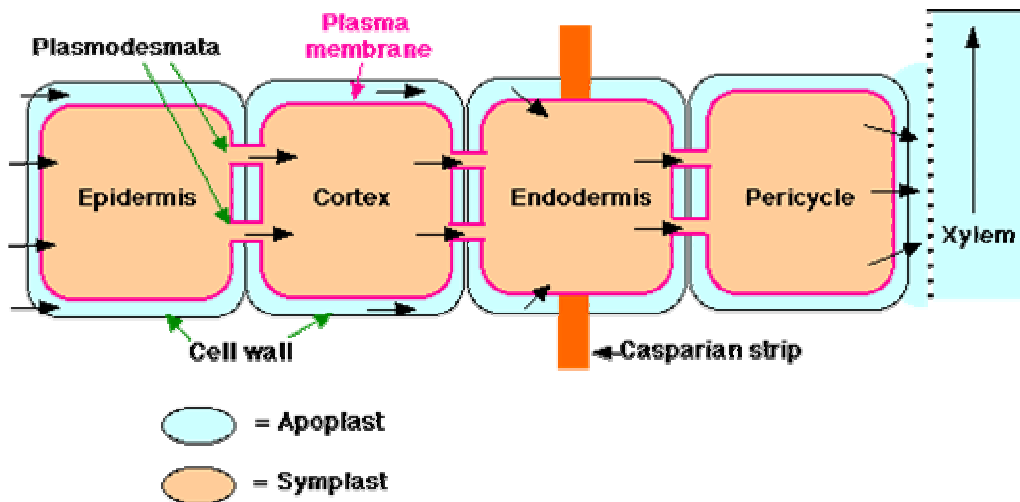


Mineral Nutrition

Plants are autotrophic and must obtain the nutrients they need to live from the soil, which they grow. The minerals enter the plants through its roots into the xylem. Most absorption takes place in the root hair where cells in the outmost layer have extension, which penetrate between the particles in the soil. The minerals are dissolved in a film of water and diffuse into root hair cells. However, minerals are also taken up by active transport. This is because the concentration of ions in the soil is higher than the concentration in the root hair cells, so it moves against its concentration gradient. This is an active process requiring energy from respiration. Once inside the root hairs, the ions follow the uptake of water and are transported into the xylem through the symplast and apoplast pathway.

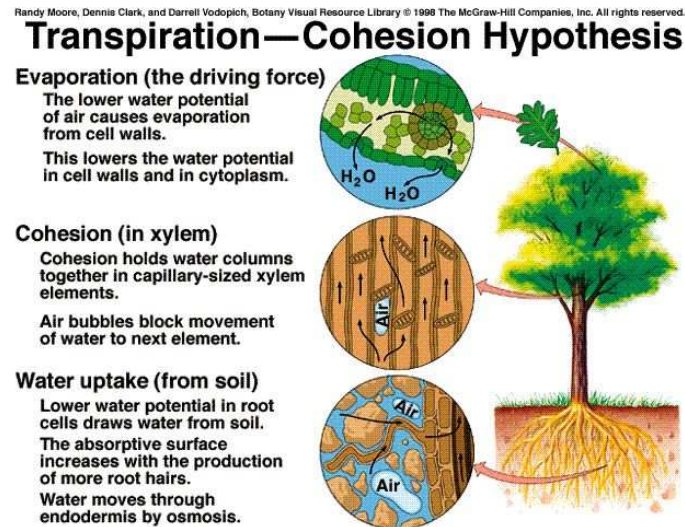
In the symplast pathway, the ion that is dissolved in water moves through the cytoplasm of the root cells and cross the plasma membrane into neighboring cells. Alternatively, in the apoplast pathway, the ions move through cell walls or non-living parts of the roots (i.e. the space between the cells) and does not cross the plasma membrane. The diagram below illustrates this.



Since the root hair are made from a series of tissue, the water carrying the ions will reach the inner boundary of the cortex, the endodermis, which is surrounded by a water impermeable casparian strip. As a result, the only way the minerals can be transported to the cells in the stele is by plasmodesmata. These are fine connection between neighboring cells. Once inside, the ions enters directly into the xylem vessel and are transported in the transpiration stream to different parts of the plant.

As mentioned in the above paragraph, the water containing the minerals moves

through the plant by transpiration. As water evaporates through the stoma at the bottom of the leaves, water is pulled out of the cells on the surface of the leaves. This is because water is cohesive and sticks together. As water molecule evaporates from the stoma, it creates a tension that pulls water molecules up from the roots and up the xylem tissue.



There are various type of minerals, plants uptake from the soil. Each of them plays a vital role in the growth and survival of the plant. One of the most important minerals is carbon. This is what plants are mainly made of and forms the backbone of many biomolecules, including starch and cellulose. It is stored in the form of carbohydrate to provide energy for biochemical reactions. Hydrogen is necessary as it builds sugar and new tissue. As a major part of ATP, phosphorus ions from the soil are needed to convert light energy to chemical energy during photosynthesis. It is also used in plant growth and formation of seeds and flowers. Potassium regulates osmotic balance and the opening and closing of the stoma. It plays a role in the control of water loss in the plant. Moreover, nitrogen is also essential as it is a major component of all protein, DNA and needed for growth and reproduction. Another important nutrient plants need is magnesium because it makes up chlorophyll and act as an enzyme cofactor in the production of ATP. Lastly, sulfur and calcium are needed for plant growth and regulating the transport of other nutrients respectively.

When growing monocultures or other crops, plant growers have to add fertilizers. In agriculture, monoculture refers to fields composed of a single crop rather than a diverse crop species. The advantages of this are that the plant competition for nutrient, space and solar radiation is reduced. However there are also problems with this

method. This is where fertilizers come in. Normally, farmers grow different crops each year to put back the nutrients into the soil. Since only one type of crop is grown, the specific nutrient the crop needs will be depleted from the soil after one harvest. In order to replace the lost nutrients, farmers must use fertilizers to ensure that their crops have a sufficient amount to grow. On the other hand, not all land has the correct nutrient for plant growth. Thus, fertilizers have to be used to provide the plant with minerals that is not available in the soil, so it can grow.