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GAS EXCHANGE IN DICOT PLANTS

In order to carry on photosynthesis, plant need a supply of carbon dioxide and also a means of disposing oxygen. Again in other to carry on cellular respiration, plant cells need oxygen and a means of disposition carbon dioxide.

Unlike animals, plants have no specialized organs for gas exchange. There are several reasons they can get along without them.

REASONS

Each part of the plant takes care of its own gas exchange needs. Although plants have an elaborate liquid transport system, it does not participate in gas transport.

Roots, stems, and leaves respire at rates much lower than are characteristic of animals. Only during photosynthesis are large volumes of gases exchanged and each leaf is well adapted to take care of its own needs.

The distance that gases must diffuse in even a large plant is not great. Each living cell in the plant is located close to the surface. While obvious for leaves, it is also true for stems. The only **living** cells in the stem are organized in thin layers just beneath the bark. The cells in the interior are dead and serve only to provide mechanical support.

Most of the living cells in a plant have at least part of their surface exposed to air. The loose packing of parenchyma cells in leaves, stems, and roots provides an interconnecting system of air spaces. Gases diffuse through air several thousand times faster than through water. Once oxygen and carbon dioxide reach the network of intercellular air spaces (arrows), they diffuse rapidly through them.

Oxygen and carbon dioxide also pass through the cell wall and plasma membrane of the cell by diffusion. The diffusion of carbon dioxide may be aided by aquaporin channels inserted in the plasma membrane

All plant cells respire all the time, and when illuminated plant cells containing chloroplasts also photosynthesise, so plants also need to exchange gases. The main gas exchange surfaces in plants are the spongy mesophyll cells in the leaves. Leaves of course have a huge surface area, and the irregular-shaped, loosely-packed spongy cells increase the area for gas exchange still further. You are expected to know leaf structure in the detail shown in the diagram

Gases enter the leaf through stomata -usually in the lower surface of the leaf. Stomata are enclosed by guard cells that can swell up and close the stomata to reduce water loss. The gases then diffuse through the air spaces inside the leaf, which are in direct contact with the spongy and palisade mesophyll cells. **Plants do not need a ventilation mechanism** because their leaves are exposed, so the air surrounding them is constantly being replaced in all but the stillest days. In addition, during the hours of daylight photosynthesis increases the oxygen concentration in the sub-stomatal air space, and decreases the carbon dioxide concentration. This increases the concentration gradients for these gases, increasing diffusion rate.

The palisade mesophyll cells are adapted for photosynthesis. They have a thin cytoplasm densely packed with chloroplasts, which can move around the cell on the cytoskeleton to regions of greatest light intensity. The palisade cells are closely packed together in rows to maximise light collection, and in plants adapted to low light intensity there may be two rows of palisade cells.

The spongy mesophyll cells are adapted for gas exchange. They are loosely-packed with unusually large intercellular air spaces where gases can collect and mix. They have fewer chloroplasts than palisade cells, so do less photosynthesis.