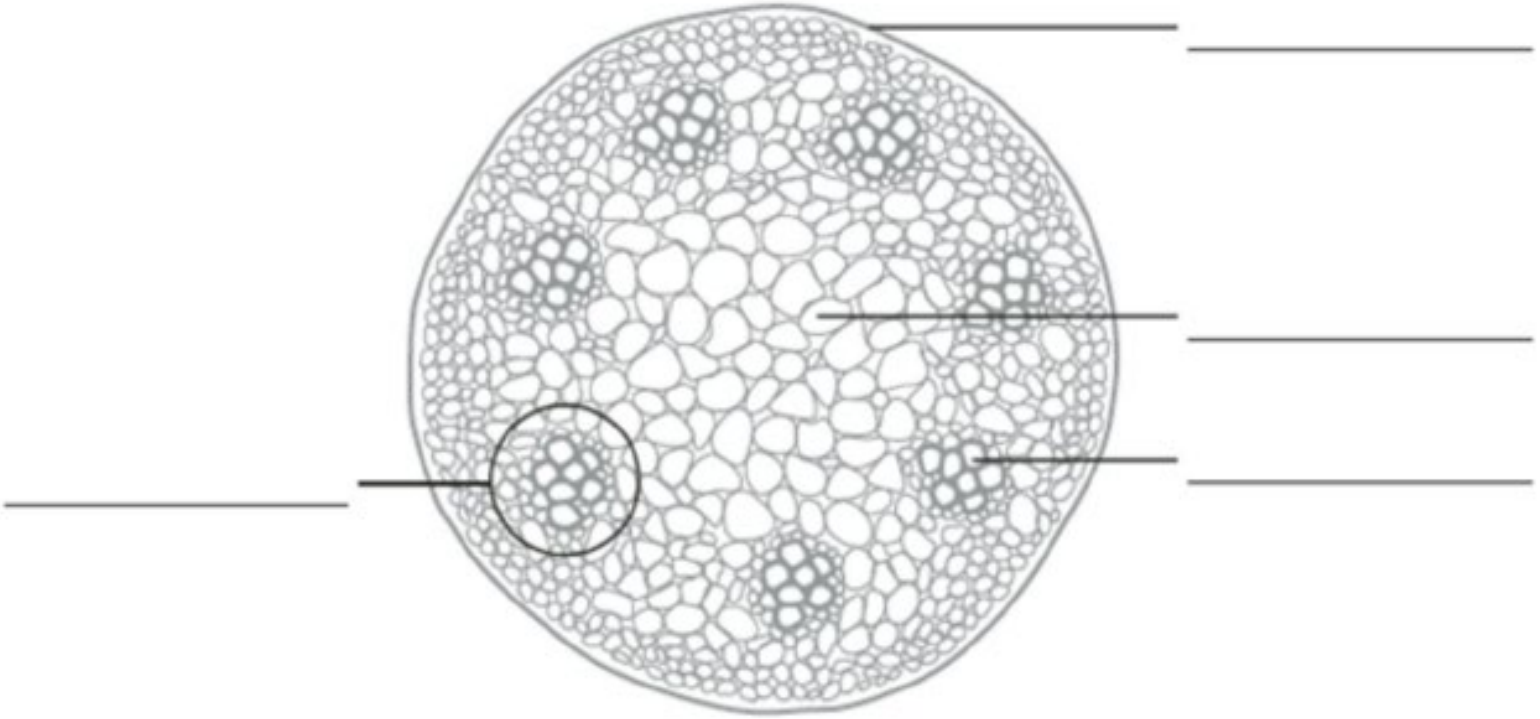
Plant Transport

Review: Label each part of the shoot system.

Label the following cross section of a plant stem using terms from the list provided.

- xylem
- stomata
- ground tissue
- epidermis
- phloem
- companion cells
- vascular bundle
- guard cells



Review:

Match each function with the correct structure from the following list.

i. cuticle	ii. stomata	iii. xylem
iv. root hairs	v. ground tissue	vi. companion cells
vii. epidermis	viii. guard cells	

_____ a. moves water and dissolved minerals from roots up the stem to the leaves

_____ b. outer layer that covers all of non-woody plants; responsible for the exchange of matter and gases into and out of plants

_____ c. form tiny pores on the under side of leaves

_____ d. tiny pores on the under side of leaves that allow for movement of gases in and out of leaves

_____ e. prevents excess evaporation of water

_____ f. directs activities of sieve tube cells

_____ g. increases absorption capacity of roots

_____ h. provides strength and support for plant; stores food and water for plant; is the location of photosynthesis

Review:

Balance the equation for cellular respiration by writing the correct number in the blank spaces given.

$C_6H_{12}O_6(aq) + \_\_\_\_ O_2(g) \rightarrow \_\_\_\_ CO_2(g) + \_\_\_\_ H_2O(l) + \text{energy}$

$$6\ CO_{2(g)} + 6\ H_2O_{(l)} + \text{energy} \longrightarrow 1\ C_6H_{12}O_{6(s)} + 6\ O_{2(g)}$$

This is the process of _____.

$$1\ C_6H_{12}O_{6(s)} + 6\ O_{2(g)} \longrightarrow 6\ CO_{2(g)} + 6\ H_2O_{(l)} + \text{energy}$$

This is the process of _____.

The process of photosynthesis and cellular respiration are critical to the survival of the plant.

As you can tell from the equations, there is a lot of movement of things into and out of the cell.

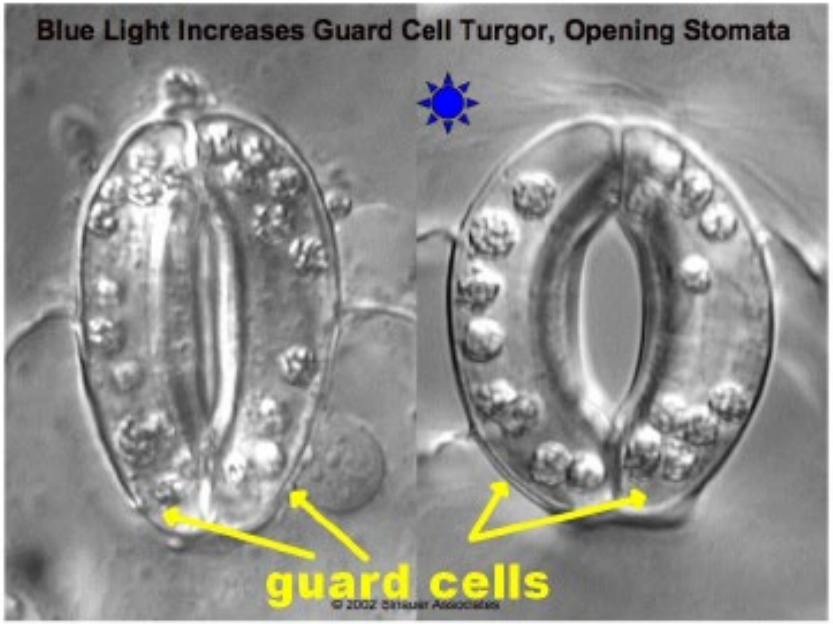
Question: So how does this transportation take place?

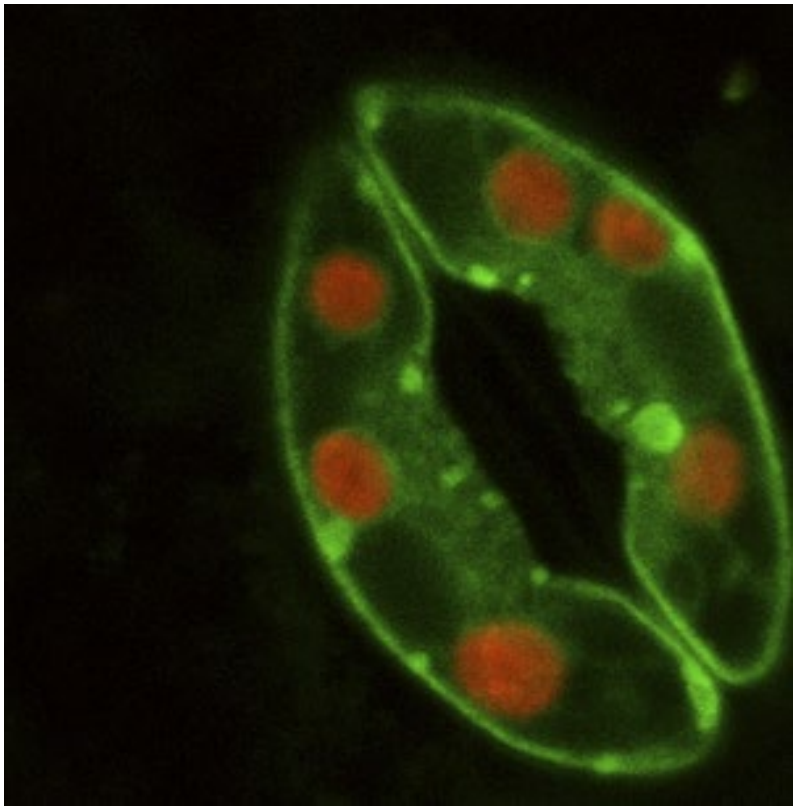
This is what we will study today. Again, we will look at each layer of tissue in the plant, this time examining the transportation taking place there.

1. Transport in the Dermal Tissue

Recall that the dermal tissue (or epidermis) is the outer layer of cells in the plant.

This outer layer has doorways implanted in it called <u>stomata</u>.





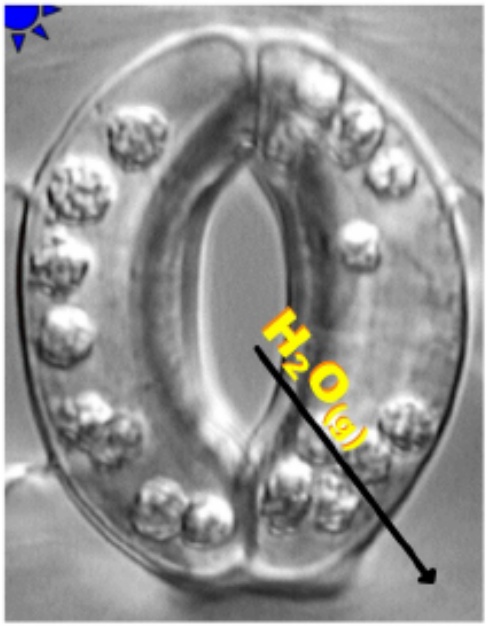
Stomata are created by two guard cells.

When light hits the guard cells, they absorb potassium ions.

The potassium ions cause water to enter the guard cell through osmosis.

Guard Cell Animation 1

Guard Cell Animation 2



The open stomata allows for movement of $CO_{2(g)}$, $O_{2(g)}$ and water.

The movement of water out of the plant is <u>transpiration</u>.

transpiration

If the stomata could not open and close, the plant would quickly become dehydrated through transpiration.

Some stomata are more sensitive than others…for example, plants that live in very dry climates have fewer stomata that only open when absolutely necessary (to reduce transpiration).

Plants that live in areas with low carbon dioxide levels have stomata that are very sensitive and will stay open even under low light.

2. Ground Tissue

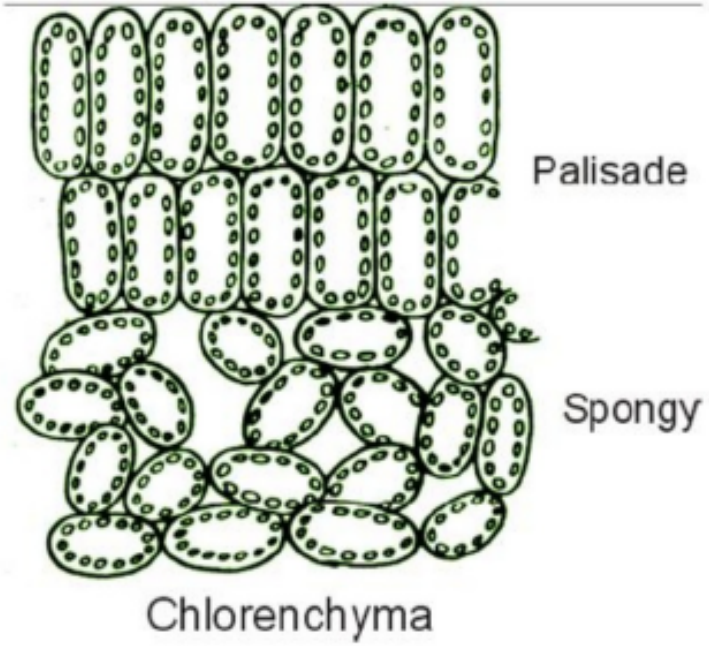
Recall that the ground tissue makes up most of the inside layer of the plant.

Some of this ground tissue is made up of a specialized tissue called mesophyll.

Two Types of Mesophyll:

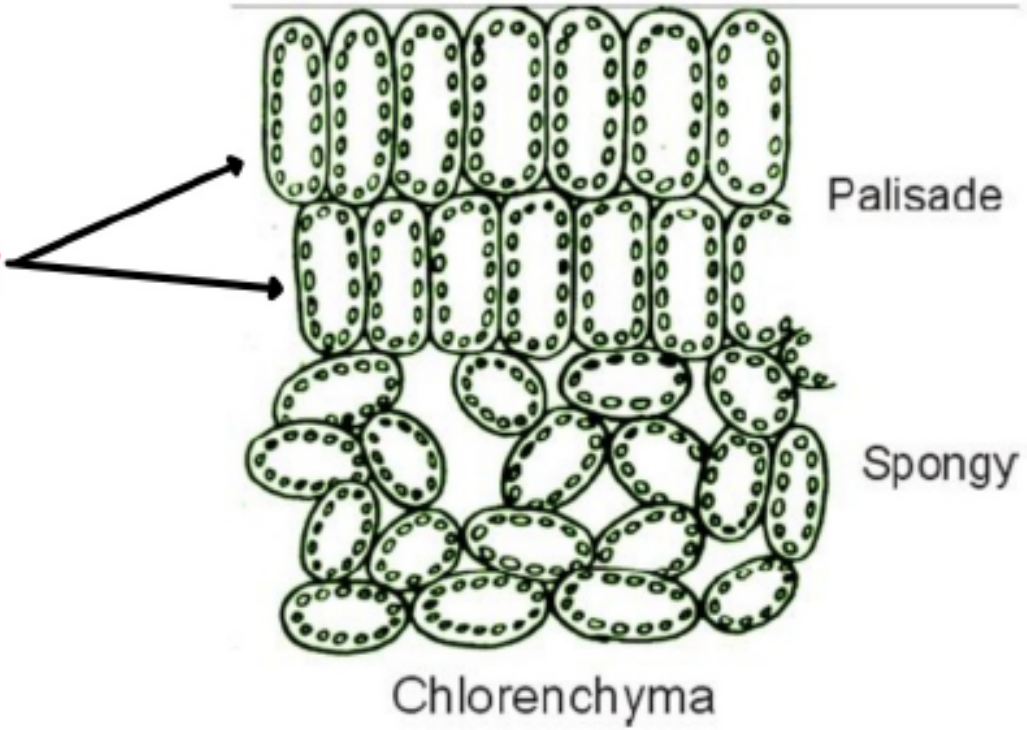
1. Palisade

2. Spongy Mesophyll



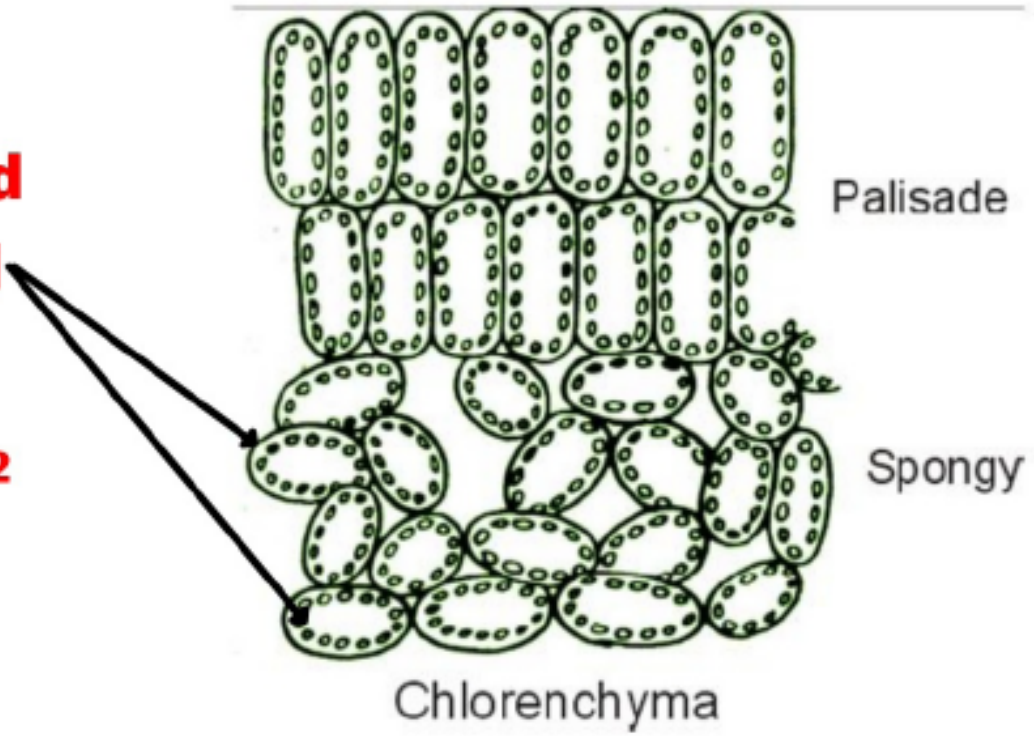
Palisade Tissue:

- found just below dermal layer
- long, rigid, rectangular, tightly packed cells
- responsible for photosynthesis



Spongy Mesophyll

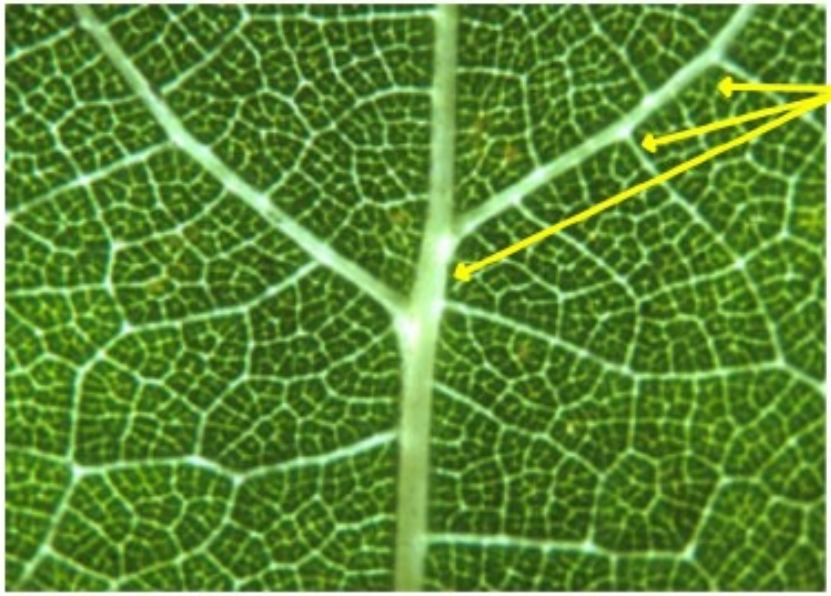
- found under the palisade
- soft, weird shaped and loosely packed
- allow for gas diffusion of O_2, CO_2 and H_2O
- move gases to palisade for photosynthesis



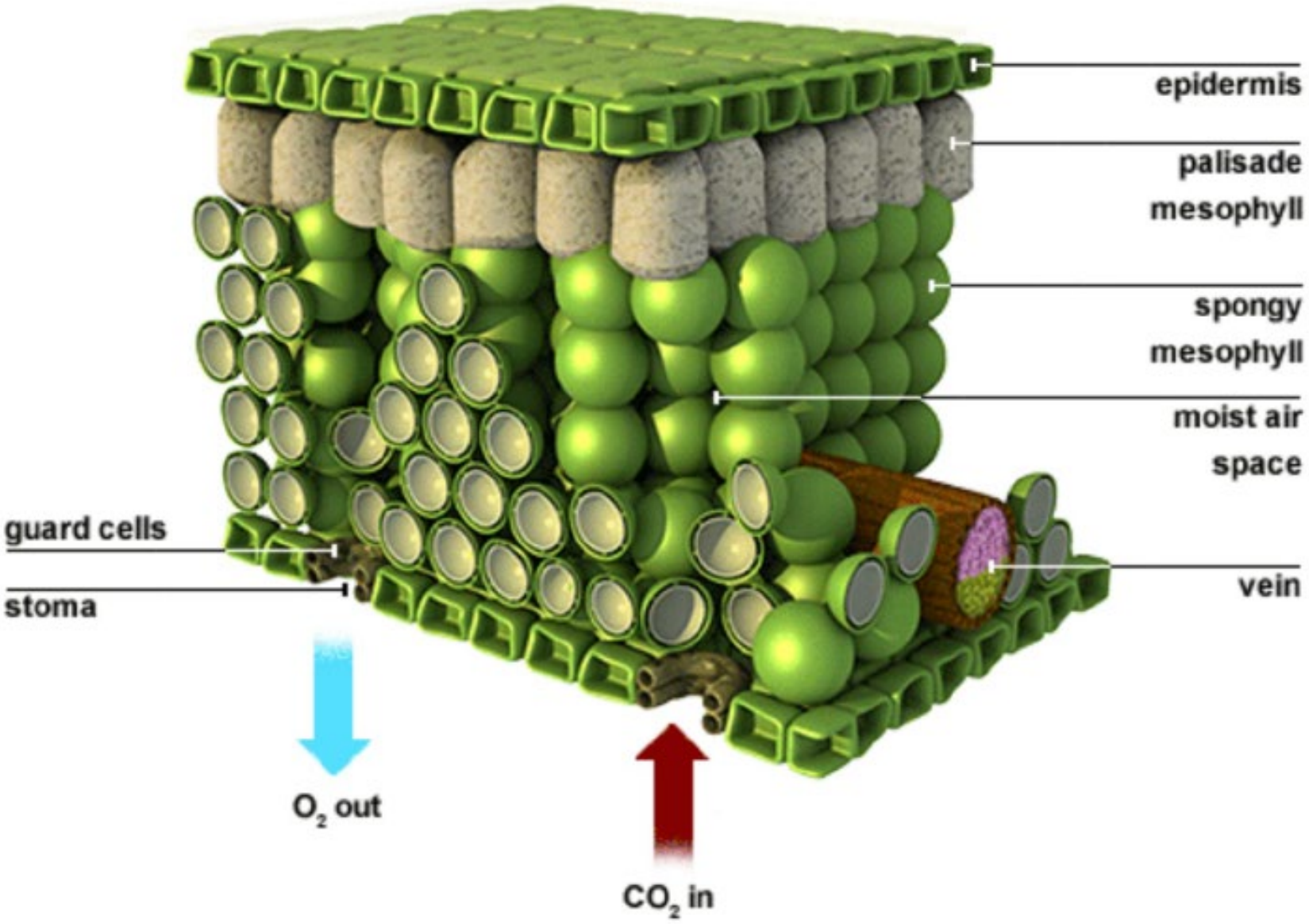
3. Vascular Tissue

Recall that the vascular tissue is made up of the phloem and xylem tissues.

The phloem and xylem travel together in a vein called the vascular bundle.

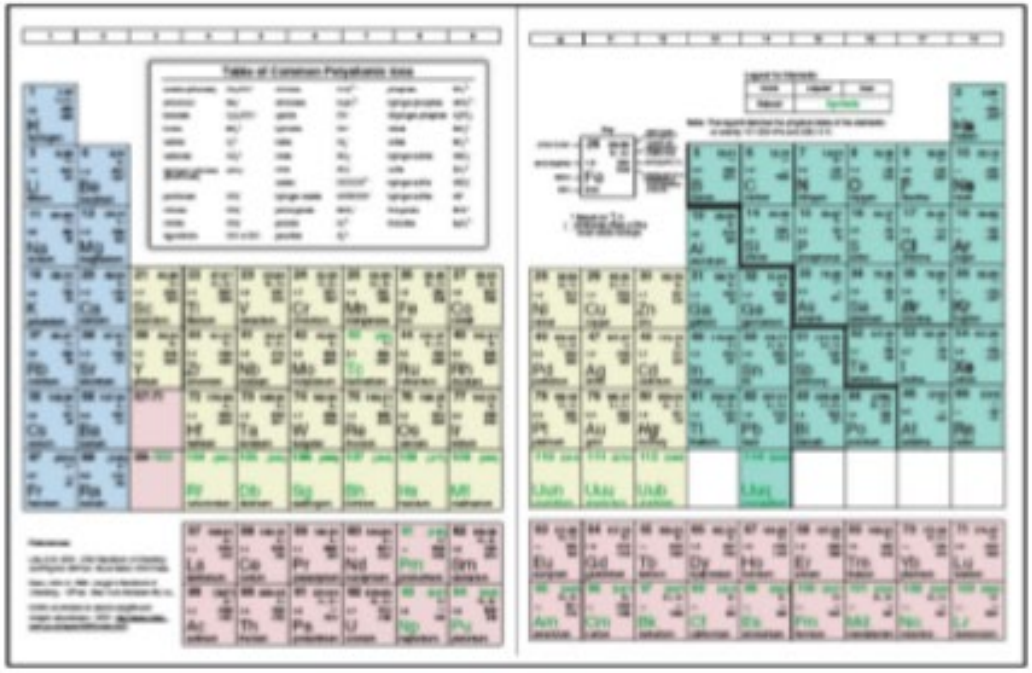


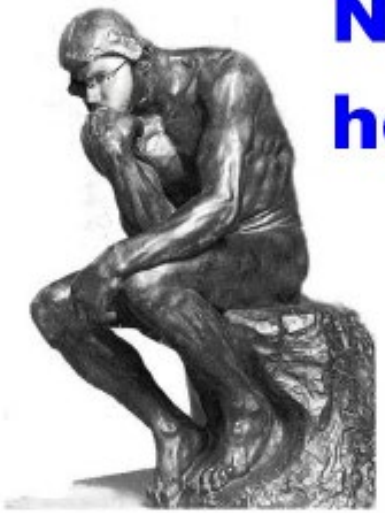
These veins are vascular bundles: the phloem moves glucose down through the plant, the xylem moves water up to the leaves of the plant.


epidermis
palisade mesophyll
spongy mesophyll
moist air space
vein
guard cells
stoma
O_2 out
CO_2 in

Gas exchange can also take place through the stem/trunk of a plant through openings called lenticels.

Review: Where are the positive ions on the periodic table? Where are the negative ions?





Now, hold on, hold on here...

how is it that a xylem can lift water all the way from the bottom of a tree to the top?

It's not as if trees have muscles, like me.

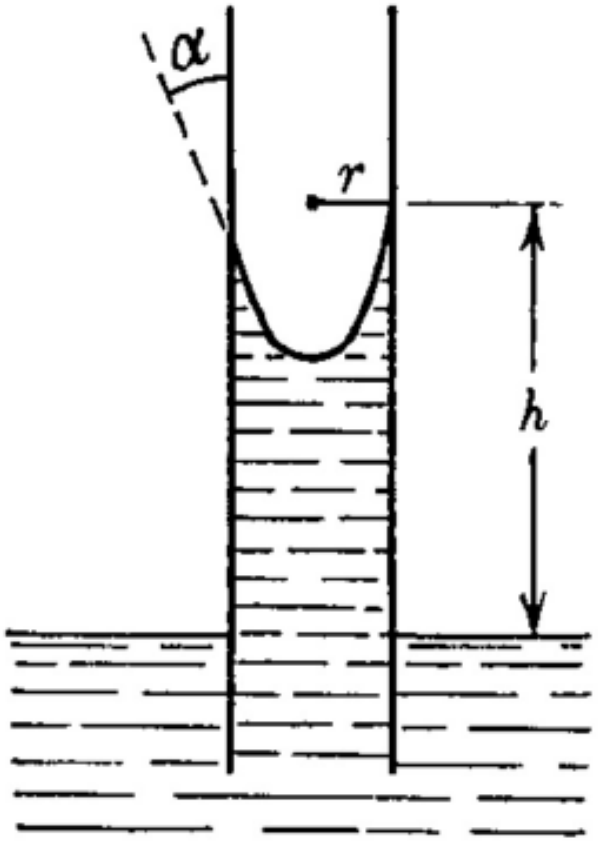
Plants are able to transport water up through some sweet chemistry principles.

Finally, back to chemistry!

If you place one corner of a piece of paper towel in a glass of water, what will happen?

Capillary Action

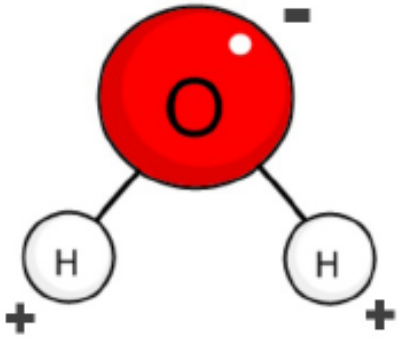
The ability for water to move upwards through porous materials or thin tubes.



Oh, the xylem in a plant is basically a thin tube!

But, why does water climb up thin tubes?

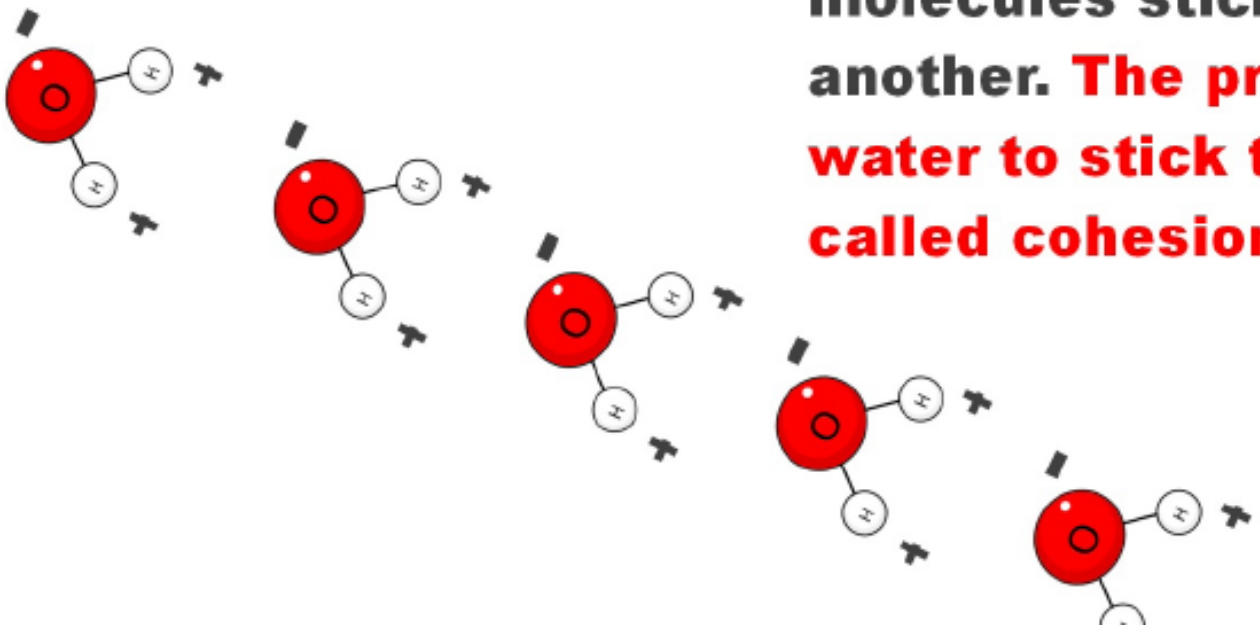
The answer comes from the fact that water, not unlike a rack of delicious ribs, is really pretty sticky.



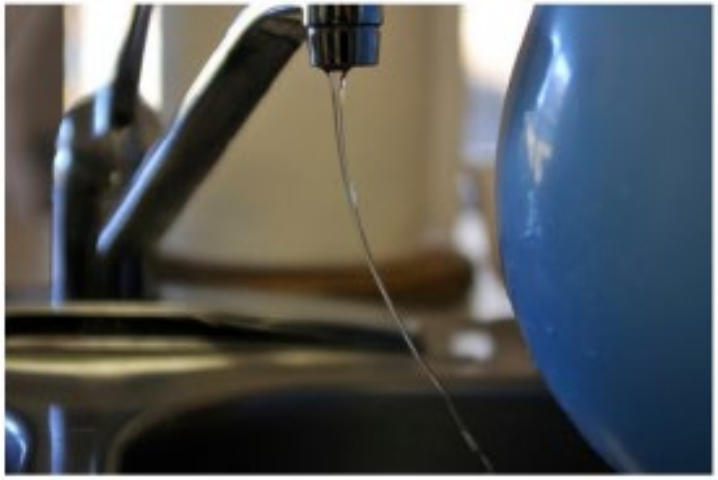
You see, water is made up of two hydrogen ions and one oxygen ion.

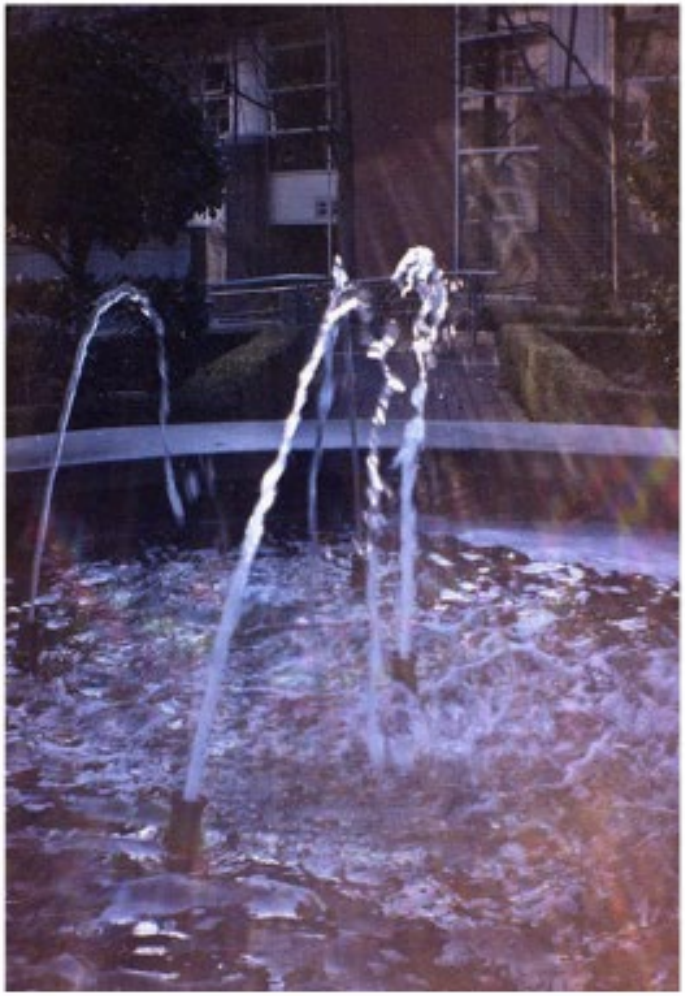
And you will recall that oxygen is negative while hydrogen is positive.

As positive attracts negative, the water molecules stick to one another. The property for water to stick to itself is called cohesion.



You've probably seen cohesion at work before:



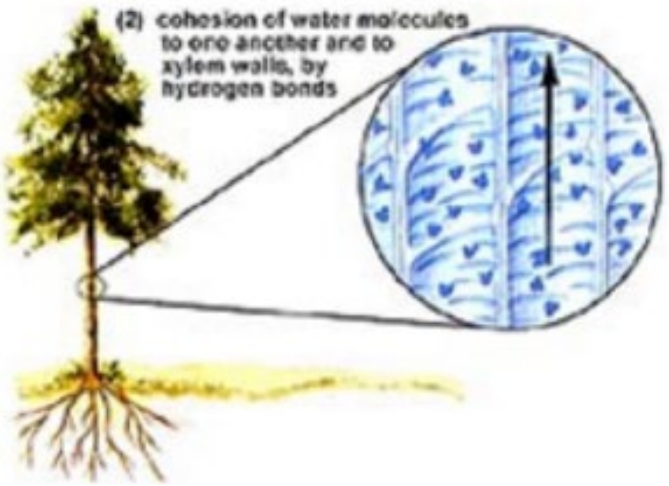


What's more, water isn't the only thing that's kind of positive and kind of negative.

Most objects have partial positive or negative charges.

This allows water to stick to other materials easily as well.

The ability for water to stick to other substances is called adhesion.



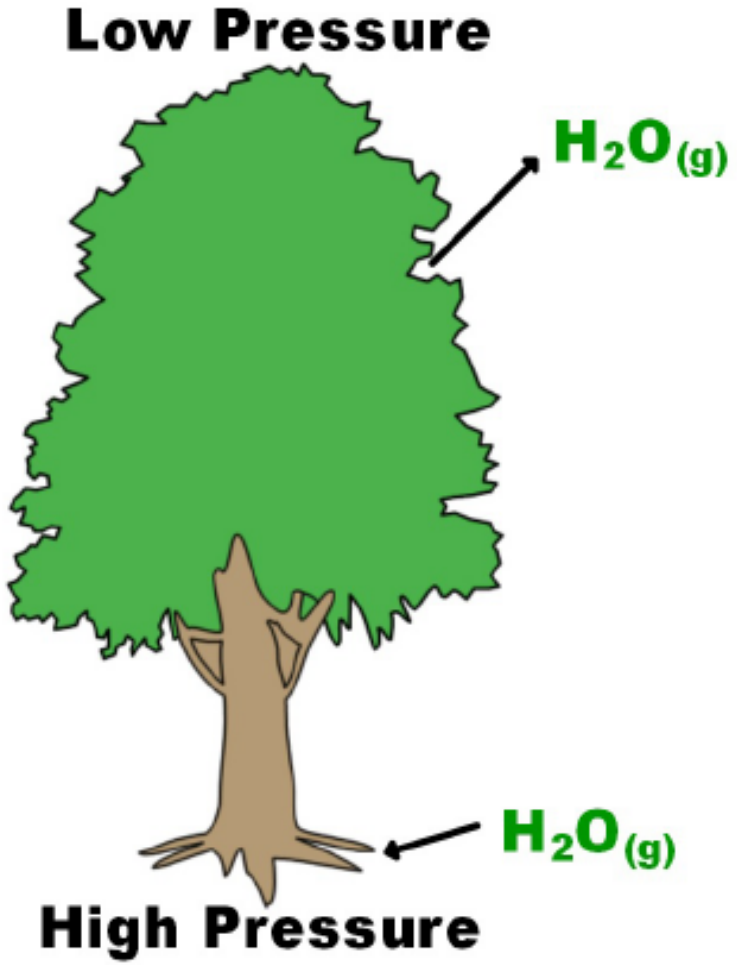
Cohesion and adhesion work together to allow water molecules to stick to the edges of the xylem and to itself and gradually move up the plant.

But that's not the whole story...

Recall that a plant loses water through its stomata through the process of transpiration. This causes a pulling effect called transpiration pull.

Water is lost from the leaves through transpiration. This leaves an area of low pressure up top and high pressure in the roots.

And, water is constantly being absorbed by the roots, causing a build-up of pressure called root pressure.



This causes a difference in pressure which also helps move water up the xylem.