The effect of windspped on the rates of transpiration of a cactus (xerophyte) and a rose (mesophyte) .

Water is transported in the plant through xylem vessels. In order to reach the xylem vessel, it must be taken up by the root hair. The root tip is covered by a tough protective root cap which is not permeable to water. However, behind the root tip are long thin root hairs which absorb water from spaces between soil particles. Water enters the root hairs by osmosis Down a water potential gradient. Soil water has a relatively high water potential. Root hair cell sap has a low water potential due to large quantities of inorganic ions and organic substances. Many plants, especially trees, have fungi located in or on their roots forming associations called myeorrhizas. They act like a mass of fine roots and absorb nutrients, especially phosphates. Once in the root, water follows the following path.

Root hair epidermis cortex endodermis pericycle xylem vessel

water moves by osmosis down the water potential gradient. It moves in 2 main ways.
1) Apoplast- cell wall to cell wall
2) Symplast- cytoplasm + Vacuoles - through the plasmodesta.

Once the water has crossed the cortex, it reaches the endodermis which is an outer layer of the stele. Its cells have a casparian strip (a thick, waterproof, waxy band of suberin) which forms an impermeable barrier to water. therefor only the symplast route is available.
Water continues across the pericycle and into the xylem vessel by osmosis.

Xylem vessels have 2 functions whcih are to transport and support. These consist of vessel elements and tracheids. Vessels are made up of many vessel elements arranged end to end. Walls are laid down with lignin (a very hard, strong substance) which causes cell cytoplasm to die, leaving an empty space or lumen inside. There is no lignin where plasmodesmata were. These non lignified areas can be seen as gaps in the walls of the xylem vessel and are called pits. The end walls of neighbouring vessel elements break down completely to form a continuous tube through the plant. This long, non living tube is a xylem vessel. In the vessels, water moves up the vessels towards the leaves. In the root, the xylem vessels are in the centre. In the stem they are nearer the outside. Tracheids, like vessles, are dead cellswith lignified walls, but they do not have open ends so they dont form vessels. they do have pits in the walls so water can move from one tracheid to another.

Plants lose lareg amounts of water vapour to the atmosphere. the loss of water is called transpiration. the cells in the mesophyll layers have many air spaces between them. The walls of these cells are wet and some of this water evaporates in to the air spaces. The air inside the leaf is usually saturated with water. If there is a water potential gradient between the air inside the leaf and the air outside, then water vapour will diffuse out the leaf down the gradient throught stomata. An increase in the water potential gradient between the air spaces in the leaf and the outside air, will increase the rate of transpiration. The following increase the rate of transpiration.

1) Air movement- when it is high
2) Humidity - when it is low (high C.G)
3) Light- when there is large amounts as the stomata are open.
4) Temperature- when it is high (transpiration causes cooling of the leaves)

The loss of water from leaves by transpiration causes water to travel upwards through the plant by mass flow. The mechanism is called 'cohesion-tension'.

1) water molecules are 'sticky' as they are attatched to each other by hydrogen bonds. This is known as cohesion.
2) Water evaporates from mesophyll cells and this lowers their water potential.
3) Water moves from high water potential in xylem to low water potential in the mesophyll cells.
4) Thus reduces the hydrostatic pressure at the top of the xylem vessel causing water to move up the xylem vessel.
5) The pull on the columns of water molecules extends all the way to the roots and into the soil.
6) Water molecules are also attracted by hydrogen bonds to cellulose in cell walls. This is known as adhesion. This helps maintain columns of water in the xylem when there is little transpiration.

Xerophytes are plants adapted to survive in dry places e.g. deserts. They have a variety pf adaptations to reduce the amount of water loss by transpiration.
They have small leaves to reduce surface area, they also have thick leaves to reduce surface area to volume ratio. There thick waxy cuticles help reduce water loss throught the epidermis and stops uncontrolled evaporation through leaf cells.

Mesophytes are plants which are adapted to neither a particularly dry nor particularly wet environment i.e plants with average water requirements.