Parts of a plant

Leaves: Site of photosynthesis and gas exchange

Stem: Contains vascular bundles which transport water/mineral salts as well as manufactured food respectively to different parts of the plant

Roots: Site of water/mineral salts absorption

Flowers: Contains reproductive organs of the plant

Photosynthesis

Plants are autotrophs: They make their own food by a process of photosynthesis

Raw materials: Carbon dioxide (diffuse in through stomata) and water (absorbed through roots)

Conditions: Chlorophyll pigment found in chloroplast traps light energy

Products: Glucose (used by plant) and Oxygen (released to surroundings)

Photosynthesis is a process in which green plants trap light energy and convert it to chemical energy for the formation of carbohydrates. This process involves the break down of inorganic molecules to synthesise inorganic molecules

This process starts of with light breaking down the water molecules into hydrogen and oxygen by a process called photolysis

The hydrogen produced by this is used to reduce carbon dioxide to form glucose

Oxygen produced by photolysis diffuses out of the stomata into the surroundings

Glucose is used by the plant n many ways. This is called the fate of glucose

Fate of glucose

The various ways glucose is used by the plant

Some glucose produced is converted to starch, a storage molecule, for future uses

Some glucose is metabolized by the plants (used by aerobic respiration to release energy)

Some glucose is converted to cellulose to enhance the rigidity of the cellulose cell walls of plant cells

Some glucose reacts with nitrate ions to form amino acids which condense to form essential proteins used by the plant

Some glucose is converted to sucrose for transport around the plant

Some glucose is converted to fats and oils for energy storage in seeds

Starch is a good storage molecule as it is insoluble in water. Hence water potential of cell sap in the plants cells remain constant and osmosis would not be affected

Factors affecting rate of photosynthesis

Limiting factors are abiotic factors that limit the rate of photosynthesis when present in a short supply

Such factors exist as raw materials of photosynthesis not always being readily available

Limiting factors of photosynthesis include: Co2 concentration, light intensity, temperature of environment

Temperature changes results in variation of photosynthetic enzyme activity, light intensity changes results in variation of the amount of light energy available to the plant to convert to chemical energy, change in amount of carbon dioxide affects amount of glucose produced

Factors affecting rate of photosynthesis (cont)

Linear change (factor in the x axis is limiting photosynthesis), when the graph plateaus (some other factor is limiting)

As temperature increases, kinetic energy of enzyme and substrate molecules increases, greater frequency of collisions, high enzyme activity. Beyond optimum temperature, enzymes will denature and lose their specific active sites and enzyme activity will decrease

Water is not a limiting factor, as the amount of water required by the plant is so small that there is hardly a case where the water supplied for photosynthesis is to little

Gas exchange

Concentration of carbon dioxide outside the leaf is greater than inside the leaf. Hence carbon dioxide diffuses from the surrounding into the leaf through the stomata during photosynthesis

Concentration of oxygen inside the leaf is greater than outside the leaf. Hence oxygen diffuses out of the leaf into surroundings during photosynthesis

Opposite during aerobic respiration

Gas exchange--> diffusion of gases in and out of leaf through stomata

Parts of leaf structure

Waxy cuticle: Prevents water from evaporating from the top of the leaf (Made of wax to allow light to penetrate through)

Upper epidermis: Contains a layer of thin and transparent cells to allow light to penetrate through and fall on the palisade mesophyll layer

By **geminifourth04**
(shreyasree)

cheatography.com/shreyasree/

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Parts of leaf structure (cont)

Palisade mesophyll layer: Contains vertically arranged palisade mesophyll layers which are tightly packed with chloroplast, allowing maximum light to be absorbed, maximizing photosynthesis

Spongy mesophyll layer: Contains spongy mesophyll cells that have intercellular air spaces in between them

Lower epidermis: Contains guard cells and stomata

Guard cell: Become turgid/flaccid due to effects of osmosis, controls the size of stoma during day and night

Stomata: Small opening which is controlled by guard cells, where gases and water vapour diffuse through diffuse through

Palisade mesophyll layer, spongy mesophyll, lower epidermis (descending chloroplast concentration

Plant Reproduction

Nuclei in pollen grain: Generative nucleus (divides into two) and pollen tube nucleus

Nuclei found in ovum: Female nucleus

Double fertilizations (one nucleus fuses to form zygote whereas the other fuses to form endosperm

Plant Reproduction (cont)

Pollen grain transferred from anther to sticky stigma of the flower. The pollen grain germinates into a pollen tube which will grow down the style of the flower. Pollen tube nucleus guides the growth of the pollen tube and the enzymes secreted by he pollen tube held o breakdown tissues surrounding it for optimal penetration down the style. The generative nucleus divides to form 2 haploid nuclei. At the micropyle of the ovary, the tip of pollen absorbs sap and bursts releases both the male nuclei into the ovary. One male nucleus will fuse with the female nucleus to form a zygote and the other male nucleus will fuse with another female nuclei to form the endosperm (support embryonic growth)

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Transport in Plants

Plants contains a vascular bundle in the stems. This vascular bundle contains xylem tissue, phloem tissue as well as cambium cells. The vascular bundle plays an integral role in transport of water and manufactured food throughout the plant

Xylem - Tissue that transports water and mineral salts absorbed by the roots to other plants of the plant. The xylem tissue is dead (contains no organelles to prevent obstruction to flow of water and mineral salts) and the walls of the xylem tissue are lignified to provide sufficient mechanical support to ensure that the tissue will not collapse. No cross walls present

Phloem - Tissue that transports manufactured food (sucrose) from leaves to sink organs down the pressure gradient. Phloem contains two types of cells, sieve tube cells as well as companion cells. As the name suggests a sieve tube cell is accompanied by a companion cell. The sieve tube cell has degenerative protoplasm/most of organelles are absent(except cytoplasm) to prevent obstruction to flow of manufactured food down the phloem. Companion cells contain many mitochondria which release a lot of energy to load sugars into the sieve tube cells by active transport. High perforated sieve plates/cross-walls are also present in the phloem tissue

Water transport

Root pressure	Hydrostatic pressure generated by the roots to drive water and mineral ions absorbed the roots into the xylem tissue

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Water transport (cont)

Capillary action in the xylem tissue	Flow of water up the xylem vessels by the combined effects of cohesion forces between water molecules as well as adhesion forces between water molecules and the wall of the xylem tissue
Transpiration pull	Pulling force produced in the xylem that drives water and mineral ions up the xylem tissue as a results of water loss in the leaves due to transpiration (replace the water lost)

Transpiration is defined as the **loss of water vapour from the leaves**. Water **evaporates** from the surface of spongy mesophyll cell and into the air spaces. The concentration of water vapour inside the leaf is higher than the water vapour in air surrounding the leaf. Hence water vapour **diffuses** out of the leaf through the stomata. Transpiration pull drags water up the xylem to replace the water lost from the surface of spongy mesophyll cell

Factors affecting rate of transpiration

Humidity	↑ humidity, ↑ WV in surroundings, ↓ steep WV concentration gradient, ↓ rate of diffusion of water vapour, ↓ transpiration

Factors affecting rate of transpiration (cont)

Wind Speed	↑ wind speed, ↓ WV in surroundings, ↑ steep WV concentration gradient, ↑ rate of diffusion of water vapour, ↑ transpiration
Light intensity	↑ light intensity, ↑ size of stomata, ↑ more water vapour can escape, ↑ transpiration
Temperature	↑ temperature, ↑ water on surface of spongy mesophyll cells evaporate and move into intercellular air spaces, ↑ water vapour lost, ↑ transpiration

Sucrose transport

Glucose produced from photosynthesis is converted to sucrose to prevent mitochondria in leaf cells from using it to release energy through aerobic respiration

Sucrose is first loaded by companion cells into sieve tube cells by active transport. WP of phloem decreases below xylem and water from xylem move into phloem. Pressure in phloem at leaf increases and manufactured food and water move down the phloem from leaf to sink organ. At sink organ, sucrose is loaded out of sieve tube cells with the help of companion cells by active transport. WP of phloem increases more than xylem and water from phloem move into xylem

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