Nutrition in Plants

Matthew Williams • Biology • May 9, 2026

Nutrition in Plants

Nutrition is how organisms obtain the raw materials and energy they need to survive. Green plants are the foundation of almost every food chain because they can manufacture their own food from simple inorganic substances using light energy.

Types of Nutrition

Type	Description	Examples
Autotrophic	organism makes its own organic food from inorganic substances using an external energy source	green plants, algae, some bacteria
Heterotrophic	organism obtains organic food by consuming other organisms	animals, most fungi, most bacteria
Saprophytic	organism obtains nutrients by secreting enzymes onto dead or decaying matter and absorbing the products	fungi, many bacteria

Holozoic nutrition is a type of heterotrophic nutrition in which organisms ingest whole food, digest it internally, and absorb the products — the pattern seen in humans and most animals.

Photosynthesis

Photosynthesis is the process by which green plants use light energy to convert carbon dioxide and water into glucose and oxygen.

Word equation:

carbon dioxide + water ’glucose + oxygen (in the presence of light and chlorophyll)

Balanced chemical equation:

6CO,+ 6HO ’CHO+ 6O,

Photosynthesis has two broad stages:

- the **light-dependent stage** — light energy splits water, releasing oxygen and producing ATP
- the **light-independent stage** — ATP is used to fix carbon dioxide into glucose

For CSEC, the key understanding is the overall equation, the raw materials, the products, and the conditions needed.

> 🧠 **Remember**
> Photosynthesis uses CO_2 and H_2O to produce glucose and O_2. Respiration does the opposite. Both happen simultaneously in plant cells, but photosynthesis dominates in bright light.

What plants do with glucose

Plants do not just accumulate glucose. They use it in several ways:

- respiration — releases energy for growth, transport, and reproduction
- converted to starch for storage (in seeds, roots, stems)
- converted to sucrose for transport through the phloem
- used to build cellulose for cell walls
- combined with nitrates to make amino acids and proteins
- converted to fats and oils for storage in seeds

Leaf Structure and Photosynthesis

The leaf is the main organ of photosynthesis. Its structure is closely matched to this function.

Cross-section of a dicotyledonous leaf

1. Upper epidermis
2. Palisade mesophyll
3. Chloroplasts
4. Spongy mesophyll
5. Lower epidermis
6. Stomata
7. Guard cells
8. Xylem
9. Phloem
10. Vascular bundle

Feature	Adaptation
Broad, flat shape	maximises surface area for light absorption
Thin structure	reduces diffusion distance for CO_2 and O_2
Transparent upper epidermis	allows light through to the palisade layer
Palisade mesophyll cells	tall, closely packed, rich in chloroplasts; positioned near the top for maximum light

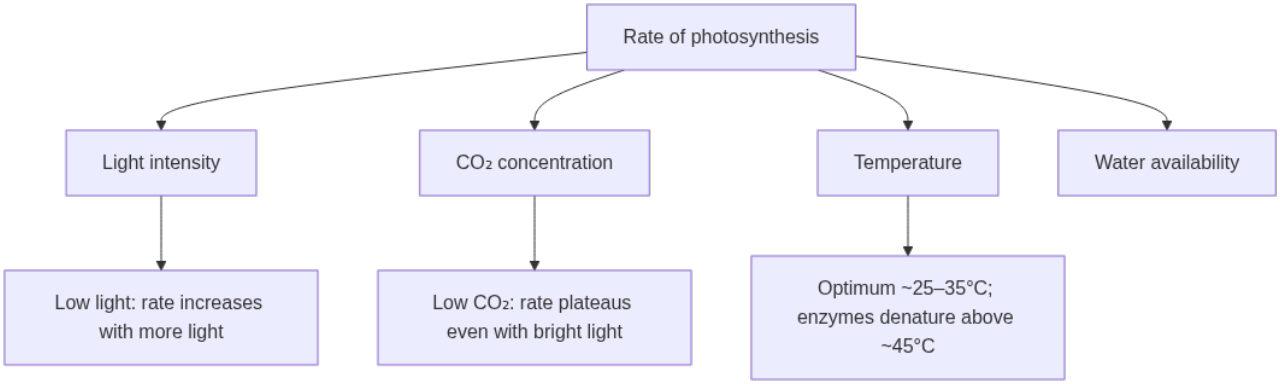
Spongy mesophyll	large air spaces for gas exchange; CO,diffuses to palisade cells
Stomata (lower epidermis)	pores for gas exchange; CO,enters, O,and water vapour leave
Guard cells	open and close stomata in response to light and water availability
Vascular bundle (midrib and veins)	xylem carries water to cells; phloem carries glucose away
Waxy cuticle	reduces water loss by evaporation

> 📝 **Exam Tip**
> A leaf structure question often asks you to explain how a named feature is adapted for photosynthesis. Always state the feature, describe its structural property, and then link it to how photosynthesis benefits — for example: "The palisade cells are packed with chloroplasts, which absorb light energy for photosynthesis."

Limiting Factors of Photosynthesis

A **limiting factor** is any variable that, when in short supply, reduces the rate of photosynthesis even if other conditions are ideal. At any given moment, one factor is most limiting.

Factor	How it limits photosynthesis
Light intensity	provides energy for the light-dependent stage; low light means less ATP produced
Carbon dioxide concentration	raw material for carbon fixation; low CO,reduces the rate even in bright light
Temperature	affects enzyme activity; too low slows reactions; too high denatures enzymes
Water availability	raw material split in the light-dependent stage; also needed for cell turgor



Limiting factors of photosynthesis

In a greenhouse, growers can increase yield by raising CO,concentration and light intensity together, since increasing one alone eventually hits a ceiling set by the other.

Mineral Nutrition in Plants

Plants absorb mineral ions from soil water through their roots. These minerals are especially important at CSEC level:

Nitrogen

Nitrogen is needed to make:

- amino acids and proteins (for growth, enzymes, and cell membranes)
- nucleic acids (DNA and RNA)
- chlorophyll

Plants absorb nitrogen as **nitrate ions (NO_3^-)** from the soil via active transport. Nitrogen-fixing bacteria in the soil and in root nodules of legumes also convert nitrogen gas into forms plants can use.

Deficiency effects: stunted growth, older leaves turn yellow (chlorosis), poor protein production.

Magnesium

Magnesium is needed to make **chlorophyll** — it is part of the chlorophyll molecule itself.

Deficiency effects: yellow leaves (chlorosis), particularly affecting younger leaves first; photosynthesis rate falls.

Calcium

Calcium is needed for strong cell walls and normal growth of young tissues. It helps cells stick together and supports root and shoot development.

Deficiency effects: poor growth, weak young leaves, and poor root development.

Mineral	Role in plant	Deficiency symptom
Nitrogen	amino acids, proteins, DNA, chlorophyll	stunted growth, yellowing of older leaves
Magnesium	component of chlorophyll molecule	yellowing of leaves, reduced photosynthesis
Calcium	cell wall formation and normal growth	weak young tissues, poor root growth

> 📝 **Exam Tip**
> Both nitrogen and magnesium deficiency cause yellowing, but nitrogen deficiency typically affects older leaves first (the plant relocates nitrogen to newer growth), while magnesium deficiency often shows in younger leaves too. Examiners may ask you to distinguish between them using symptom location.

PRACTICE — NUTRITION IN PLANTS

Autotrophic nutrition
Making organic food from inorganic substances using an external energy source; the method used by green plants.

Heterotrophic nutrition
Obtaining food by consuming other organisms.

Saprophytic nutrition
Obtaining nutrients by secreting enzymes onto dead matter and absorbing the breakdown products.

Photosynthesis
The process by which plants use light energy, CO, and water to produce glucose and oxygen.

Chlorophyll
The green pigment in chloroplasts that absorbs light energy for photosynthesis.

Limiting factor
The factor in shortest supply that restricts the rate of photosynthesis at any given time.

Palisade cells
Tall, chloroplast-rich cells near the top of the leaf; the main site of photosynthesis.

Stomata
Pores in the leaf epidermis through which CO, O, and water vapour are exchanged.

Nitrogen deficiency
Causes stunted growth and yellowing of older leaves due to lack of amino acid and chlorophyll production.

Magnesium deficiency
Causes yellowing of leaves because magnesium is needed to make chlorophyll.