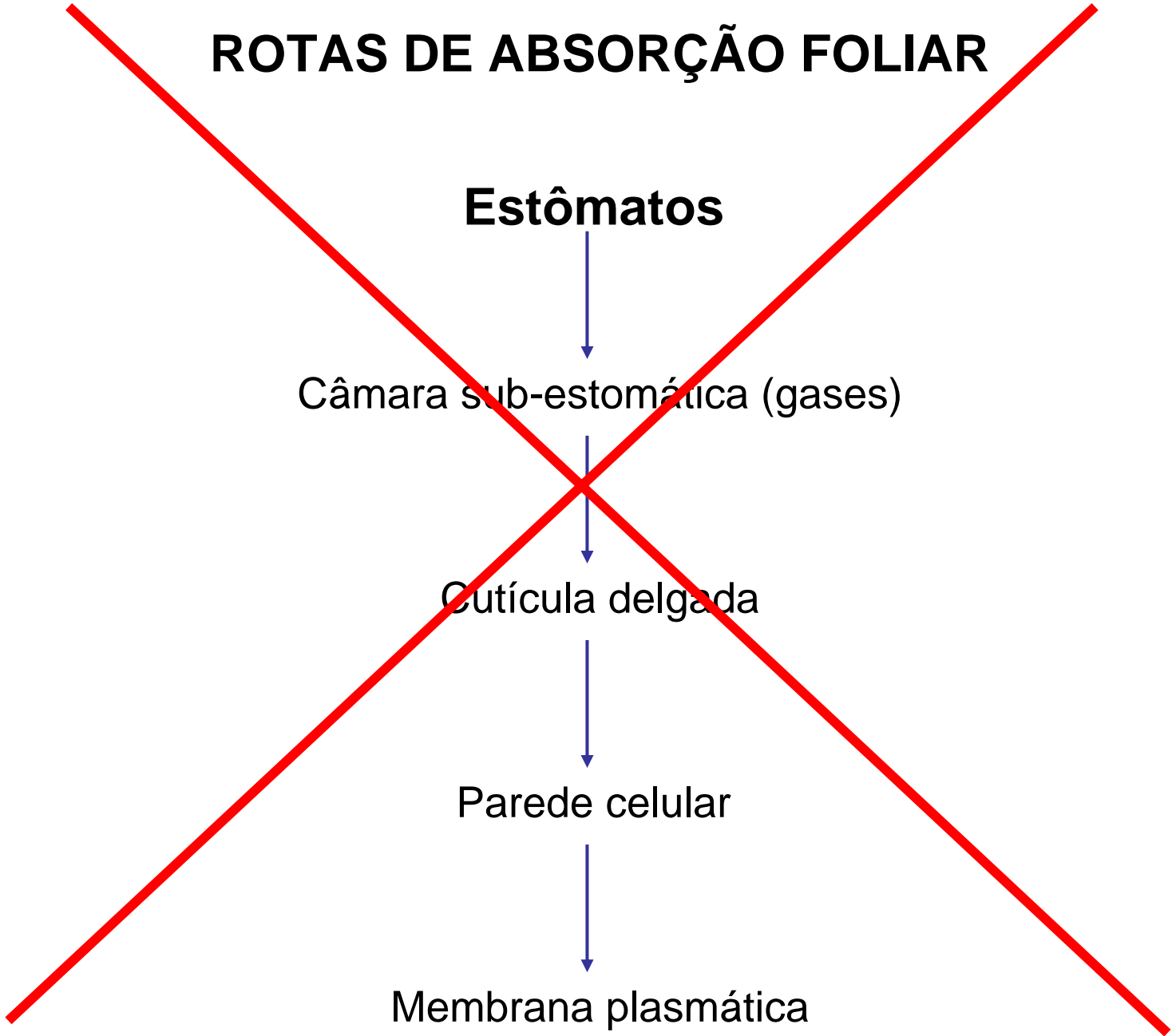
Cutícula delgada



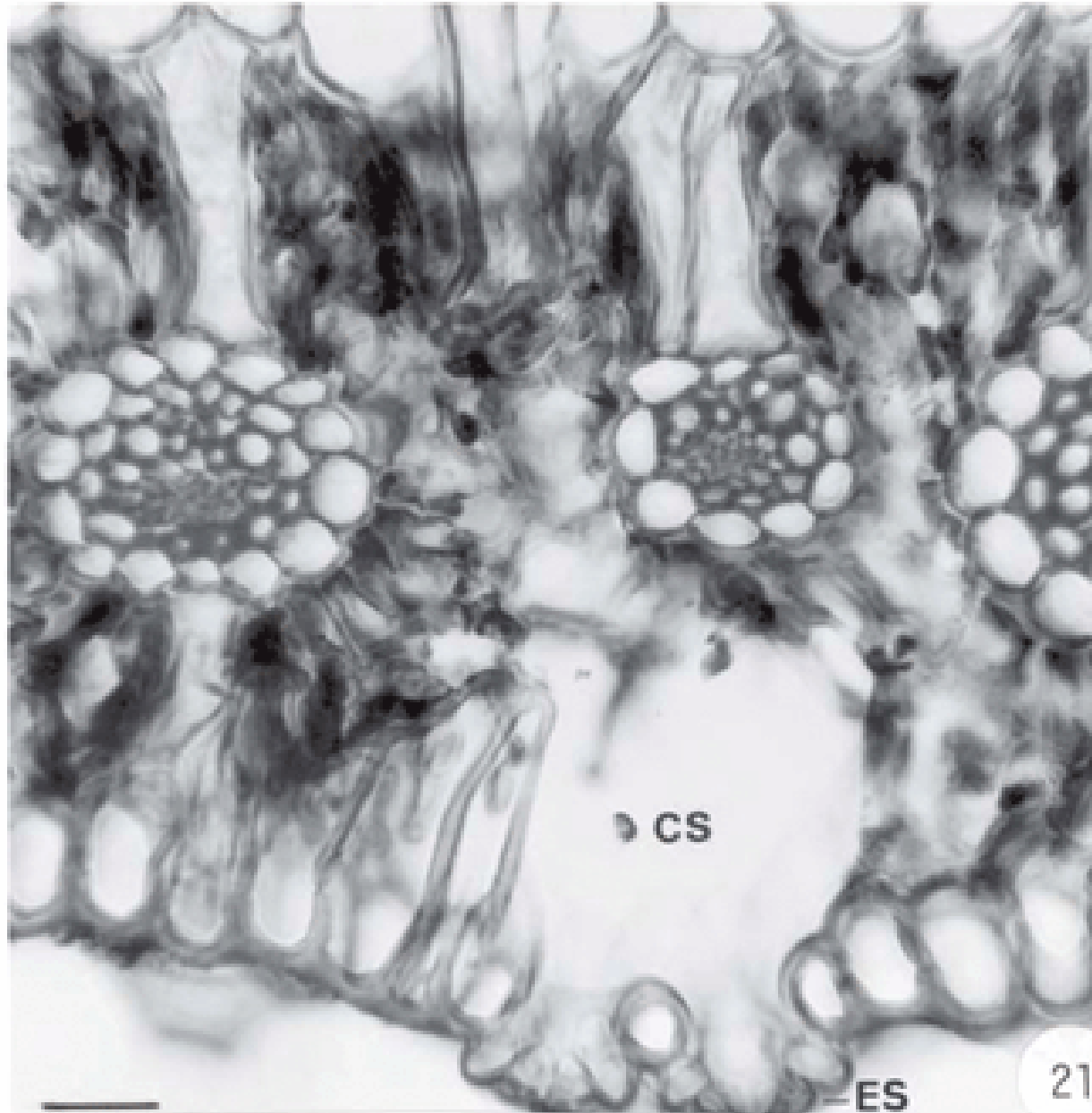
Parede celular



Membrana plasmática



**ESTÔMATO
CÂMARA SUB-ESTOMÁTICA**



FATORES QUE AFETAM A ABSORÇÃO FOLIAR

1. FATORES DA FOLHA

- ESTRUTURA
- ESTADO DE HIDRATAÇÃO DA FOLHA
- IDADE DAS FOLHAS
- CRESCIMENTO
- RELAÇÃO PARTE AÉREA / PARTE RADICULAR

2. FATORES EXTERNOS

- DISPONIBILIDADE DA SUBSTÂNCIA
- CONCENTRAÇÃO DA SOLUÇÃO
- TEMPERATURA
- U.R. E DISPONIBILIDADE DE ÁGUA NO SOLO
- LUZ
- INIBIDORES METABÓLICOS
- APLICAÇÃO DAS PULVERIZAÇÕES FOLIARES
- ÂNGULO DE CONTATO
- CHUVA



FIM!

