Understandings:

1. Explain transpiration.

- Plants undergo photosynthesis. In order to do so, they need to absorb CO_2 and release O_2. This happens in the lower part of the leaf (epidermis) that has small pores called stomata.

So, when the gas exchange takes place, there is inevitably water loss as well. This is one of the negative aspects of stomata. Plants must constantly rehydrate if they want to do photosynthesis.

The pores may be controlled by a structure between the stomata called guard cells. These basically have the ability to open and close the opening.

2. Explain how plants compensate for the water losses from transpiration.

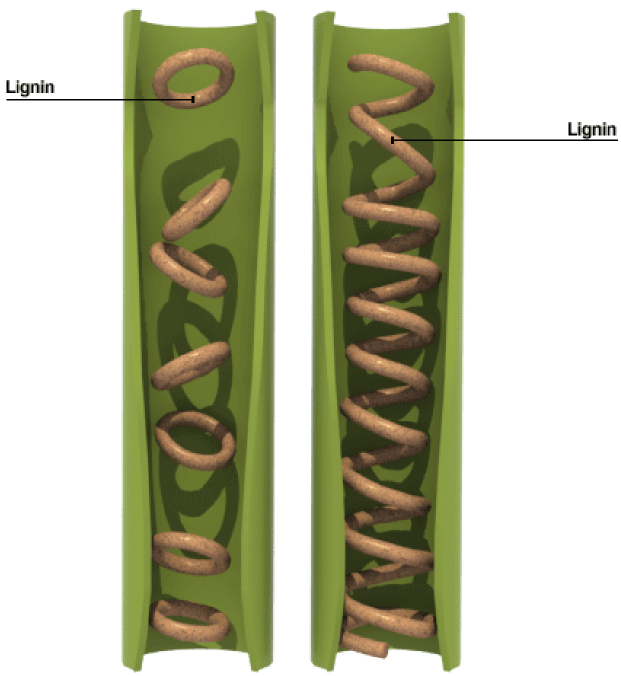
- So as mentioned, plants must somehow regain that water. That water is regained from the roots.

But here comes the question: how do plants defy gravity to pull water up, even to the highest tip of the tree? Well, there are four major mechanisms in use, which are cohesion, adhesion, osmosis and transpirational pull (most important).

3. Explain how plants use cohesive property of water and xylem structure to transport water.

- Water is a polar molecule, so they are attracted to each other. This is called cohesion and it makes it easier for water molecules to stick and therefore move up as a unit.

Xylem is a long tube of dead cells. So unlike human intestine, it does not contract to push water whatsoever. What they do have in similar to what we have is our trachea. We have cartilage rings in trachea to prevent tube to collapse. Similarly, plants have rings or helixes called lignin that prevents collapse in low pressure.



4. Explain how plants use adhesive property of water and evaporation to transport water.
- In order for water to move up, it must also be able to attach to the xylem. Indeed, xylem has got hydrophilic parts.

But cohesion, the structure, and adhesion are not enough to move water. What is needed is pressure. We know that pressure moves from high to low. Logically, when plants transpire, the pressure of water in the leaves is very low since there is no longer water vapour there. Thus, water is naturally pulled to the leaves where there is low pressure. This pressure change is apparently larger than force of gravity. This is called transpiration pull.

And when water moves up, it is easy for the water stream to break, but thanks to cohesion, water molecules stick together. Nevertheless, when there becomes an empty space between liquid or solid, it is called cavitation.

5. Explain how osmosis is used to transport water.
- Water needs to be absorbed from somewhere, and that is from the roots.

The way roots do this is by osmosis and in order for osmosis to happen; there must be higher solute concentration in the roots. This is done by actively pumping mineral ions from the soil and into the root. Certain ions have certain pumps on the root!

But well, what if the soil is not well drained so it is not supplied with new ions? In that case, plants have developed a mutualistic relationship with fungus. Fungus grows on the root and absorbs ions for the roots, and roots reward them with sucrose. Wow!

Applications and skills:

1. Explain some adaptations of plants in deserts and in saline soils for water conservation.
- A genus called Xerophytes is adapted to dry ecosystems. So how do they keep photosynthesis going without water loss?

1. They are adapted in terms of leaves. Most cacti species have spines and very few leaves. They have contractible stems that can store water. They also have thick waxy cuticle and few stomata on their stem. They open stomata during night when it is cold and close them during the day.

2. Some species such as Marram Grass have rolled leaves that also prevent water loss. They also have hairs in the curl which can trap moisture.

A genus called Halophytes is adapted to saline soils (very salty soils). Similarly, halophytes also have to preserve water because otherwise they will dry out fast because of the high solute concentration. In addition, salt makes it difficult to absorb water. Thus they share similar properties as xerophytes.

It includes reduced leaves, thick waxy cuticle, long roots, removing salt system; water storage in leaves, stomata is very low to minimize exposure to sun.

Extra notes

- We should also know some adaptations of the root that enable this effective ion intake.

1. They can live in symbiosis with fungus as mentioned.

2. They have root hairs to maximize branching and surface area.

3. They have many mitochondria because ion intake is fundamentally an active transport.

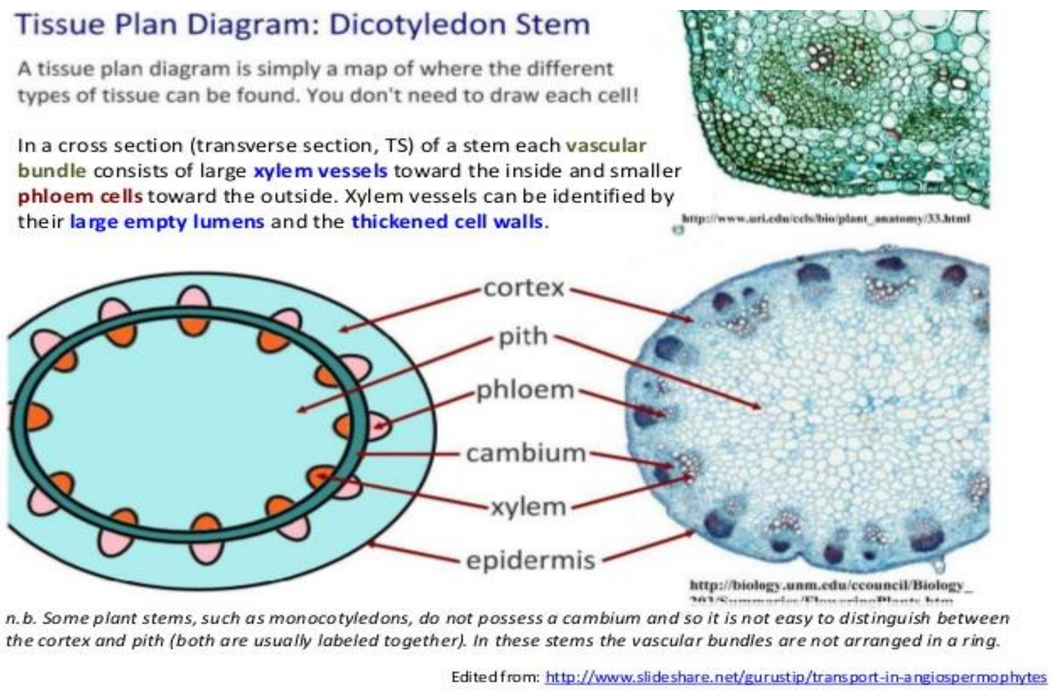
2. Be able to understand models of water transport in xylem using simple apparatus including blotting or filter paper, porous pots and capillary tubing.

- Another practical thingy.

3. Be able to draw the structure of primary xylem vessels in sections of stems based on microscope images.

- Mature stems have secondary and primary vessels, but it is not required for us to draw the secondary.

Understand, and then draw.



The structure is basically what we have in the very centre of the stem. We need to know all the six structures labelled. On the very end, we have epidermis. Then we have the cortex. Then in the outer, we have the phloem. Between that and xylem we have cambium (these cells grow to increase width). Then we have xylem vessels with large lumen and thick cell walls. And finally, we have pith (stores nutrition and some transporting as well).

Extra notes

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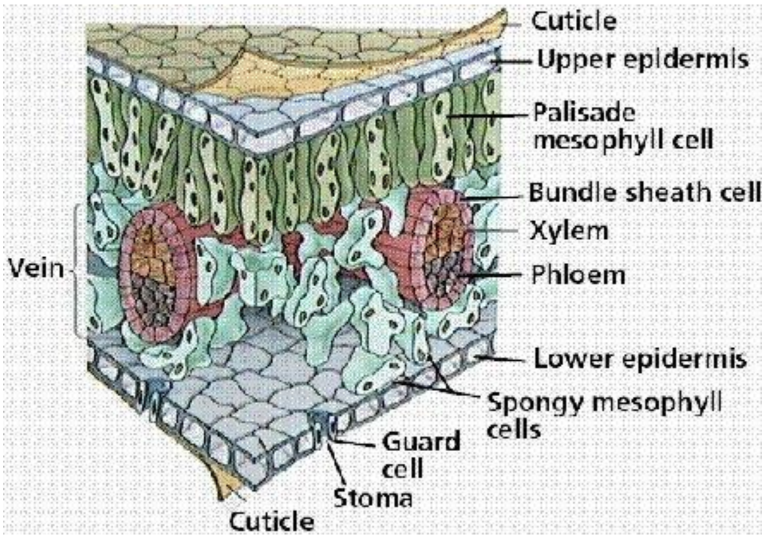
If you want to know you can know the structure of leaves as well.

<u>Xylem = inner over</u> (inner for cross-sectional stem view and outer for leaf view)

<u>Phloem = outer under</u> (outer for cross-sectional stem view and under for leaf view)

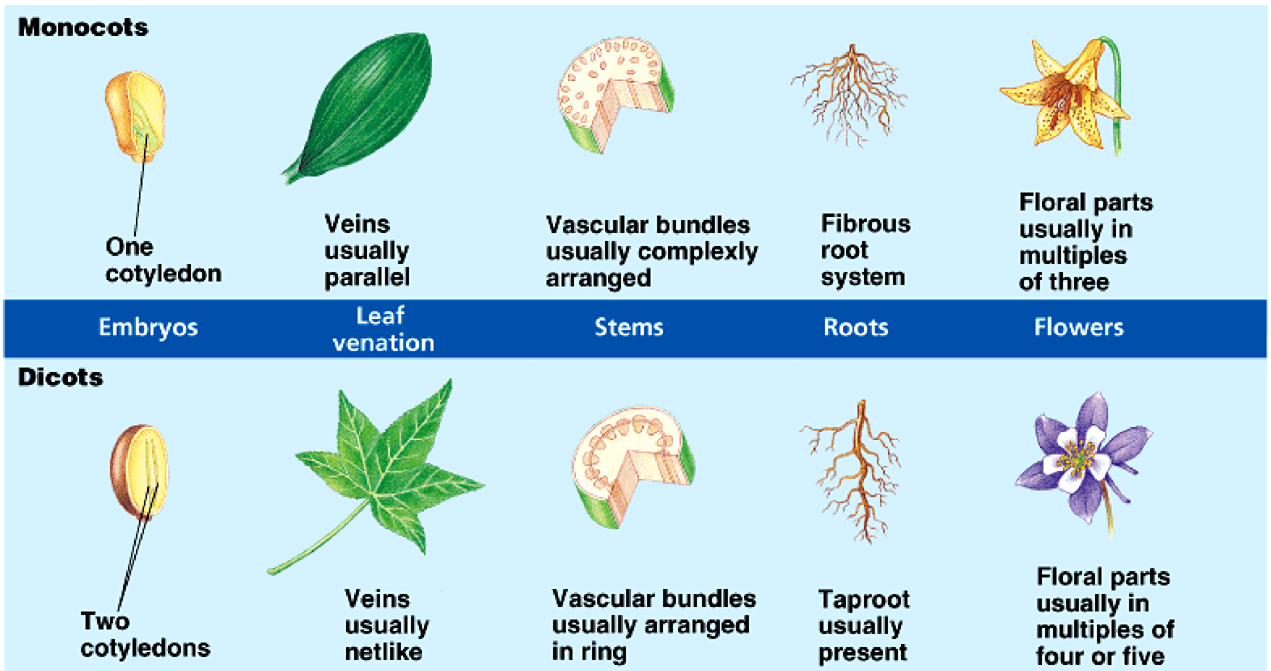


You must know the structure of these and the functions!

Extra notes

- It is also advisable to know some distinct characteristics of monocots and dicots.

I tell you already now. These five differences are crucial. Also note the terms such as "parallel", "netlike", multiples of three and multiples of four or five.



4. Be able to measure transpiration rates using potometers.

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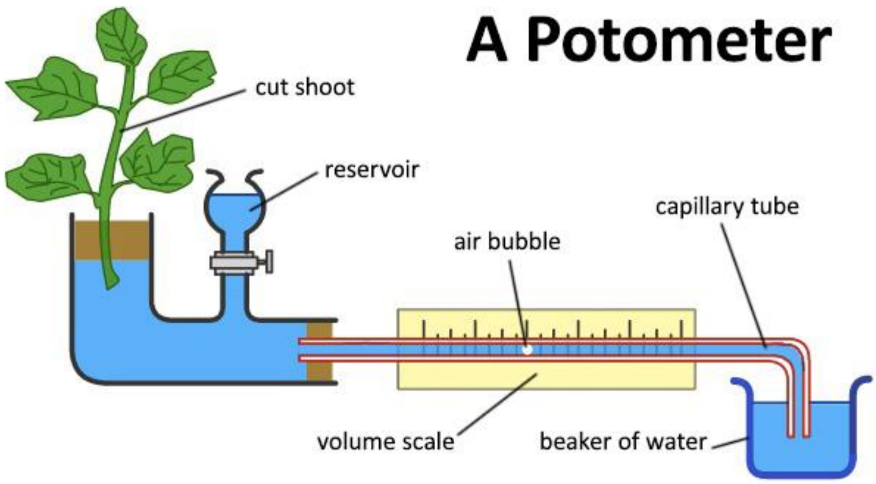

This is basically a device to measure how fast the water uptake is by movement of bubble. Since water is lost by transpiration, air bubble will move towards the plant. Reservoir is to remove the air bubble so new trials can be made.

5. Be able to design an experiment to test hypotheses about the effect of temperature or humidity on transpiration rates.

- Sort of.