A PLANT NEEDS WATER FOR PHOTOSYNTHESIS AND FOR TURGIDITY. DISCUSS THE METHODS USED TO MOVE WATER AND MINERALS THROUGH THE ROOTS AND UP THE STEM.

Water is a necessity for plants. It is required for the transport of mineral salts and organic solutes around the plant.

The roots of a plant allow the exchange of substances with the soil environment. The water in the soil contains a weaker solution of mineral salt; therefore this has higher water potential. Inside the vacuole of the root hair, there is a stronger solution of sugars and other dissolved substances' giving the vacuole lower water potential. This enables water to pass from the soil into the root hair cell, down the water potential gradient, by osmosis.

The water potential in the root hair cell now increases to higher than that of the neighbouring cells. As a result water, from the root hair cell moves to the cortex cell next to it. This process is repeated from cell to cell across the root and enters the xylem tissue in the centre of the root. This is a simplistic way of understanding how water is transported. Realistically there are two main pathways along which water travels.

The apoplast pathway, this is the movement of water passing through the cell walls of the cortex cells. The cellulose cell wall is made up of cellulose fibres; this is a loose mesh, water is able to pass along the intercellular spaces between these fibres. As the water exudes between the fibres, the cohesive force of the hydrogen bonds, between the water molecules mean that the more water is pulled along the apoplast route. The apoplast route becomes blocked when it reaches the endodermis. The cell wall of the endodermis is impregnated with a waxy material, known as suberin. This forms a band of wax around the cells called a Casparian strip. Suberin is waterproof, so the casparian strip prevents water passing along the cell wall. The only way in which water is able to pass across the endodermis is by the symplast route.

The symplast pathway; the movement of water passing through the cytoplasm of the cortex cells. Water passes from the soil into the cytoplasm of the root hair cells, and then from the cytoplasm of one cell to another via the plasmodesmata (strand of cytoplasm that passes through a plant cell wall, connecting the cytoplasm to near by plant cells.) This movement of water occurs down the water potential gradient.

There is a persistent movement of water from the roots into the xylem and moves upwards. Neighbouring cells replace the water in the xylem, reducing their water potential. As this is reduced water re-enters the cell, down the water potential gradient, by osmosis.

As water passes through the cytoplasm of the endodermal cells, they actively secrete mineral salts into the xylem tissue. This lowers the water potential in the xylem, causing water to be drawn through the endodermis. This 'pulling' of water into the xylem from surrounding cells produces a positive hydrostatic pressure inside the xylem, forcing the water to move upwards. This positive pressure is known as root pressure. Root pressure is a minor force in the movement of water up the stem of plants.

Cohesion-tension theory, is the major way in which water reaches the tip of the plant from the root. As water molecules are removed from the xylem, more water is being 'pulled up' to replace then. This pulling force is the transpiration pull. The negative pressure produced causes tension on the water molecules in the xylem. The

mass flow of this water relies on two important properties of water; cohesion, the tendency of the holding together of water molecules. Adhesion, the attraction of two different substances, one liquid and the other not, in this case the water molecule is attracted to the inside of the xylem vessel.