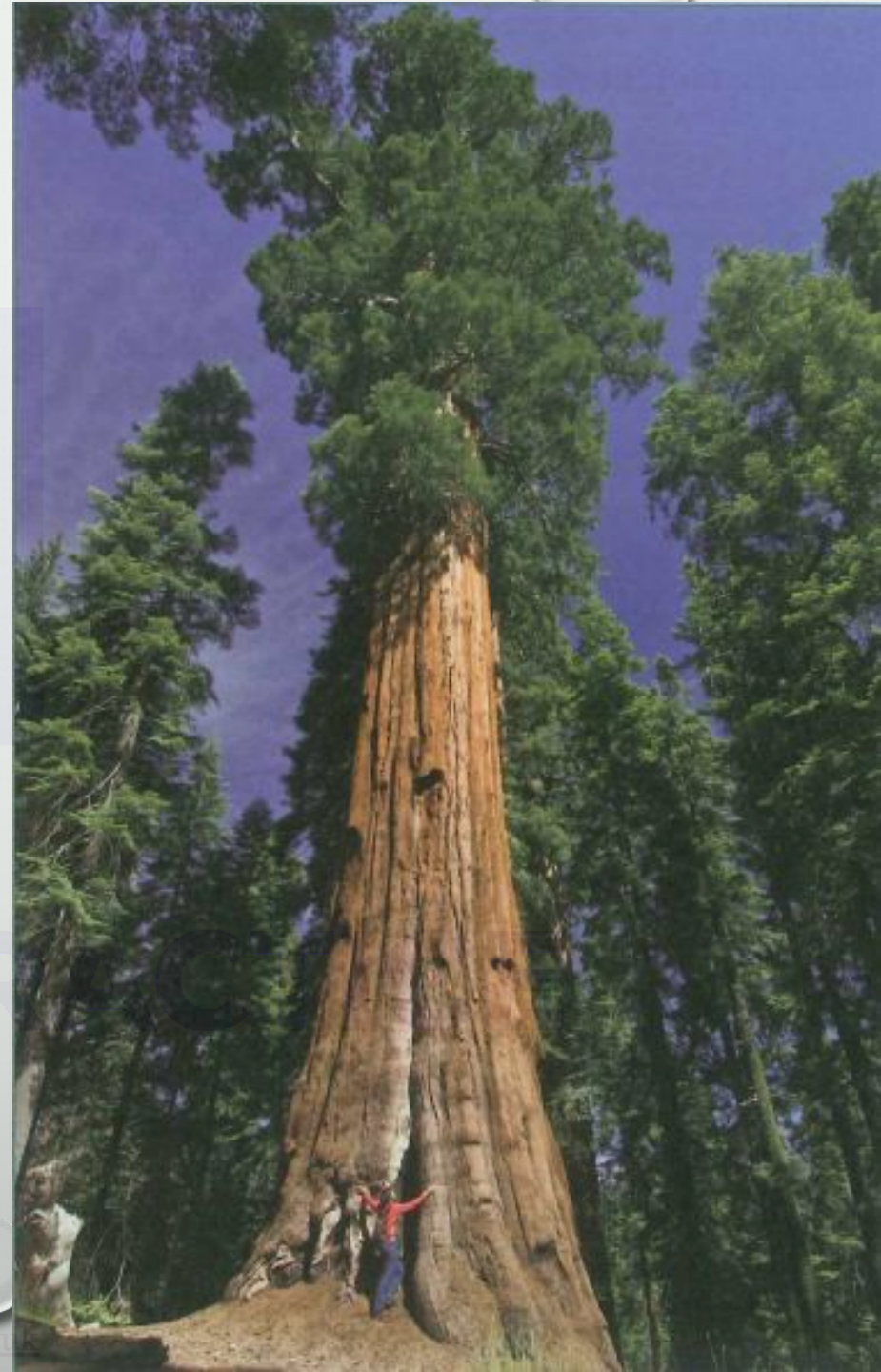
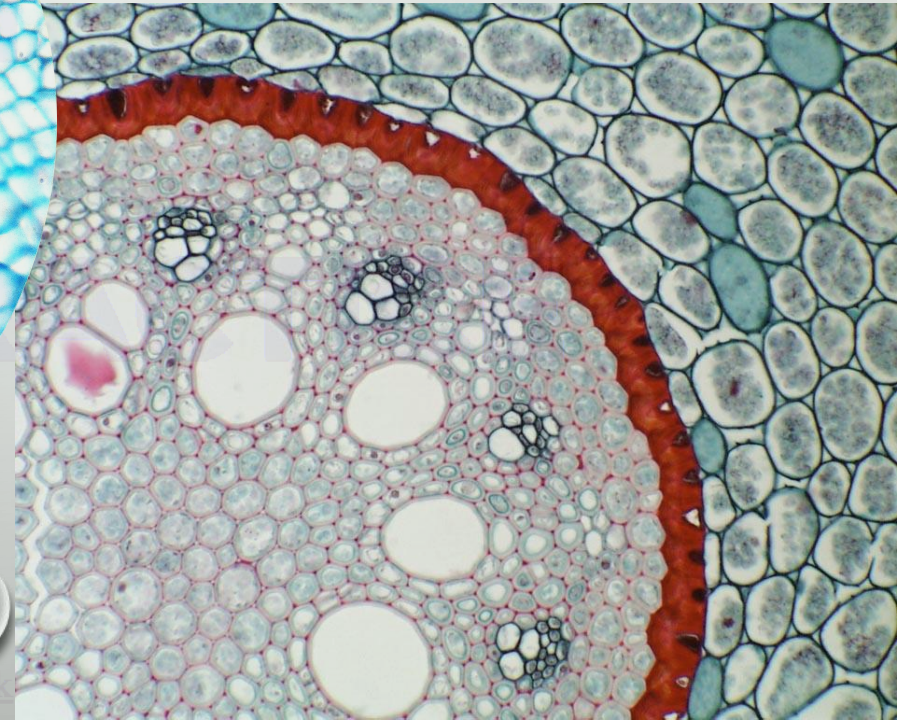
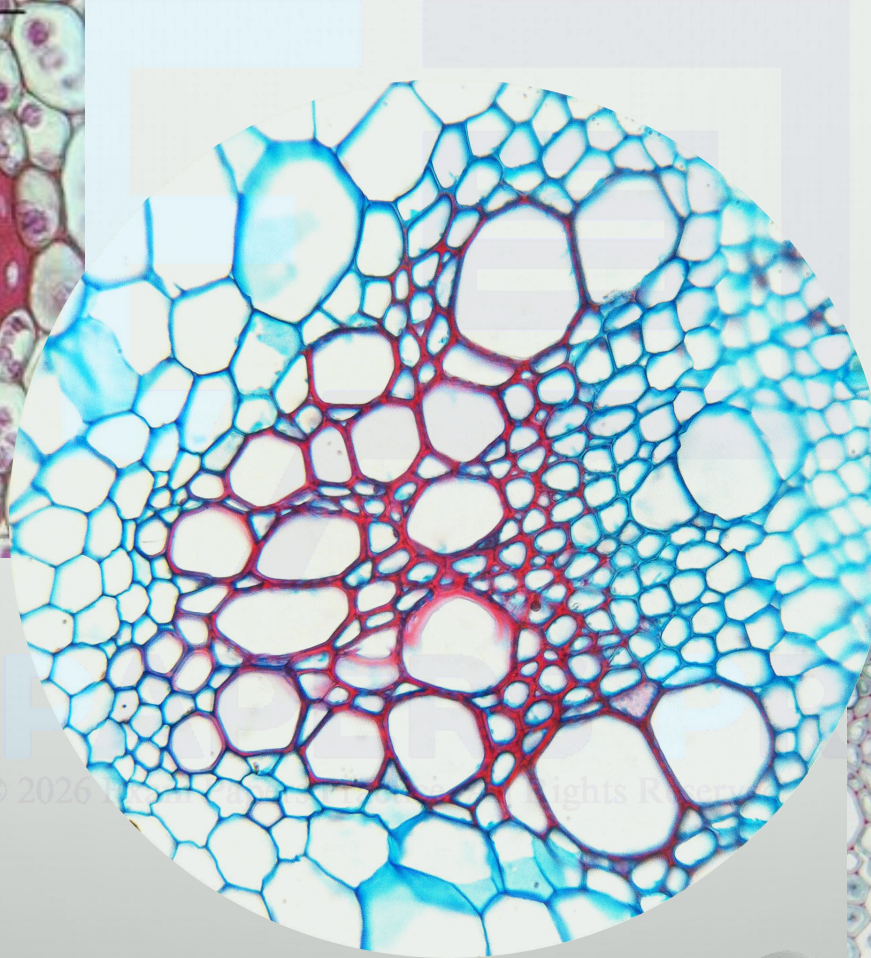
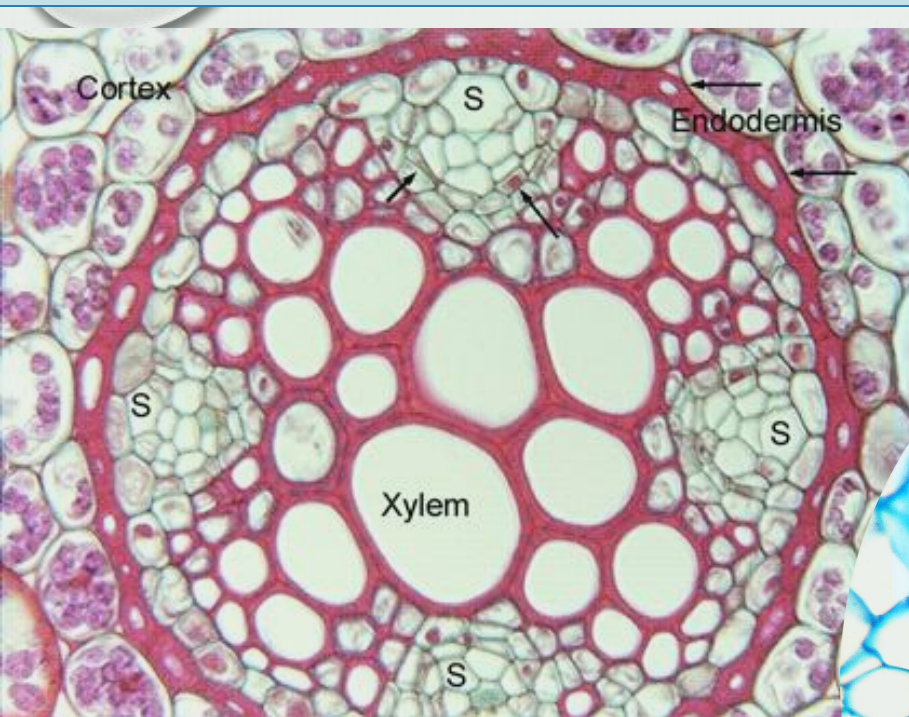


Transport in plants



Transport in plants

Plant transport systems



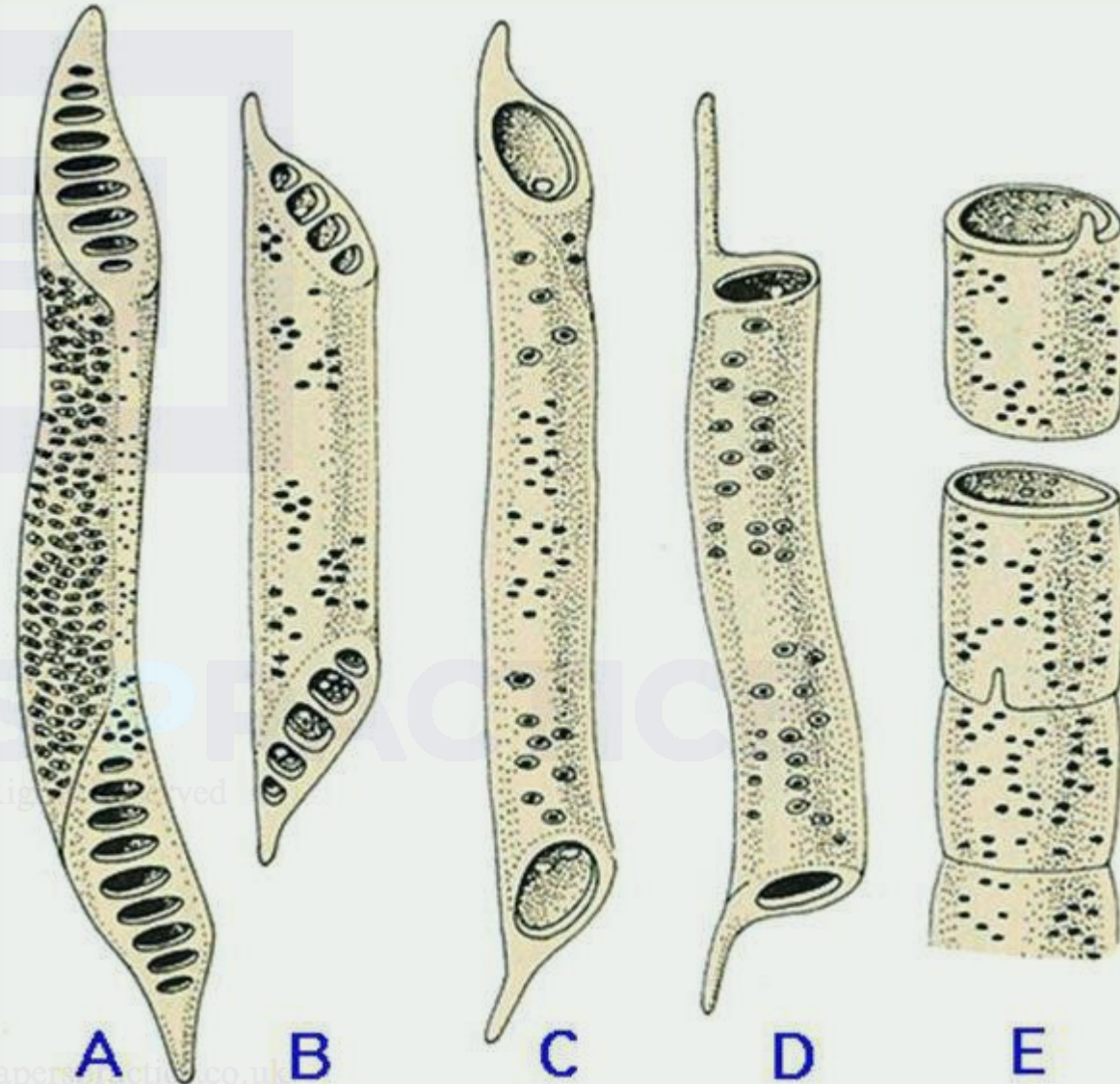
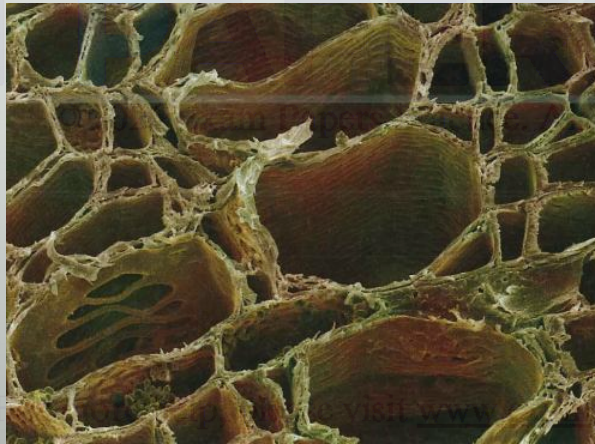
Transport in plants

Plant transport systems

Xylem

- ♣ xylem vessel element → → xylem vessel
- dead, hollow
- no cytoplasm or nuclei
- cell walls are made of cellulose and lignin (lignin is very strong, so xylem vessels help to keep plants upright.)
- the end walls of cells have disappeared

xylem vessel 木质部导管
xylem vessel member
木质部导管分子
lignin 木质素
transverse section 横切面
longitudinal section 纵切面



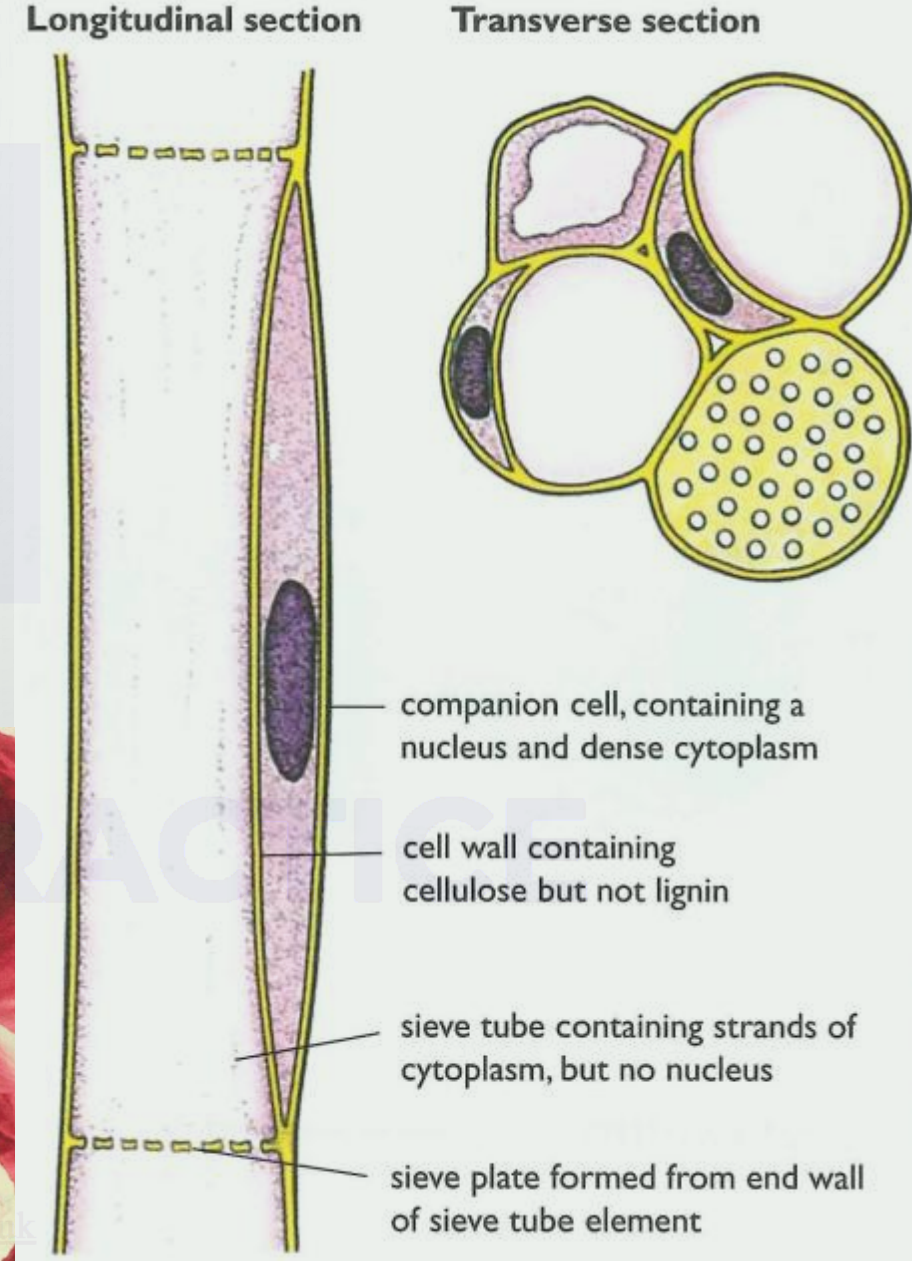
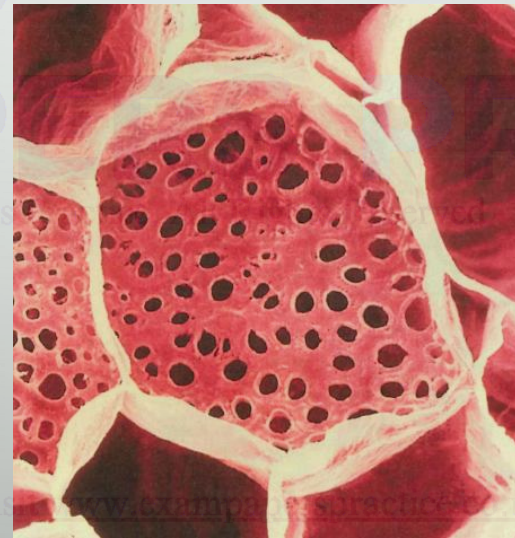
Transport in plants

Plant transport systems

phloem

- ♣ Phloem tube element →→ phloem tube
 - contain **cytoplasm**, but **no nucleus**
 - do not have **lignin** in cell wall
 - their end walls have **not completely broken down**.
- ♣ companion cell
 - have **nucleus** and many **other organelles**
 - probably supply sieve tube element with some of requirements

phloem 韧皮部
phloem tube element 筛管
companion cell 伴胞

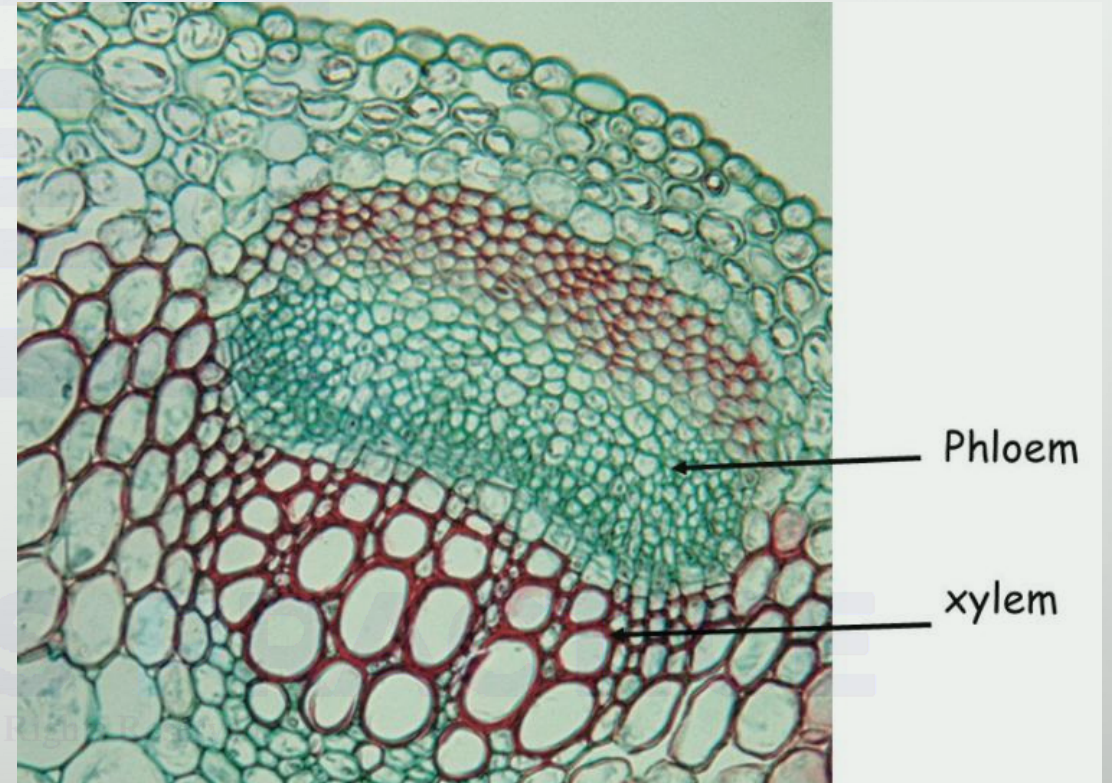


Transport in plants

Plant transport systems

Vascular bundles

♣ phloem + xylem



vascular bundle 维管束



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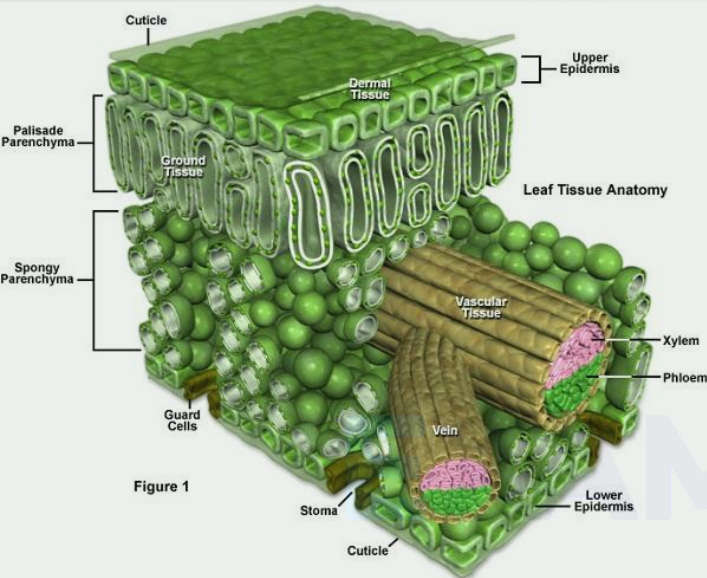
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Transport in plants

Plant transport systems

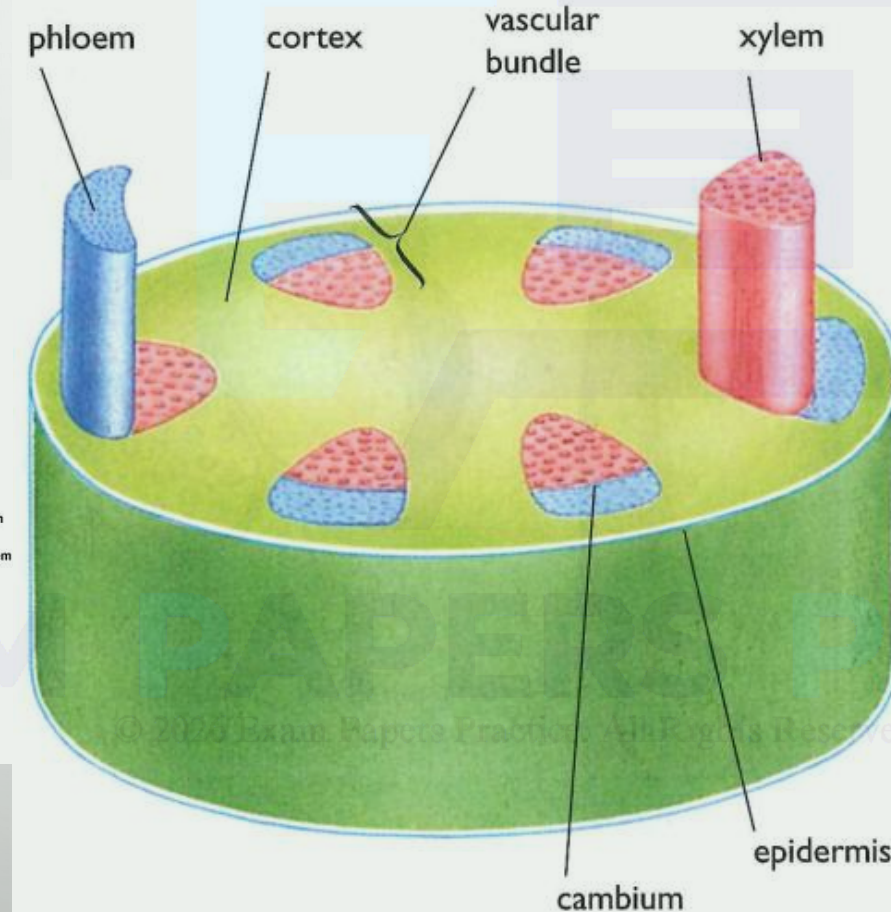
Vascular bundles

leaf

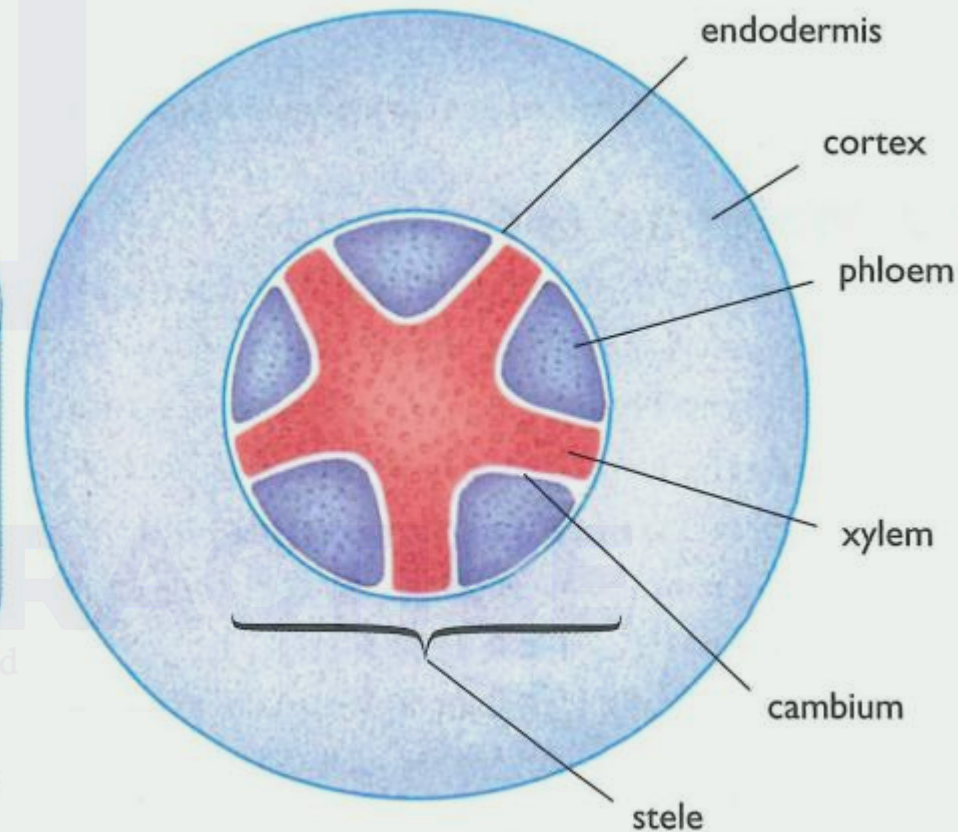


cortex 果皮
cambium 形成层
stele 中柱

stem



root



- ♣ what do xylem vessels carry?
- ♣ what substance makes up the cell walls of xylem vessels?
- ♣ what do phloem tubes carry?
- ♣ give three ways in which phloem tubes differ from xylem vessels?
- ♣ what is a vascular bundle?

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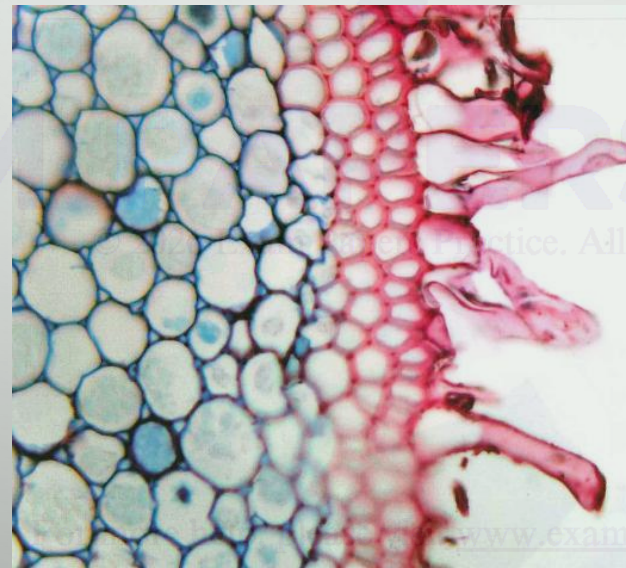
Transport in plants

Water uptake

Root tip

- ♣ root cap
- ♣ root hair (absorb water and minerals from the soil by **osmosis**)

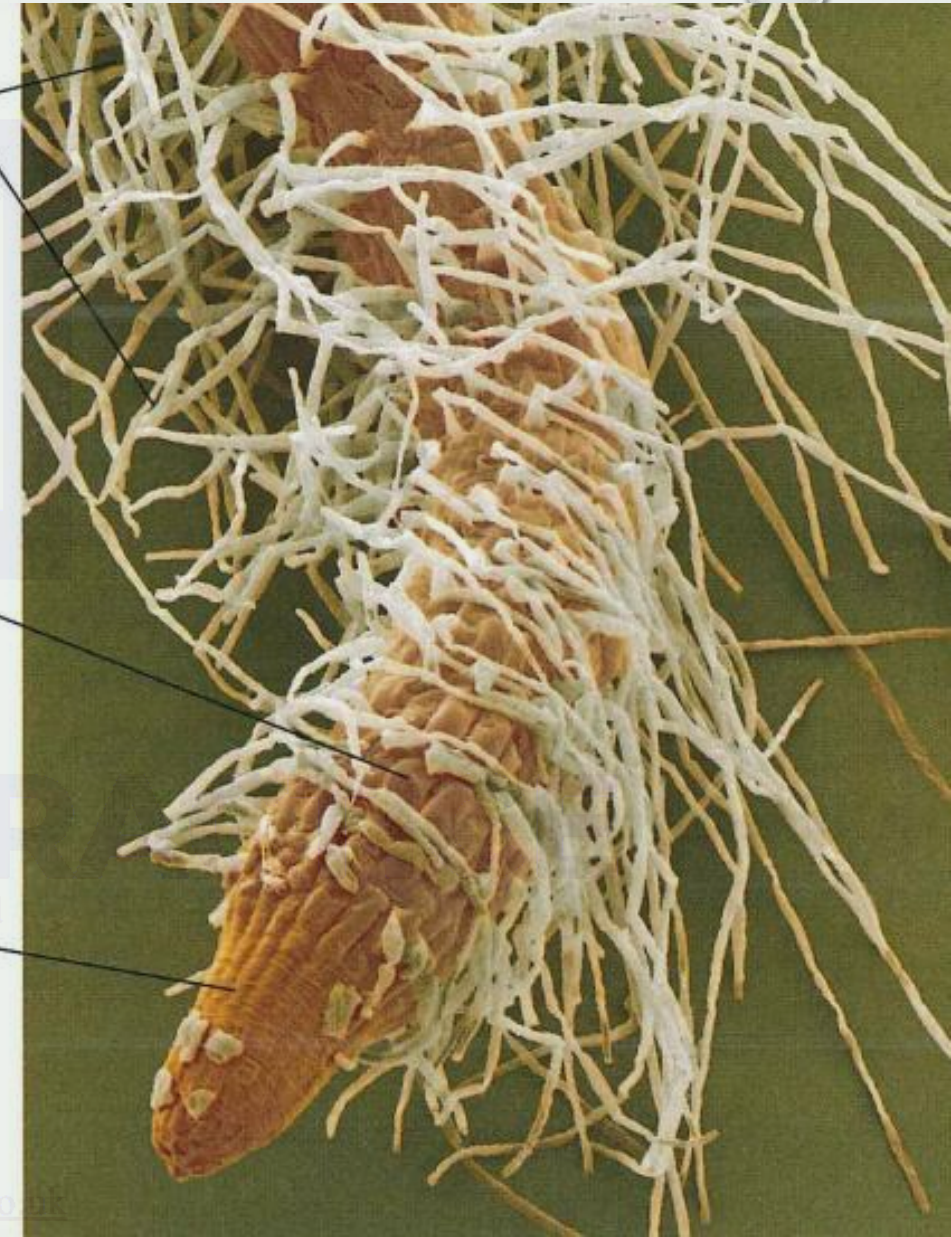
root tip 根尖
epidermis 表皮
root cap 根冠
root hair 根毛



root hairs

epidermis

root cap

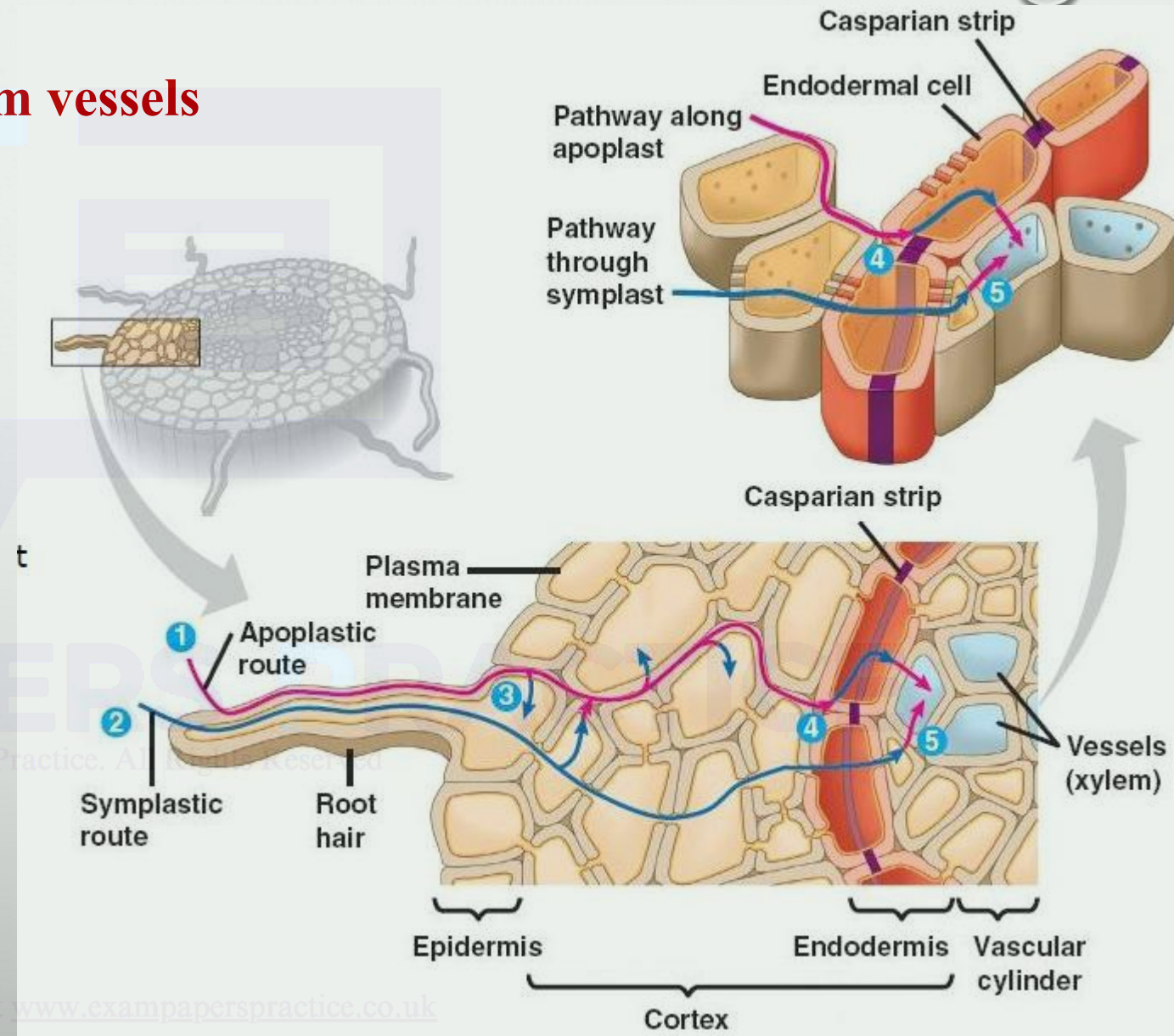


Transport in plants

Water uptake

Paths of water traveling from soil to xylem vessels

- ♣ from cell to cell by osmosis, through the cortex
- ♣ through the spaces between the cells
- ♣ through the cells walls



Transport in plants

Water uptake



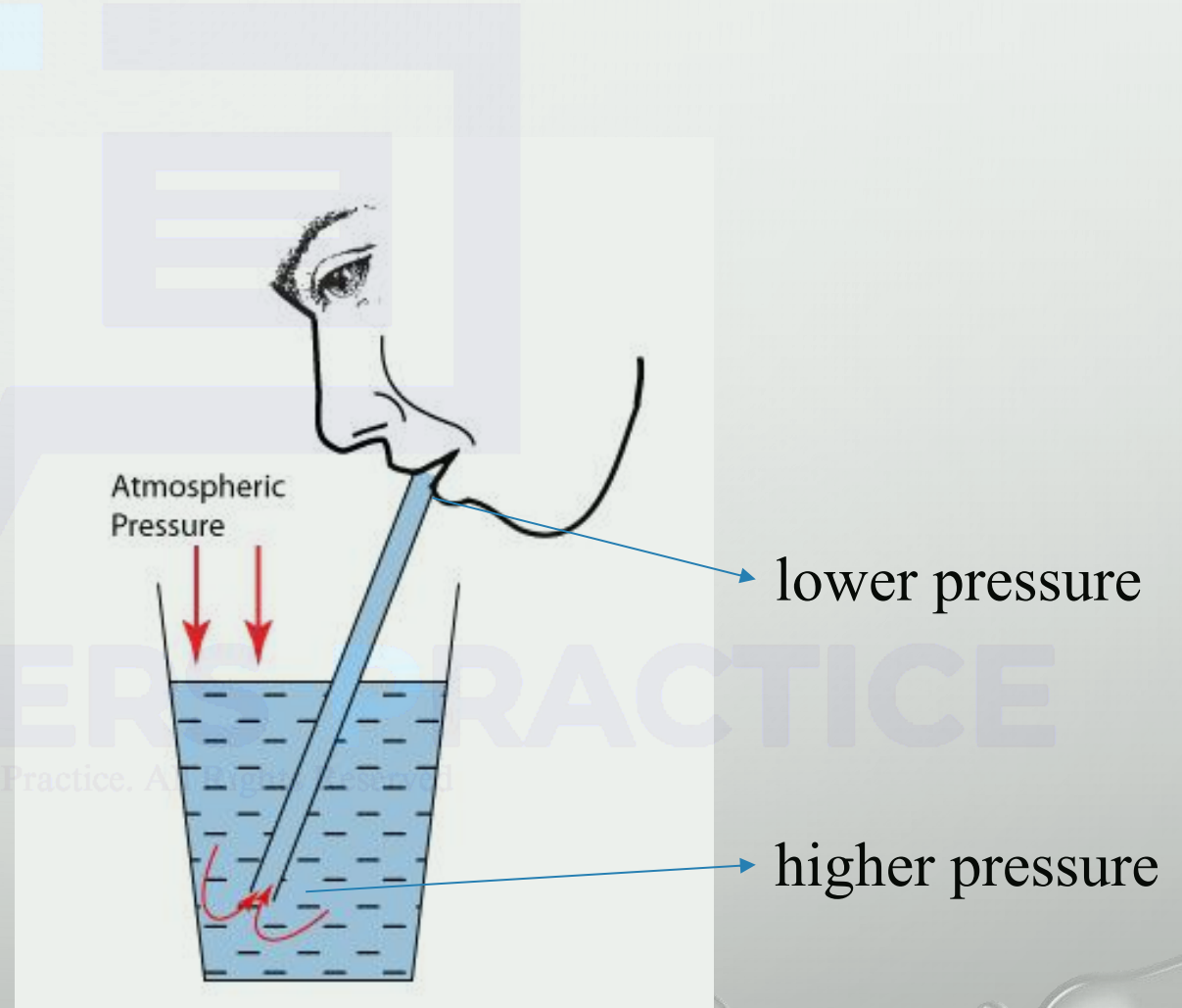
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Transport in plants

Water uptake

Why water can flow upside ?



Transport in plants

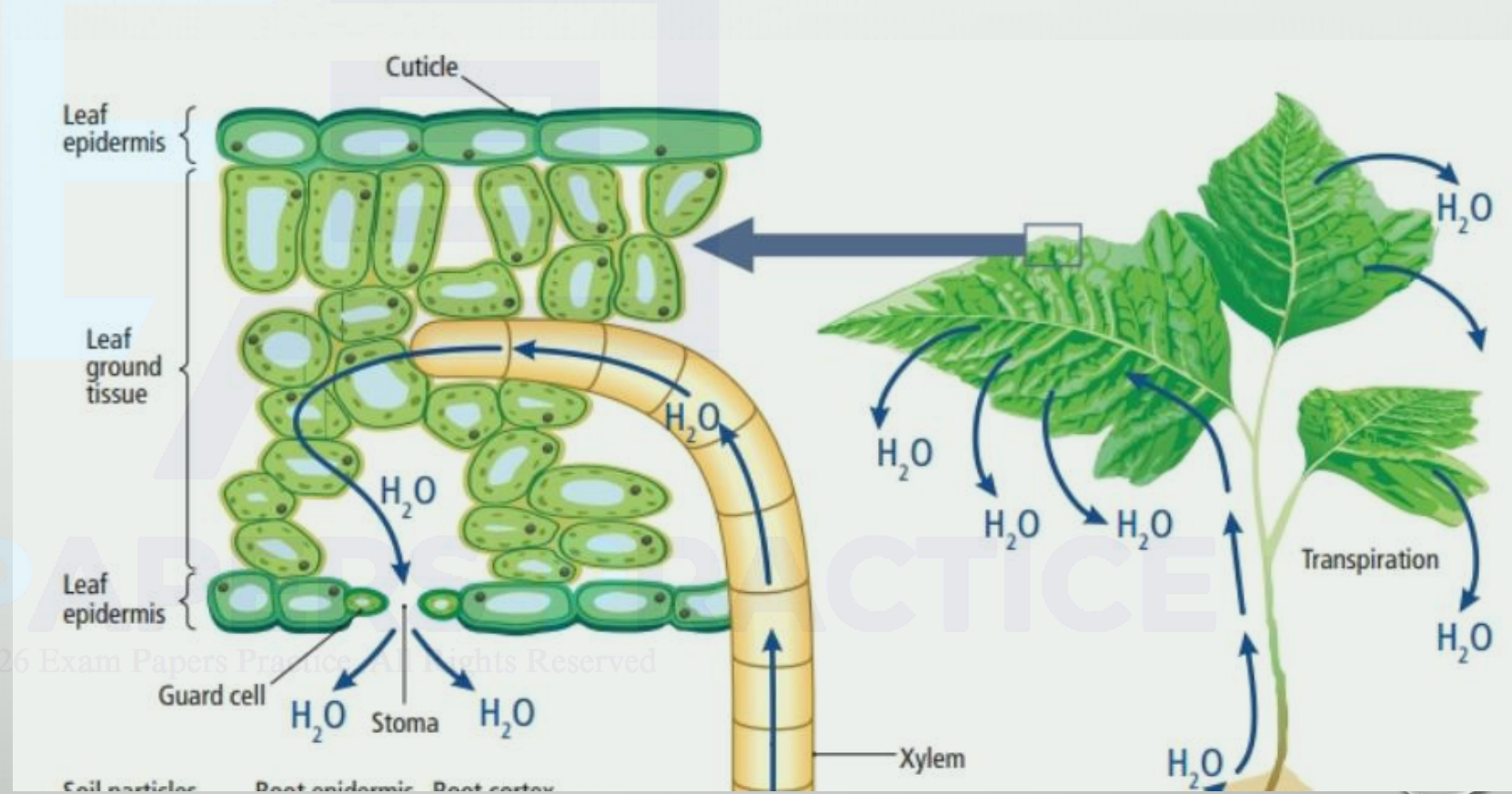
Transpiration

Why water can flow upside ? —— **transpiration**

Transpiration

Loss of water from plants leaves by **evaporation** of water at the surfaces of the mesophyll cells followed by loss of water vapour through the **stomata**.

transpiration 蒸腾作用



Transport in plants

Transpiration

transpiration stream

Water potential gradient

Loss of water vapour from leaves

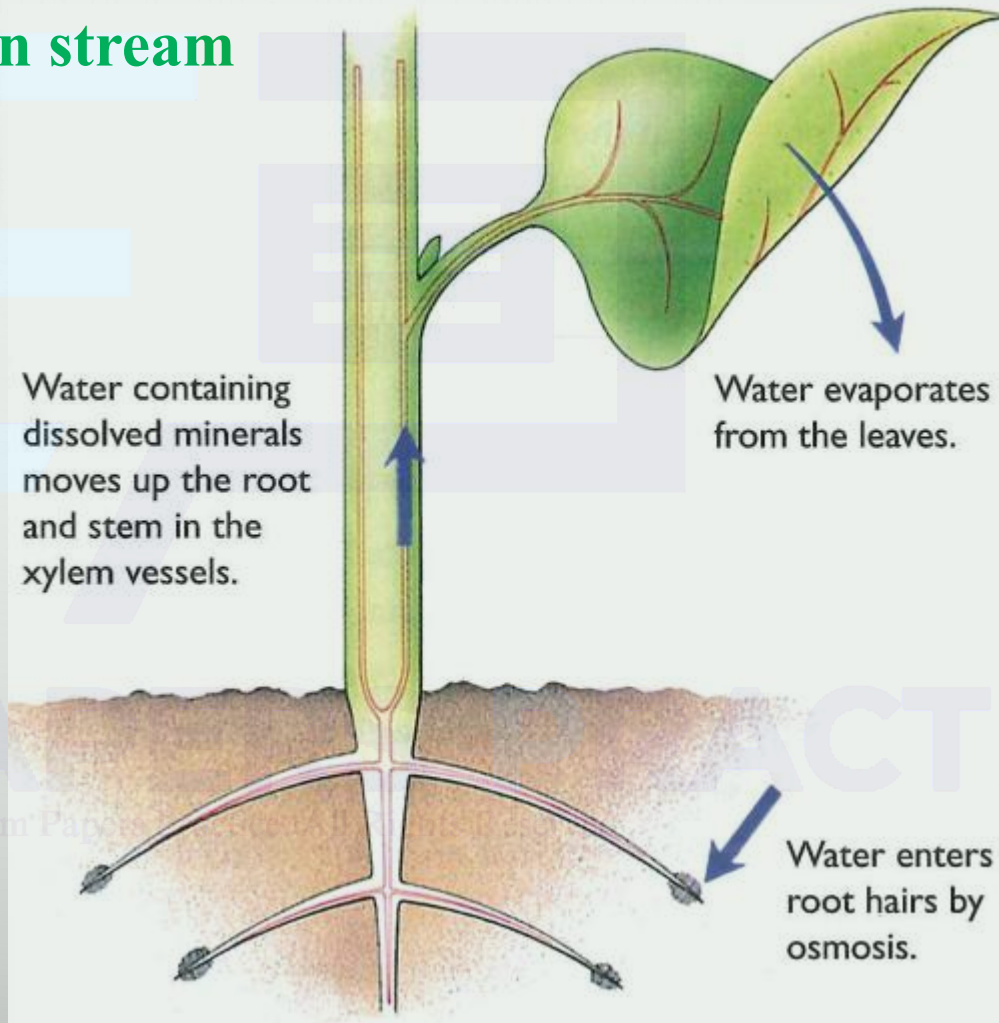


Low water potential in the leaves



Produce a 'pull' from above, drawing water up the plant
(cohesion → water column)

transpiration stream 蒸流
cohesion 内聚力



Lower water potential

highest water potential

● **Structures** of a plant is adapted to help it to take up water and move it up through the plant

♥ **root hair** → provide a huge surface area through which water can be absorbed

♥ **hollow, narrow xylem vessels** → provide an easy pathway for water to flow

♥ **many air spaces inside the leaf** → provide a large surface area from which water can evaporate

♥ **stomata** → allow water vapour to diffuse easily out of the leaf

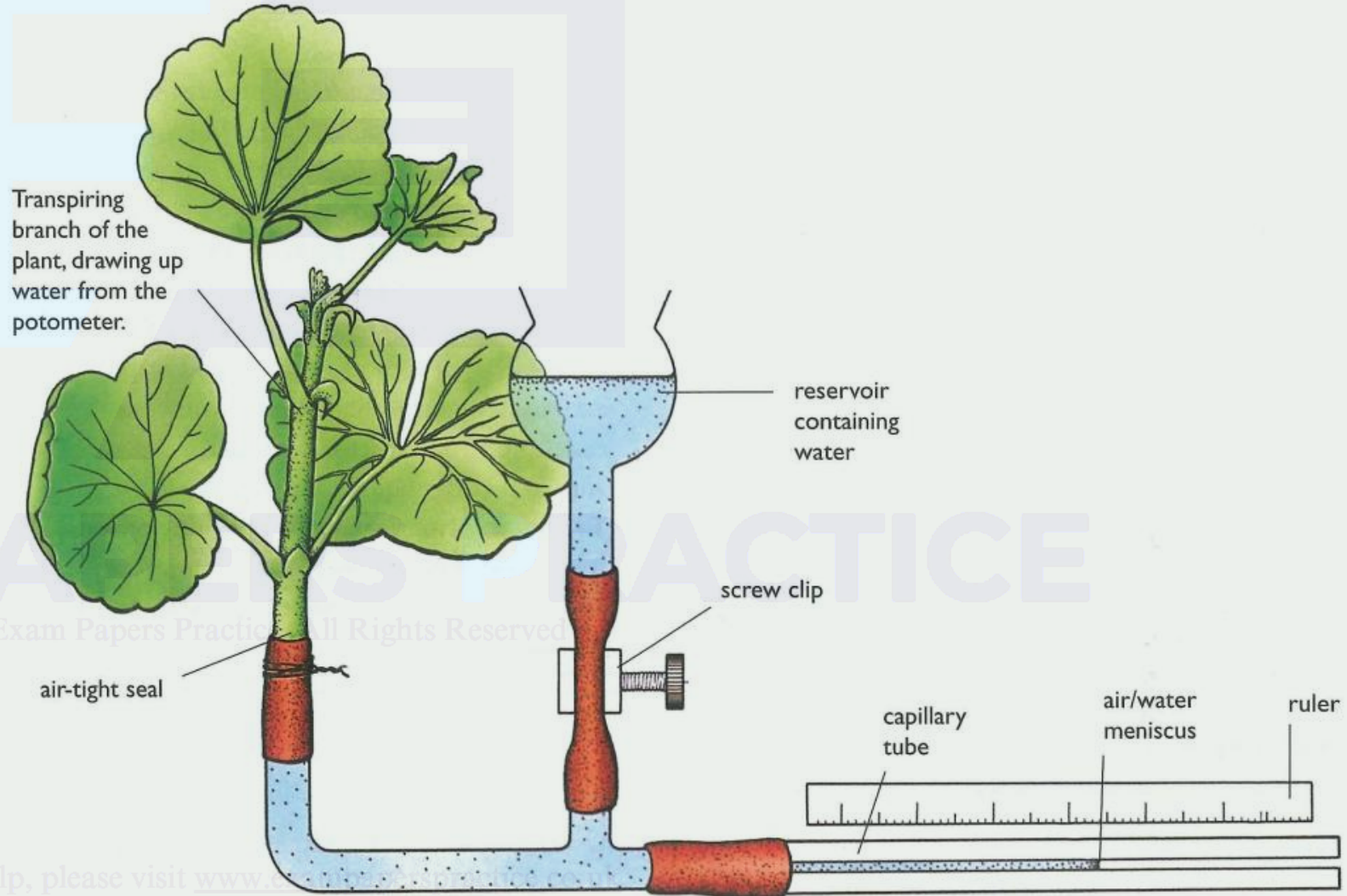
Transport in plants

Transpiration — activity

The faster a plant transpires, the faster it takes up water

Measuring transpiration rates

Potometer



potometer 蒸腾计

meniscus 半月板, 弯月面

air/water meniscus 空气/水弯月面

shoot 枝条

Conditions that affect transpiration rate

♠ temperature

♠ humidity

The higher the humidity, the less water will evaporate from the leaves

♠ wind speed

Transpiration increases as wind speed increases

♠ light intensity

High light intensity → more stomata open (carbon dioxide/ photosynthesis)
→ transpiration increases

♠ water supply

Short supply of water → more stomata close
→ transpiration decreases

If lose too much water, the roots may not be able to take up enough to replace it.
→ wilt (flaccid)

humidity 湿度

Light intensity 光强

water supply 供水

wilt 萎蔫

flaccid 松弛

Transport in plants

What is the function of a root cap ?

Explain how water goes into root hairs. How does this process differ from the way in which minerals enter?

What is transpiration ?

What are stomata?

What is photometer used for?

Explain how temperature and light intensity affect the rate of transpiration?



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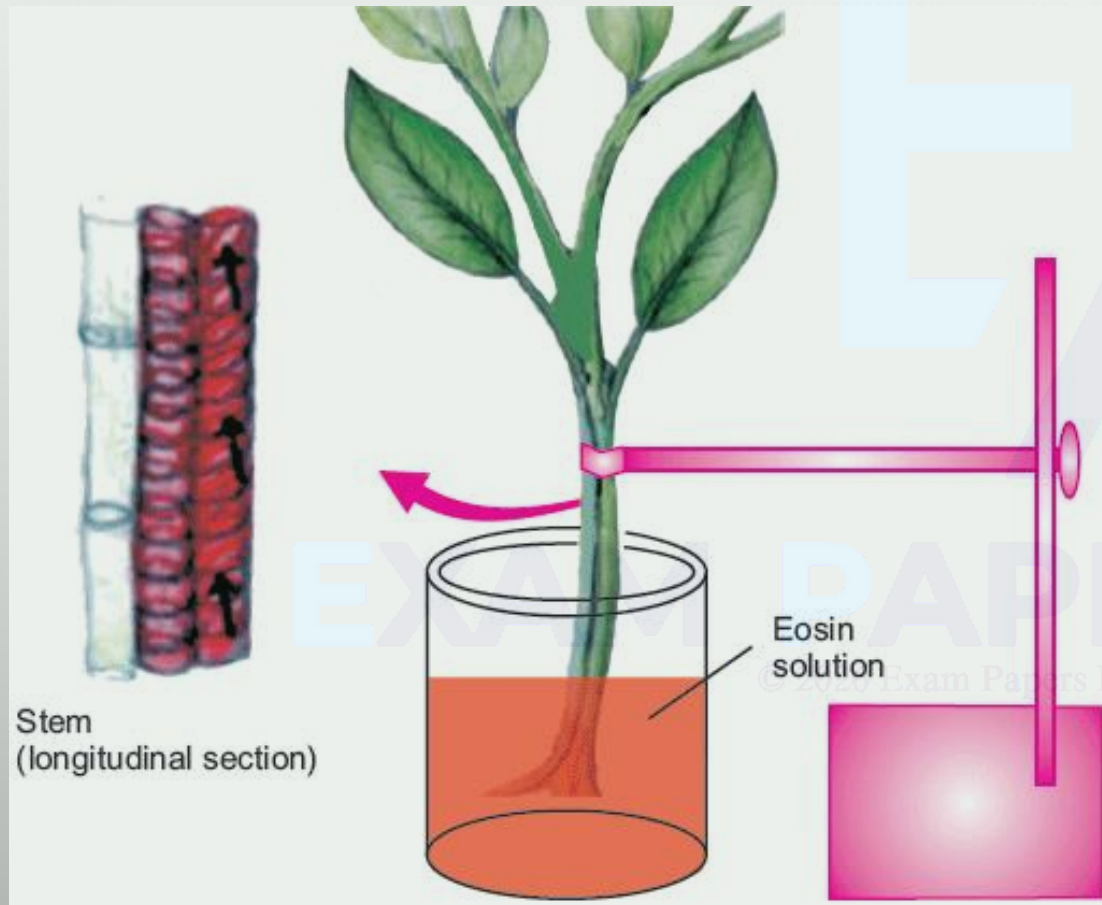
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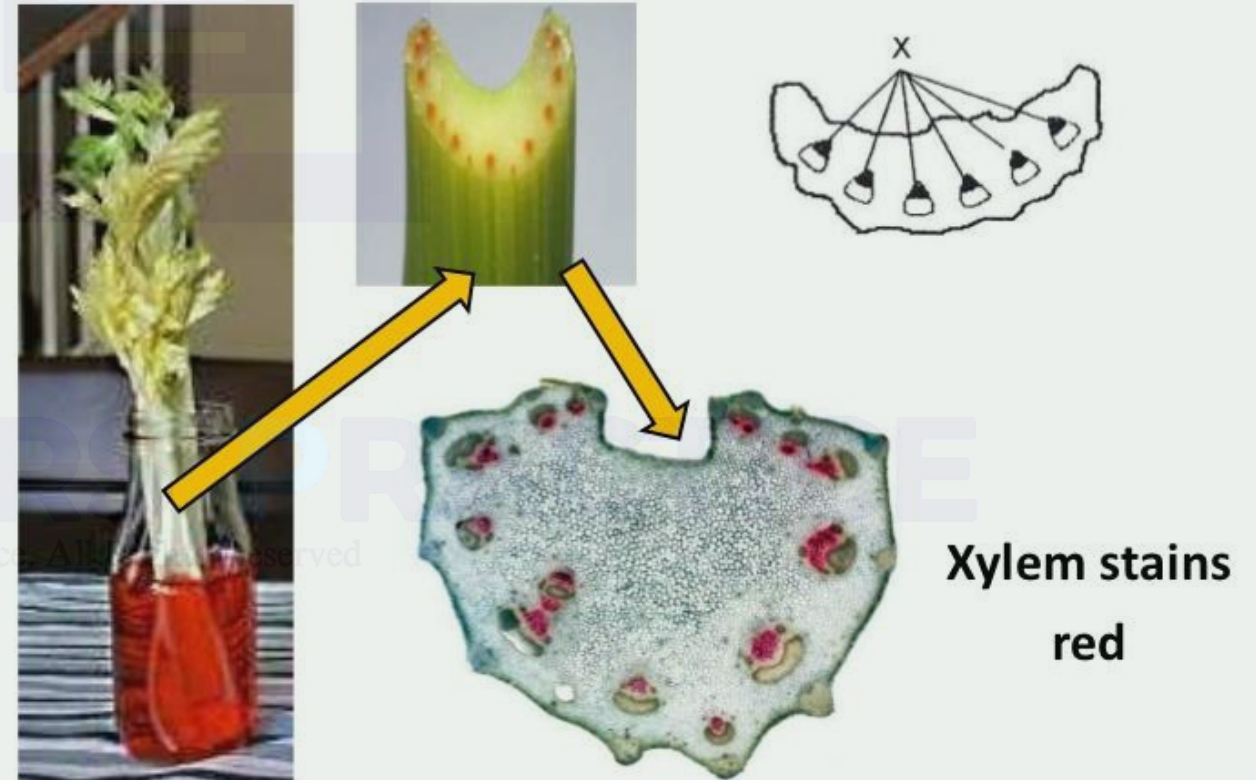
Transport in plants

Transpiration - activity 1

Activity 1 : to see which part of a stem transports water and solutes



Celery stem under microscope



Activity 1 : to see which part of a stem transports water and solutes

Which part of the stem contained the dye?

What does this tell you about the transport of water and solutes up a stem?

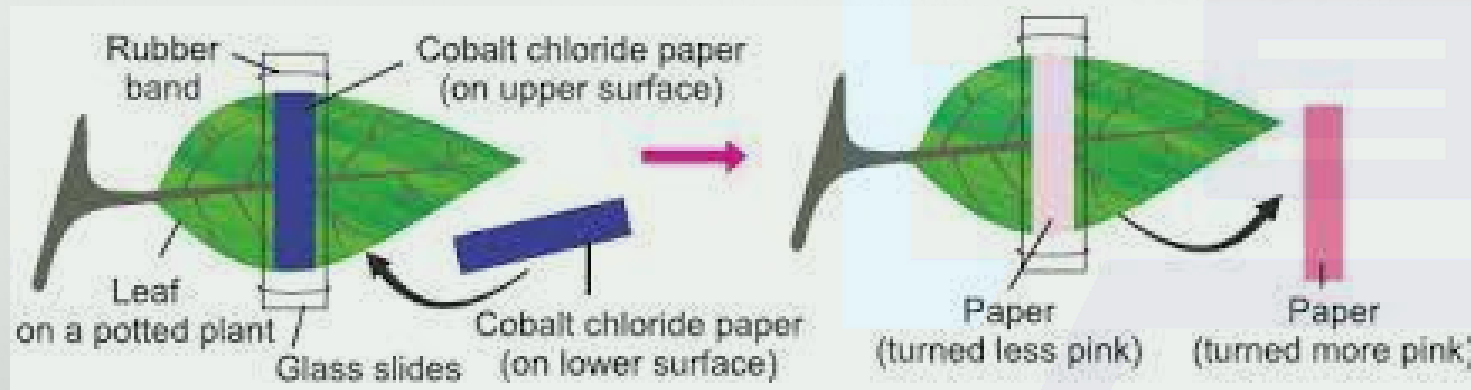
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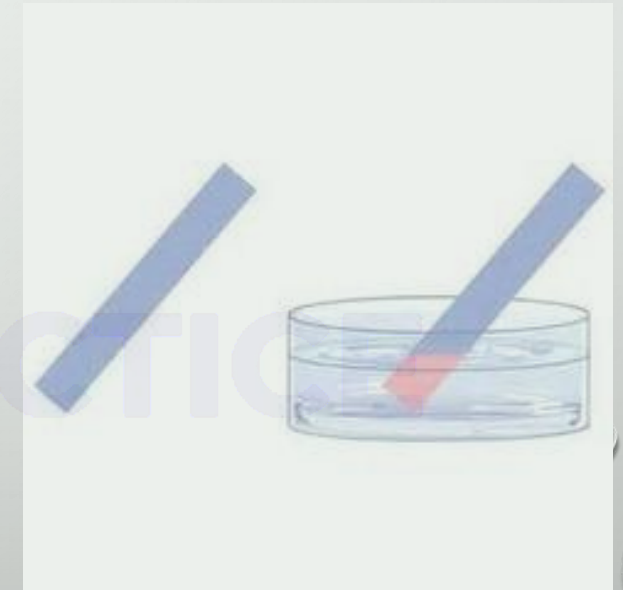
Transport in plants

Transpiration - activity 2

Activity 2 : to see which surface of a leaf loses most water



Cobalt chloride paper is blue when dry and pink when wet.



Which piece of cobalt chloride paper turned pink first?

What does this tell you about the loss of water from a leaf?

Why does this surface lose water faster than the other?

Why is it important to use forceps, not fingers, for handling cobalt chloride paper?

cobalt chloride 氯化钴

Activity 3 : to measure the rate of transpiration of a potted plant



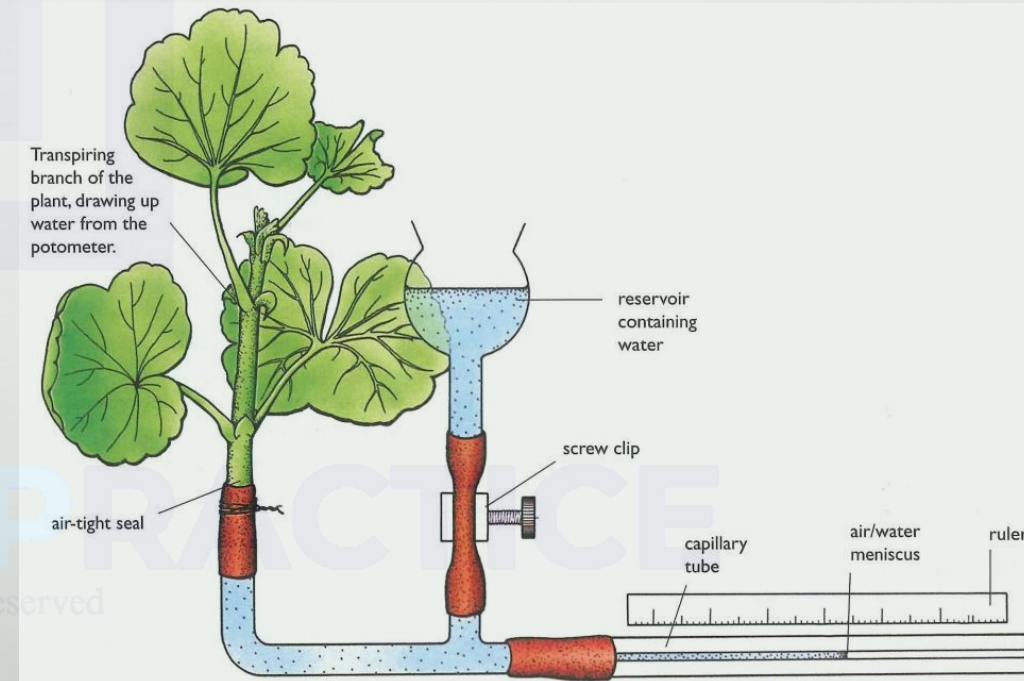
Which plant lost mass ? Why ?

Do you know this is a good method of measuring transpiration rate ?
How could it be improved ?

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Activity 4 : using a potometer to compare rates of transpiration under different conditions

- 1 set up the potometer. The stem of the plant must fit exactly into the rubber tubing, with no air gaps. Petroleum jelly will help to make an air-tight seal.
- 2 fill the apparatus with water, by opening the clip.
- 3 close the clip again, and leave the apparatus in a light, and airy place. As the plant transpires, the water it loses is replaced by water taken up the stem. Air will be drawn in at the end of the capillary tube.



Activity 4 : using a potometer to compare rates of transpiration under different conditions

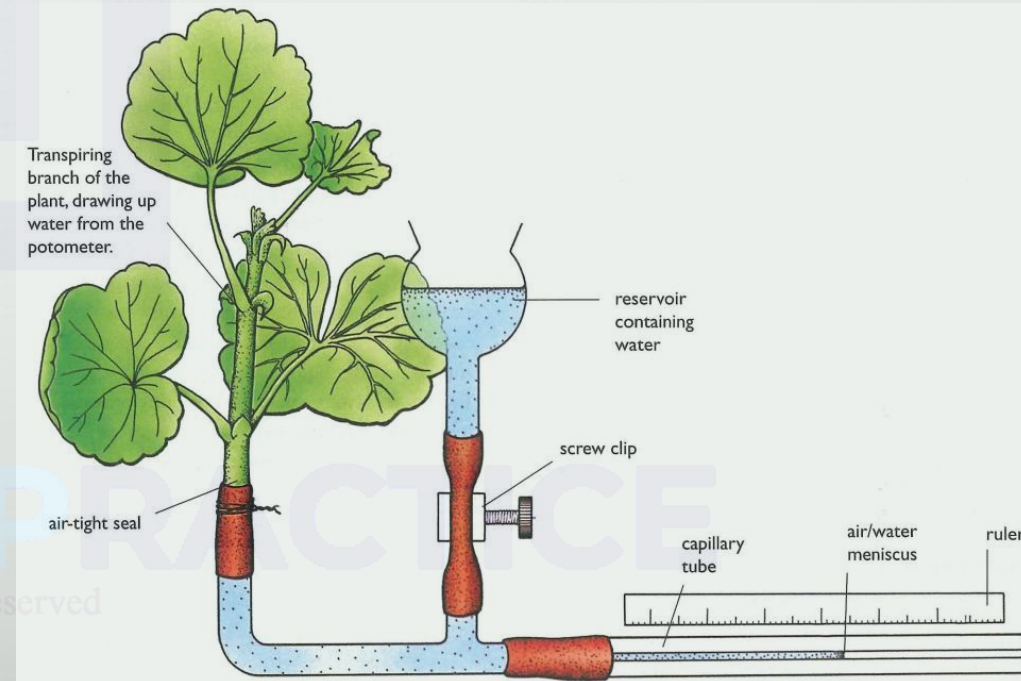
4 when the air/water meniscus reaches the scale, begin to record the position of the meniscus every two minutes.

5 when the meniscus reaches the end of the scale, refill the apparatus water from the reservoir as before.

6 now repeat the investigation, but with the apparatus in a different situation. You could try each of these:

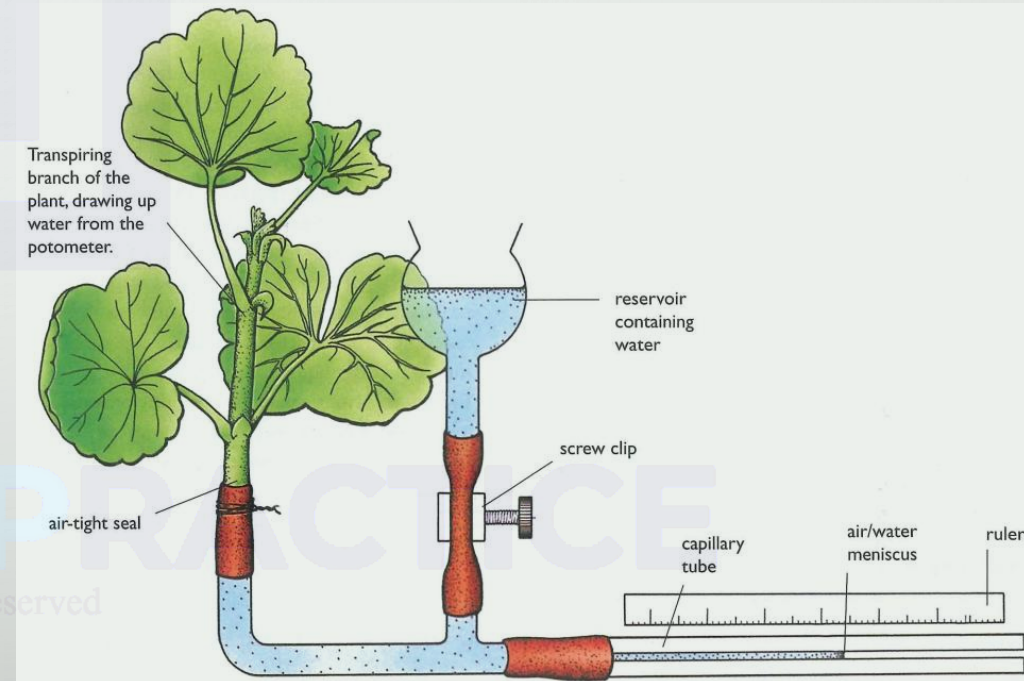
- ◆ blowing it with a fan
- ◆ putting it in a cupboard
- ◆ putting it in a refrigerator

5 draw graphs of your results



Activity 4 : using a potometer to compare rates of transpiration under different conditions

Under which conditions did the plant transpire
a most quickly, and **b** most slowly?



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Transport in plants

Uptake of ions

Question 2: explain how water goes into root hairs. How does this process differ from the way in which minerals enter?

Water

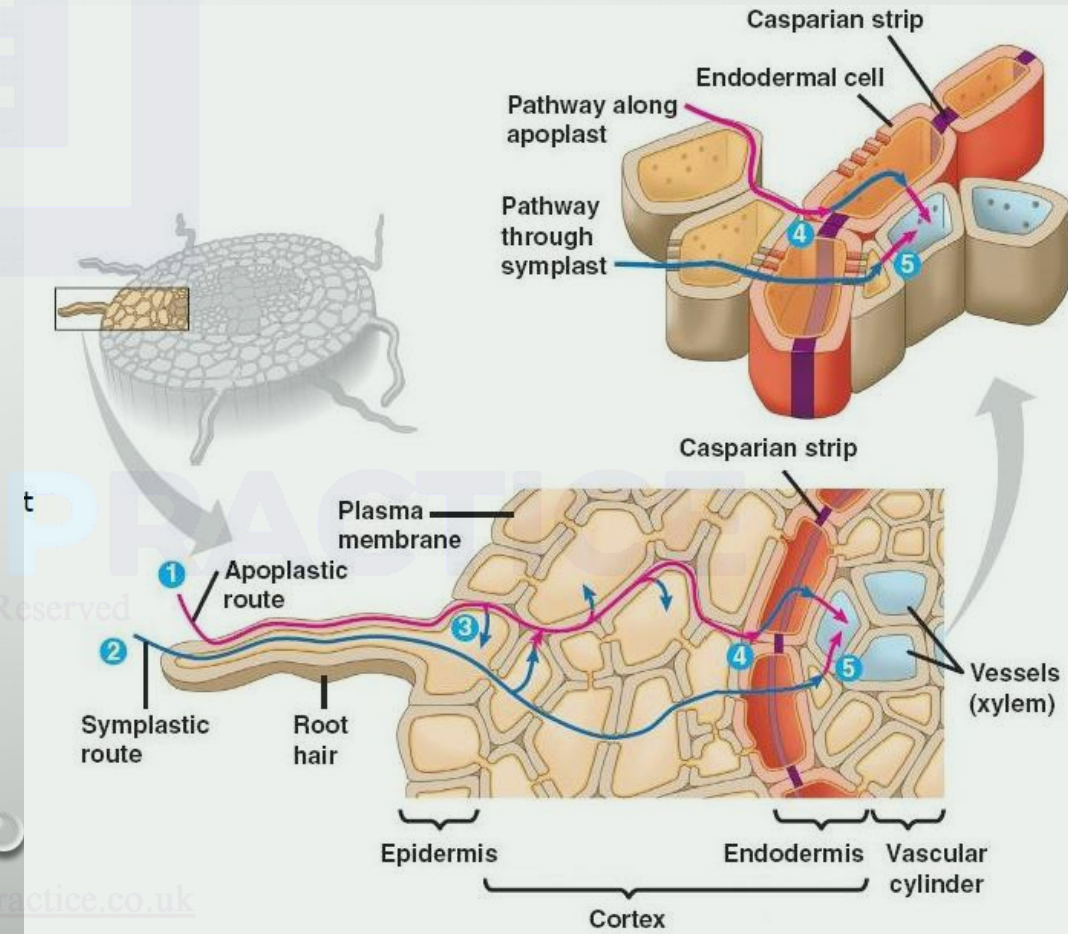
- ♣ from cell to cell by osmosis, through the cortex
- ♣ through the spaces between the cells
- ♣ through the cells walls

Mineral salts (ions)

active transport

low concentration in soil

High concentration in root cells



Transport in plants

Key definition

translocation – the movement of sucrose and amino acids in phloem, from regions of production (source) to regions of storage, or to regions of utilisation in respiration or growth (sink)

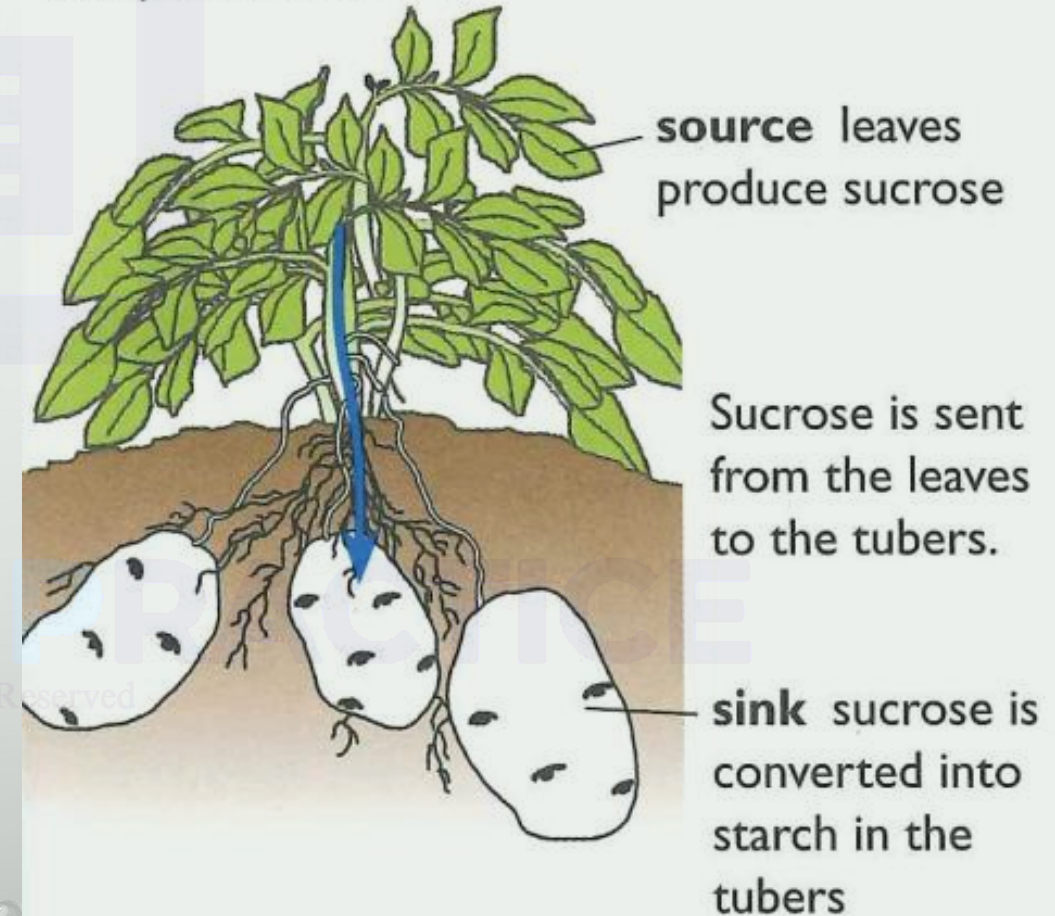
Source : the part of from which sucrose and amino acids are being translocated.

sink : the part of the plant to which they are being translocated.

source 来源
sink 沉积处
translocate 易位
translocation 易位

Transport of manufactured food

Summer the leaves photosynthesise and produce sucrose



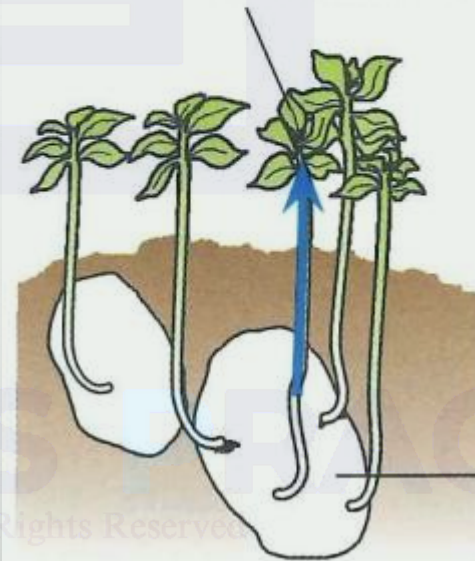
Transport in plants

Transport of manufactured food

Winter starch is stored in the tubers



Spring sucrose is sent to the new shoots



sink sucrose is used by the new shoots as they grow

Sucrose is sent from the tubers to the new shoots.

source starch is converted into sucrose in the tubers

dormant休眠