

TRANSPORT IN PLANTS

What do plants need water for?

Photosynthesis

❖ Water is one of the **raw materials** needed for photosynthesis

❖ When water is in short supply the rate of **photosynthesis is limited**



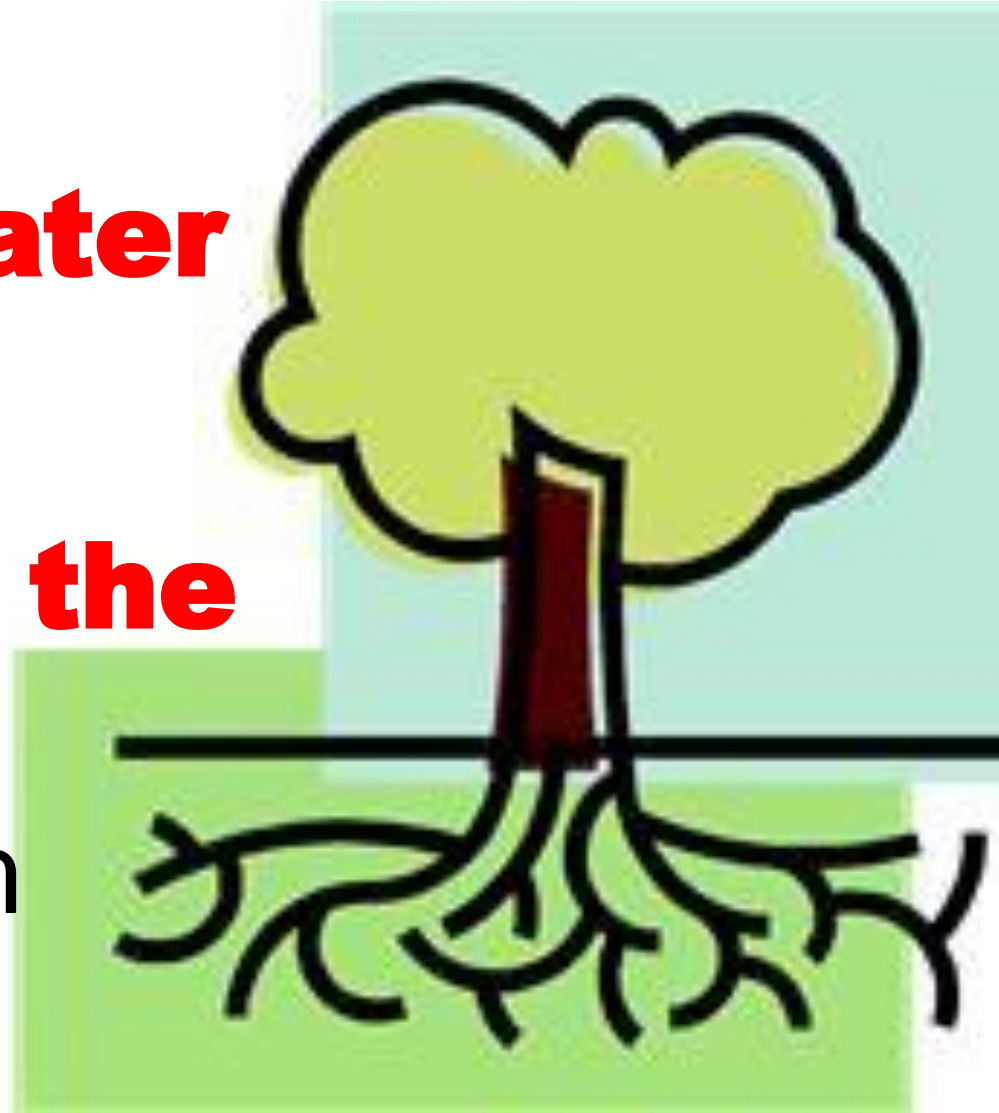
Support

- ❖ Water is needed **to ensure plant cells remain turgid**
- ❖ When water is in short supply the plant **starts to wilt**



Transport

- ❖ Mineral salts **dissolve in water**
- ❖ They are then **moved within the plant** to cells which need them



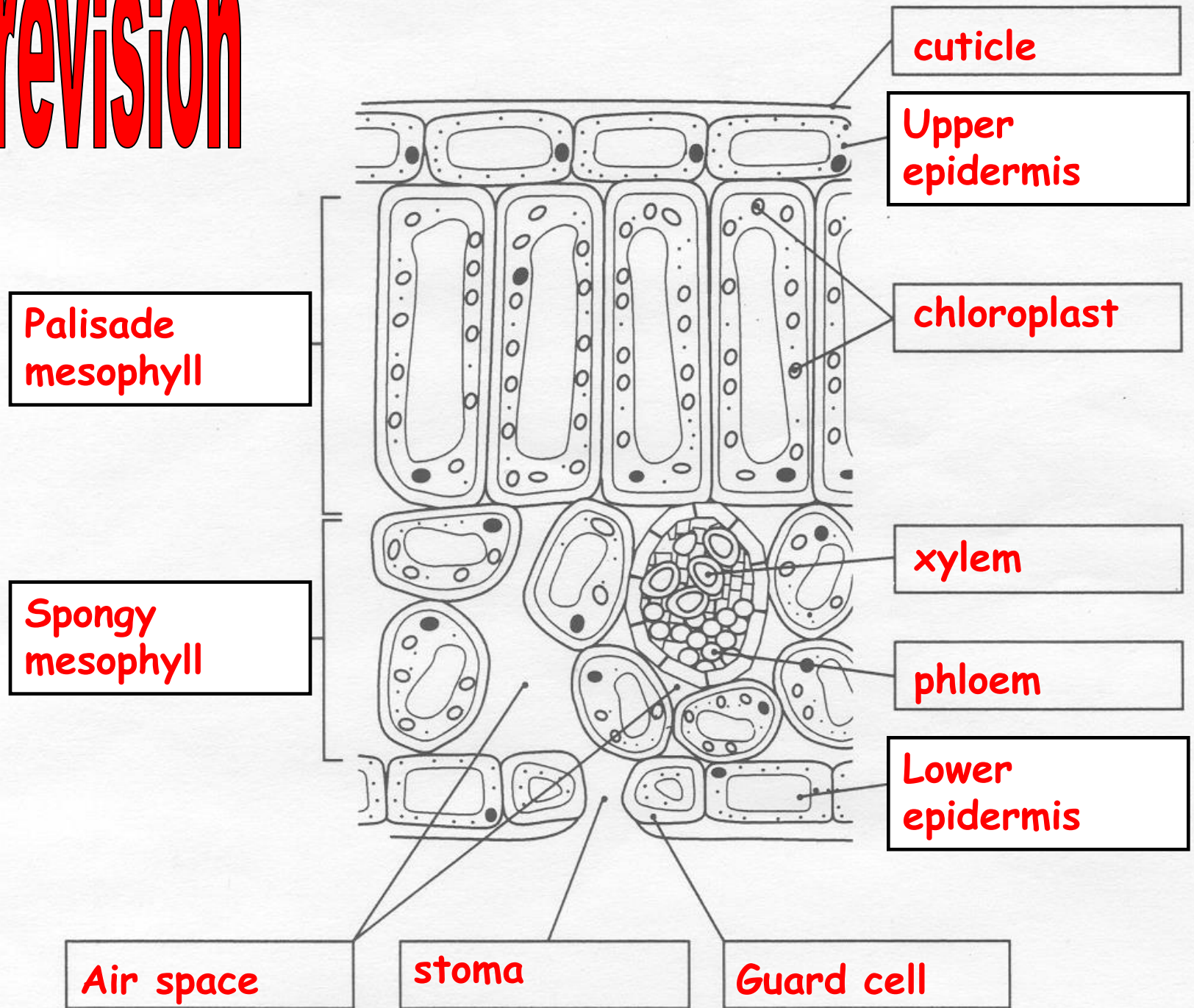
Transpiration

❖ Much of the water that enters the leaves **evaporates** into the atmosphere

❖ The loss of water by evaporation is called **transpiration.**



FOR REVISION



❖ Evaporation of the water takes place from the **spongy mesophyll cells**

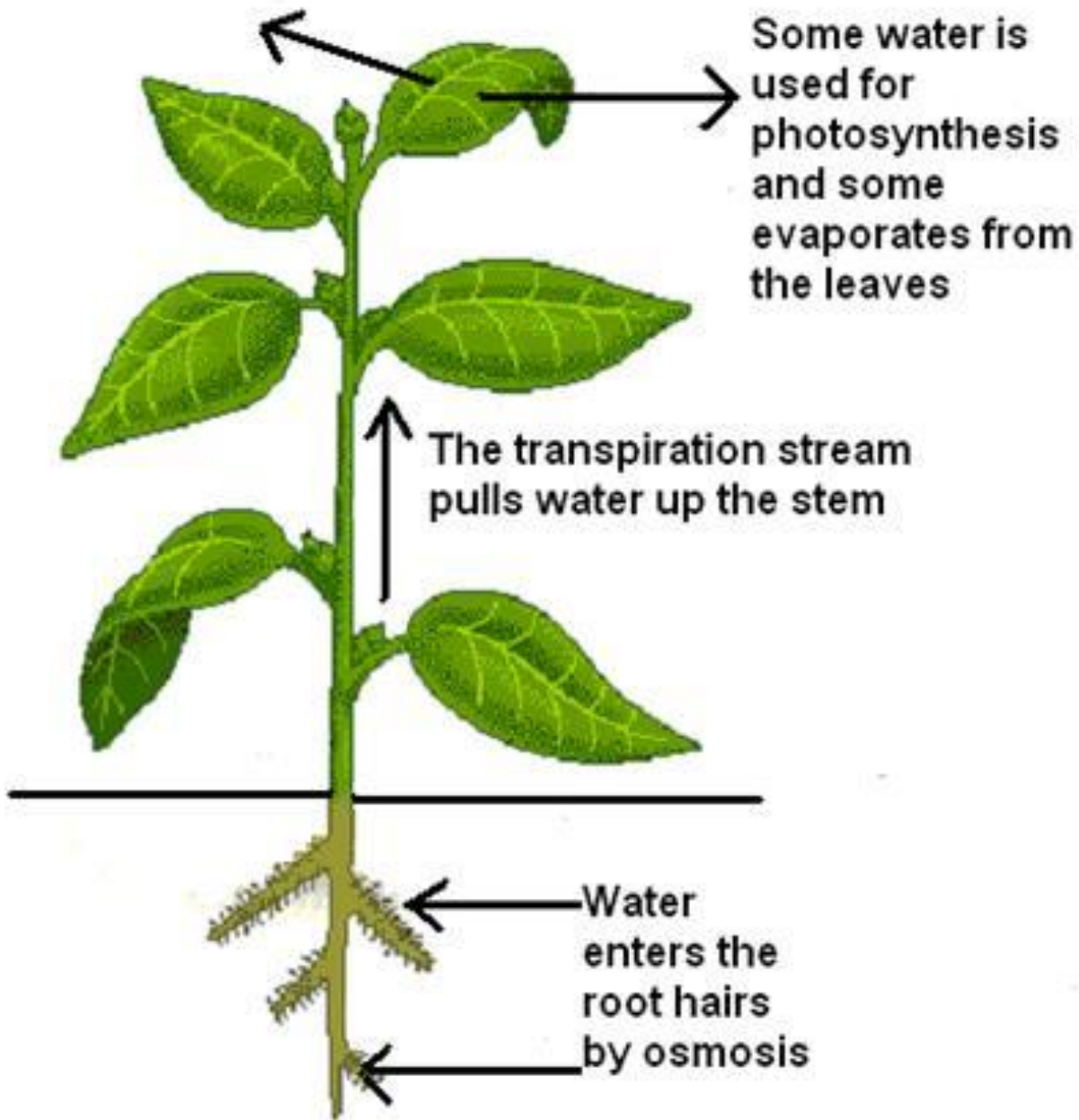
❖ The water vapour diffuses through the **air spaces** and out through the **stomata**

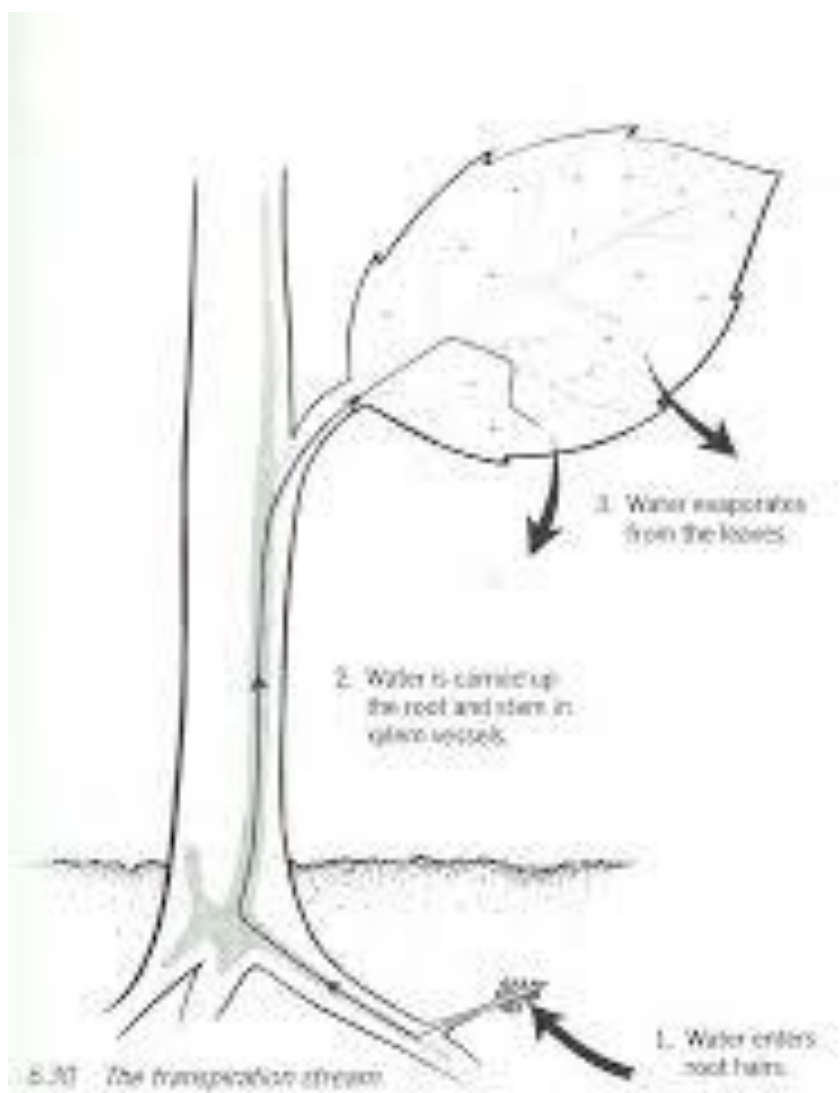


❖ This creates a slight shortage of water in the leaf **which draws more water up from the rest of the plant** which in turn draws more up from the roots

❖ Water travels in the **xylem vessels**

❖ The continuous flow of water through the plant is known as the **transpiration stream**





6.30 The transpiration stream

Reducing water loss

If a plant needs to reduce its water loss it can do so in several ways

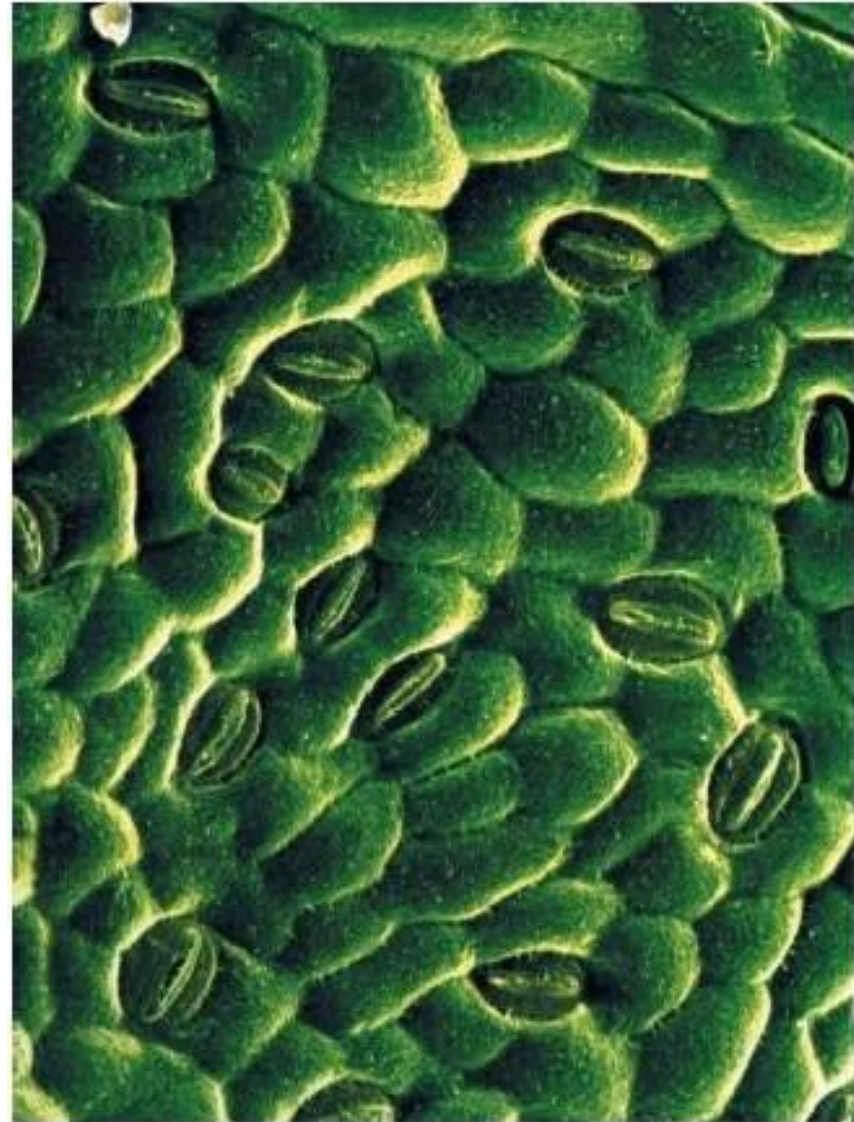
❖ Having a **waxy cuticle**

This reduces evaporation from the surface of the leaf

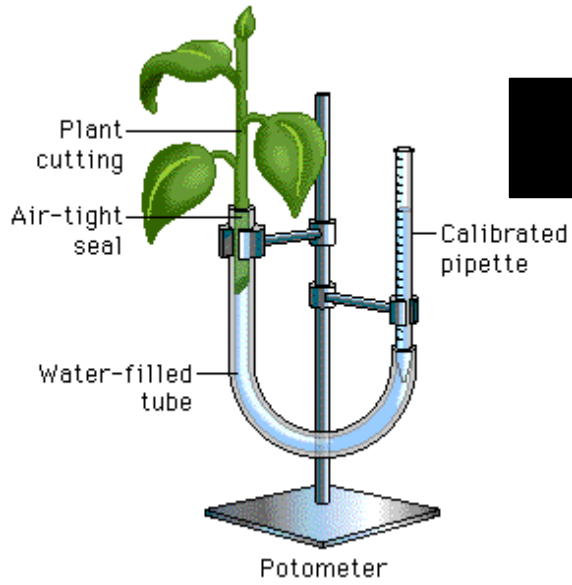


❖ Closing the stomata

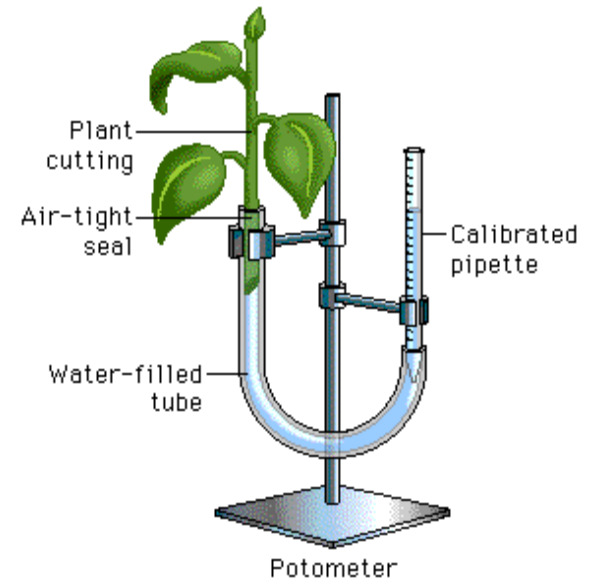
- Stomata are open during the day to enable the exchange of gases
- The guard cells can close the stomata if it becomes important to conserve water



transport in plants



The

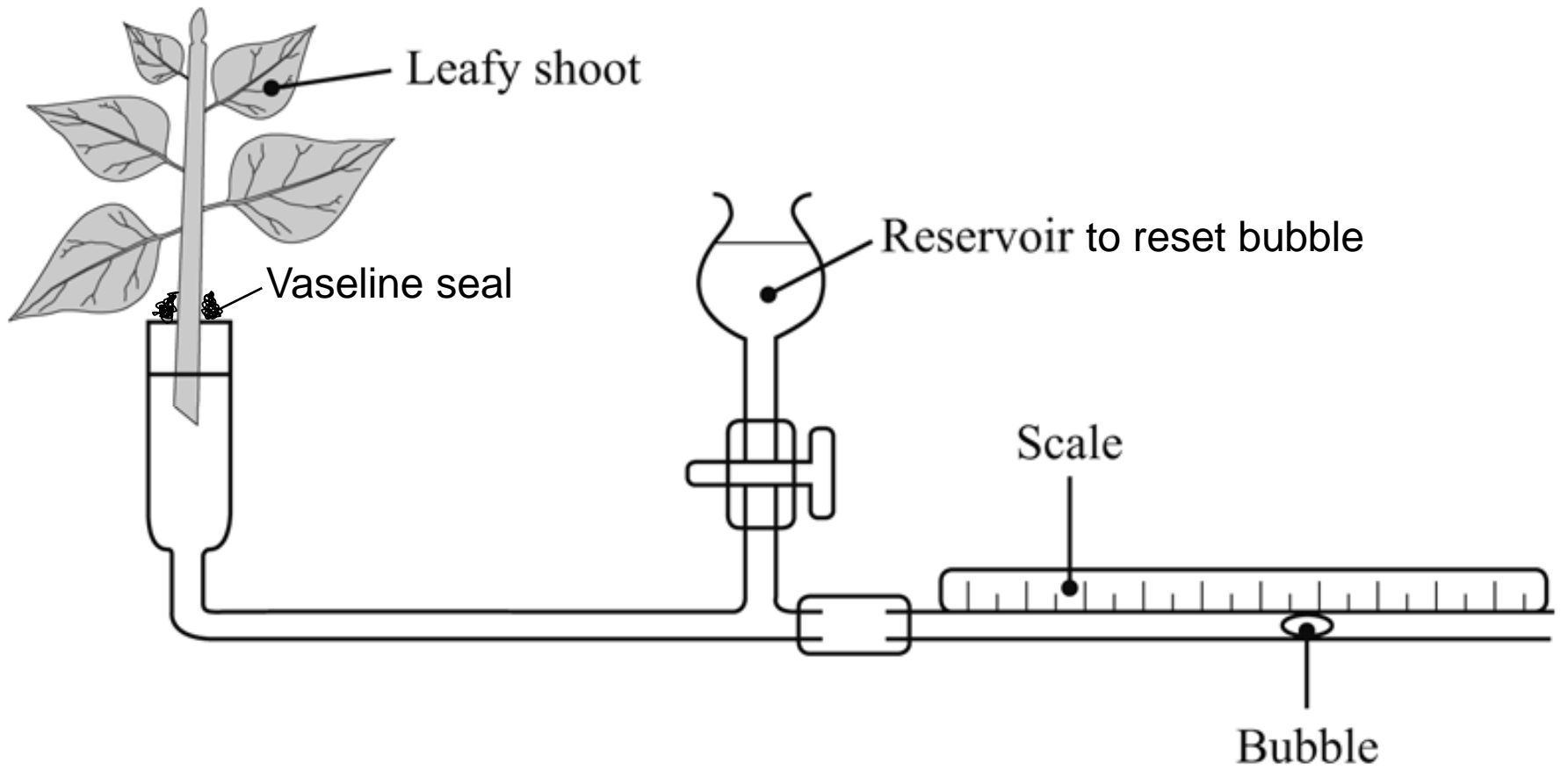


Potometer

- A piece of apparatus used to measure **water uptake of a shoot.**
- As water evaporates from the leaves **the shoot takes up water from the apparatus**

The distance the air bubble moves in a particular time is used to calculate the rate of water uptake

- **It does not measure the rate of transpiration**
- Some of the water taken up by the plant will be **used in photosynthesis**
- Some will move into cell vacuoles **to support the plant.**
- **Therefore the volume of water transpired will not be the same as the volume taken in.**



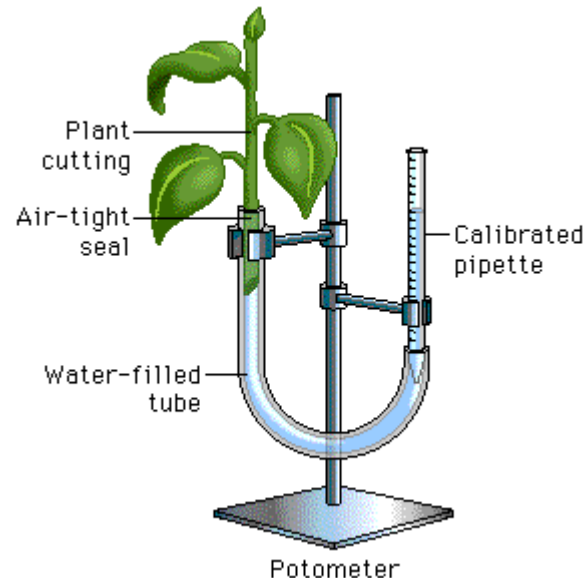
Setting up the potometer

- The apparatus must be assembled **underwater** - to prevent unwanted air bubbles in the water column (xylem)
- The apparatus should be sealed with **vaseline** - to prevent air leaks
- The reservoir allows the apparatus **to be reset** – to enable replicates to be carried out or the effect of other environmental factors recorded.

- The potometer can be used to test **how environmental factors affect the rate of water uptake**
- Conditions which increase the rate of evaporation will increase the rate of water uptake eg **high temperatures or high wind speed**
- Conditions which decrease the rate of evaporation will decrease the rate of water uptake eg **humidity**

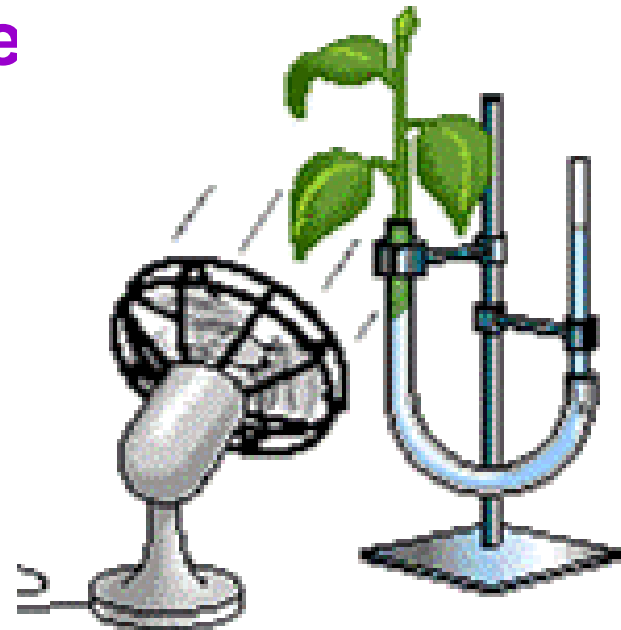
- **High temperatures**

- This affects the rate of water uptake because **it increases the evaporation from the leaf surface, as there is more KE**
- The potometer can be placed in different areas which have differing temperatures **but there should be no increase in light intensity or air movement.**



- **Wind Speed**

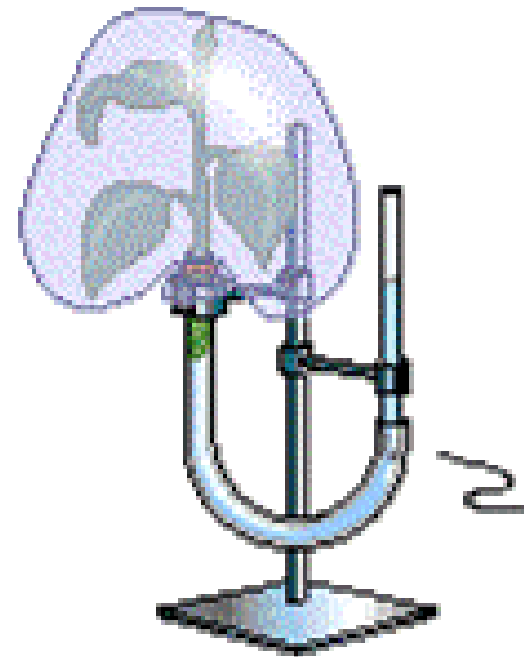
- This affects the rate of water uptake because **it increases the evaporation from the leaf surface**
- A fan set at different speeds can be used to increase wind speed **but it should not increase temperature**



C. Wind

• Humidity

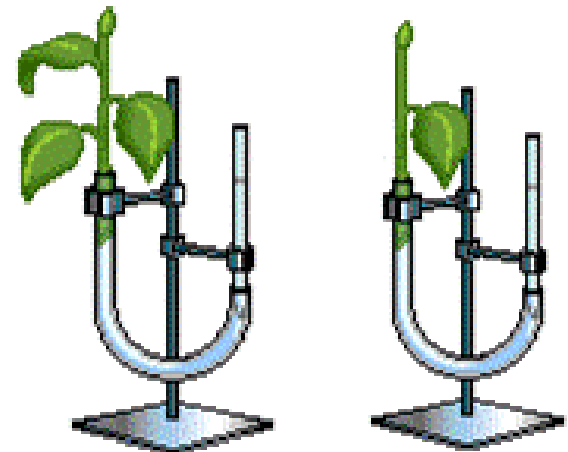
- This affects the rate of water uptake because it **decreases the evaporation from the leaf surface**
- A **clear plastic bag** placed over the shoot can be used to increase humidity.
- This decreases the **concentration gradient** between the leaf and the air
- So less water vapour is lost.



B. Mist

- **Leaf Surface Area**

- This is **not an environmental factor** but it does affect the rate of water uptake.
- Leaves with a large surface area or a shoot with a large number of leaves **will have a greater number of stomata**
- This will mean there can be **more diffusion out of the leaf** and hence an increase in the rate of water uptake



POTOMETER

ANIMATION

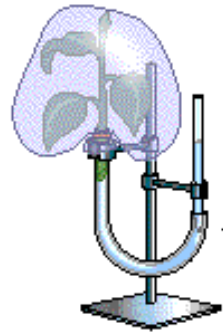


1. Assemble 4 potometers.

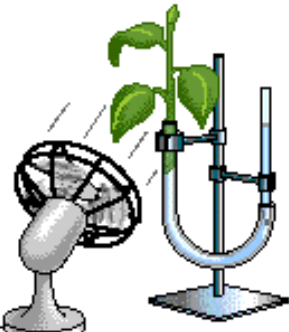
2. Place each potometer in a different environment: room conditions, mist, wind, and bright light.



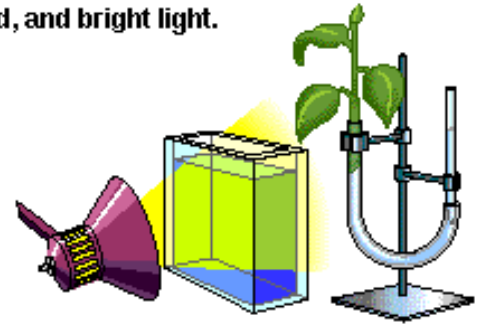
A. Control: room conditions



B. Mist

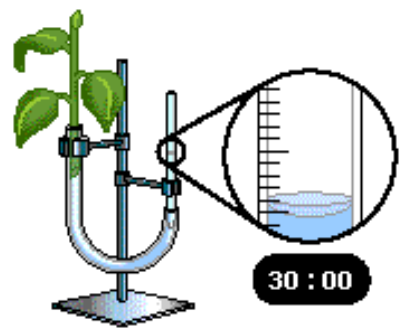
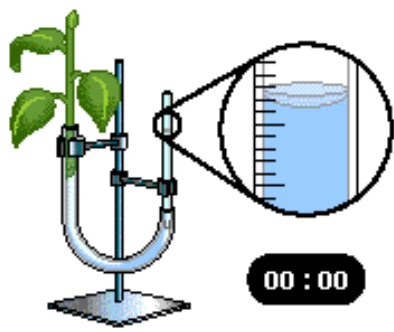


C. Wind

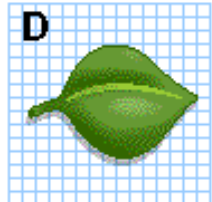
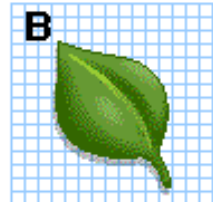


D. Bright light

3. Measure water loss in each potometer every 3 minutes for 30 minutes.



4. Calculate leaf surface area for each cutting.



weight potometer



find initial mass of shoot, water and container
leave for 24 hours
find final mass of shoot, water and container
calculate loss in mass

what is the purpose of
the layer of oil on the surface of the water?

Prevent water being lost from the cylinder

- Calculate the rate of water loss by dividing the loss in mass by the time (water loss per hour)
- Repeat and average
- Repeat the experiment with the shoot in a bag.
- Keeping the light intensity, temperature and shoot the same.