NUTRITION IN PLANTS

AUTOTROPHIC NUTRITION

Specific Objectives

By the end of the topic, the learner should be able to:

- (a) define nutrition and state its importance in living organisms
- (b) differentiate various modes of feeding
- (c) describe photosynthesis and show its importance in nature
- (d) explain how the leaf is adapted to photosynthesis
- (e) explain the factors affecting photosynthesis

define nutrition

Nutrition is the process by which a living organism obtains food and assimilates it into its body.

define nutrition and state its importance in living organisms



Importance of nutrition

All organisms need food in order to:

- Produce new cells and tissues for **growth** and **development**.
- **Repair** and **replacement** of damaged tissues or worn out cells.
- Provide energy within the cells for the various biological processes, e.g. excretion, locomotion, reproduction.
- Store excess ingested and assimilated nutrients as reserves for growth and sustenance.

Types of food

carbohydrates,

proteins,

lipids,

vitamins,

mineral salts,

Water,

Types of Nutrition

- *Autotrophic* nutrition,
- *Heterotrophic* nutrition,

differentiate various modes of feeding

- **Heterotrophic nutrition** is the method of feeding on complex organic foods used by heterotrophs, .
- **Autotrophic nutrition is** the process by which autotrophs manufactures their own complex organic foods.

Modes of nutrition videos



Nutrition in plants (autotrophism)

Type of autotrophic nutrition include;

- **Chemosynthesis** autotrophs use **chemical** energy. E.g. nitrifying bacteria, *Nitrosomonas sp*. and *Nitrococcus sp*.
- **Photosynthesis**, autotrophs use light energy.

Photosynthesis

- *Photosynthesis is a biochemical process during which green plants manufacture organic compounds using sunlight and simple inorganic compounds – carbon IV oxide, water and oxygen as a by-product.*

Photosynthesis importance in nature

- Source of food (chemical energy),
- Reduce the level of carbon IV oxide in the atmosphere,
- Restores oxygen back into the atmosphere,

Internal Structure of the Leaf

The leaf of structures include:

- *upper epidermis*
- *lower epidermis*
- *palisade mesophyll*
- *spongy mesophyll*
- *vascular tissues (or veins)*
- *stomata: those occur in the epidermis*

Cuticle of the leaf

- The upper leaf surface is covered by a transparent protective shiny or waxy cuticle, which permits light to enter the leaf,
- reduces water loss from the leaf.

Leaf Epidermis

- The main function of the epidermis is to protect the delicate inner tissues.
- The turgidity of the epidermal cells gives **support** to the entire leaf.

Palisade Mesophyll of the leaf

- Palisade cells contain numerous chloroplasts whose chlorophyll is responsible for the dark green colour of the upper surface of leaves.
- The main function of the palisade mesophyll is the site of **photosynthesis**.

Leaf Spongy Mesophyll

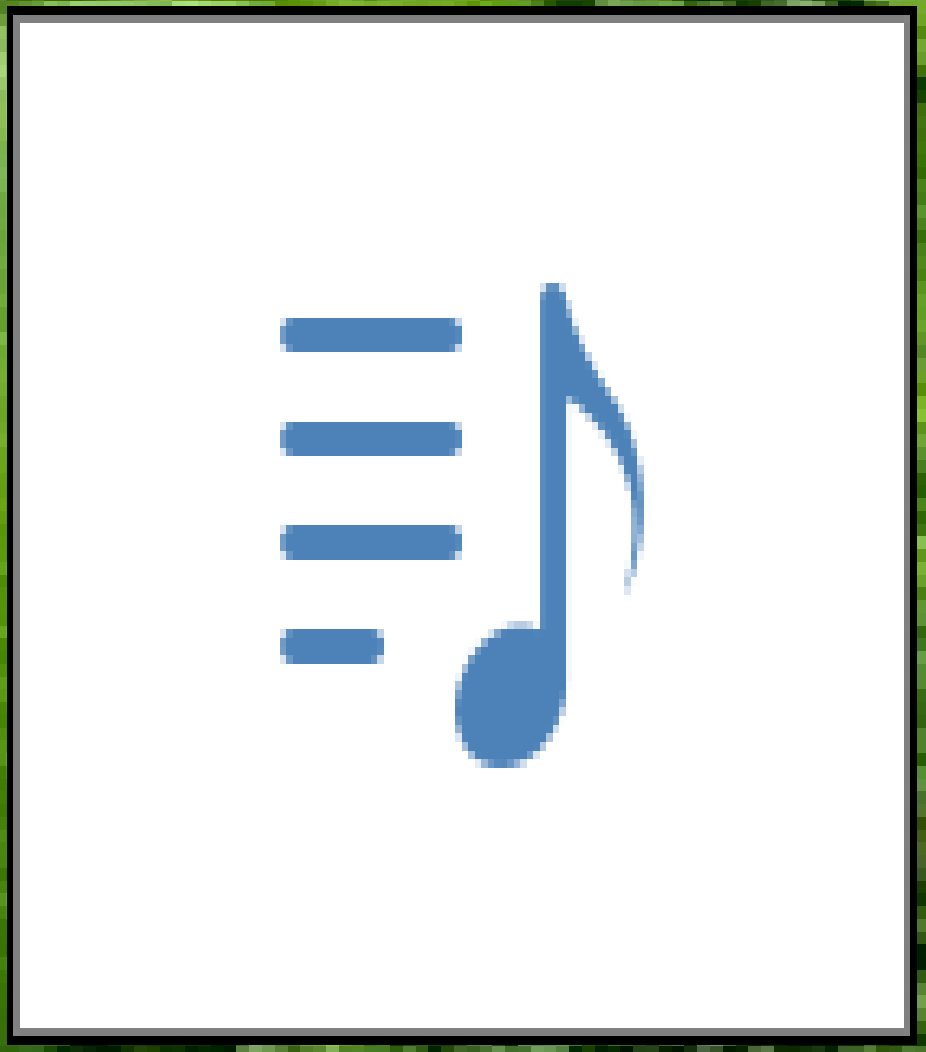
- Spongy mesophyll is a tissue of loosely arranged cells that surround several air spaces. The air spaces allow rapid diffusion of CO_2 and O_2 passing through the Stomatal pores.
- Spongy mesophyll cells outer surfaces are lined with a thin film of moisture that dissolves CO_2 and O_2 before gaseous exchange.
- Besides photosynthesis, the spongy mesophyll also carries out **gaseous exchange.**
- Excess water within the plant is expelled via the spongy mesophyll cells, in the form of *water vapour* in the process of **transpiration.**

Vascular Tissue

- Vascular tissue is made up of **xylem** and **phloem involved in transport.**
- Water and minerals are carried along the xylem tissue to the leaf tissue. The products of photosynthesis and other organic foods, translocated along the **phloem** tissue, from the leaf to the rest of the plant.
- The network of vascular bundles provides firm **support** for the entire leaf.

Stomata

- Stomata are important in photosynthesis since they serve as passage-ways for the rapid movement of CO_2 and O_2 into and out of the plant.



Structure & working of Stomata video



Adaptations of leaf to photosynthesis

- Mosaic arrangement of leaves i.e. leaves not overlapping ensures that all leaves are exposed to receive maximum amount of light.

Continued

- Turgidity of the cells in the veins and the stiffness of the veins help to hold the leaves in a horizontal position so as to be able to absorb maximum light for faster rate of photosynthesis.

Continued

- The palisade cells have numerous chloroplasts for faster rate of photosynthesis.

Continued

- Presence of a film of water surrounding the spongy mesophyll layer of cells to dissolves carbon IV oxide therefore faster diffusion into the photosynthetic cells.

continued

- Presence of large air space into the spongy mesophyll layer of cells to allow carbon IV oxide and oxygen to circulate rapidly inside the leaf.

Continued

- Presence of dense network of veins consisting of xylem and phloem to provide mechanical support.
- Xylem vessels conduct water and mineral salts to the photosynthetic cells.
- phloem tissue translocate manufactured food from the leaves to other parts of the plant.

Continued

- The palisade cells are situated next to the upper epidermis for maximum exposer to light and to trap maximum light from the sun.

continued

- The palisade cells are elongated and closely packed so as to be many per unit surface area and therefore have a large number of chloroplasts per leaf for effective photosynthesis.

Continued

- Presence of waxy cuticle to protect the inner parts of the leaf from bacterial attack, from mechanical damage and reduces water loss due to evaporation.

Continued

- Both cuticle and epidermis are transparent so as to allow penetration of light to the photosynthetic cells.

Continued

- Presence of stomata in the leaf ensure efficient diffusion of carbon IV oxide into the leaf

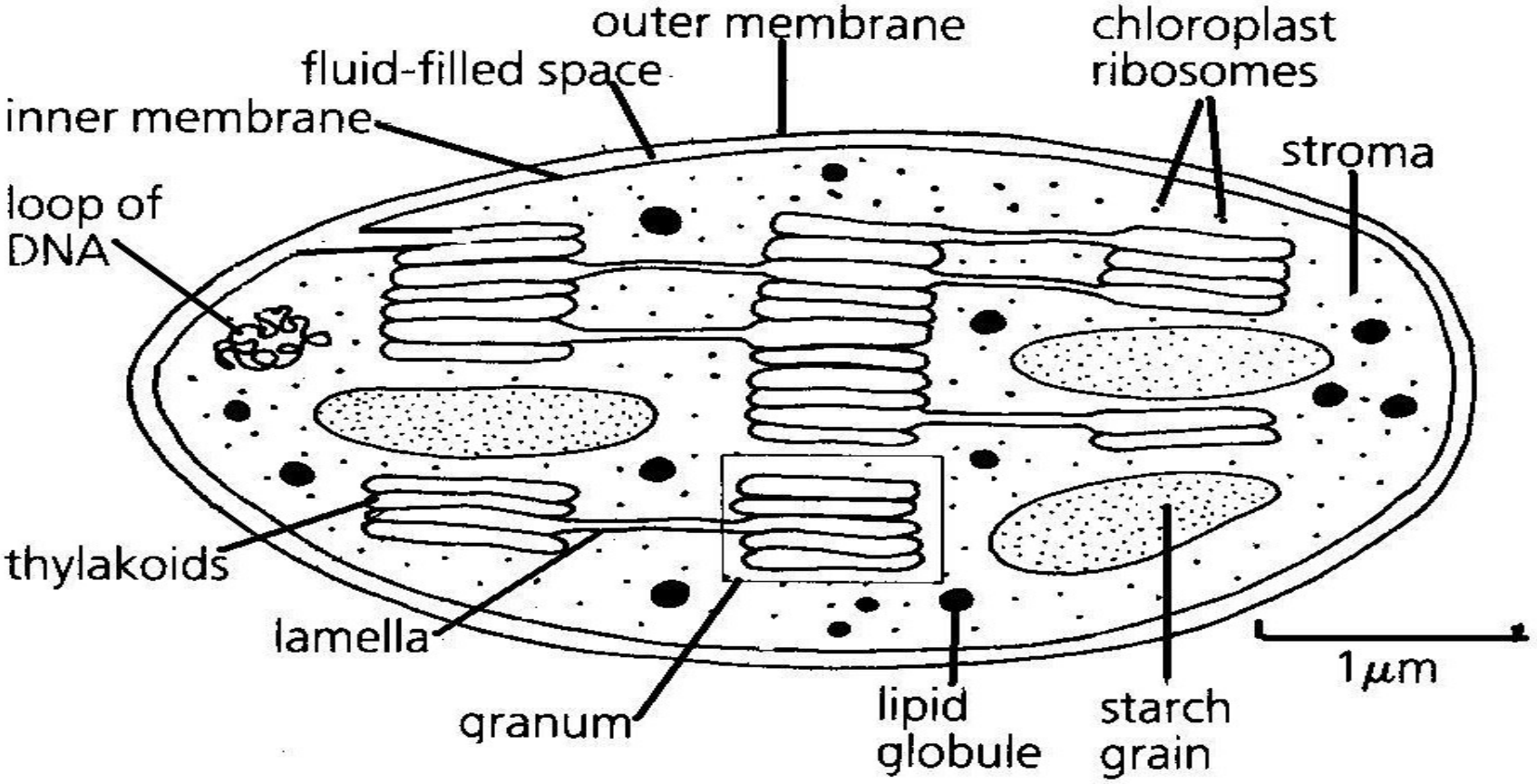
Continued

- Leaf has a thin lamina to reduce the distance over which carbon IV oxide and light pass to reach the photosynthetic cells for faster rate of photosynthesis.

continued

- Broad and flat lamina to provide a large surface area for absorption of carbon IV oxide and sunlight.

Structure of a chloroplast



Structure of a chloroplast

Function of a chloroplast

- Site of photosynthesis



Adaptations of chloroplasts

- **Inner membrane is folded into Lamellae and grana which provide a large surface area for attachment of chlorophyll,**
- **Chlorophyll traps light energy,**
- **stroma** site of carbon IV oxide fixation and it contains water, ions, lipids, enzymes and sugars

Process of photosynthesis

- Photosynthesis is the conversion of light energy into chemical energy by plants.

The reaction can be summarized as follows:

- **Carbon IV oxide + water = Glucose + O_2**

The process of photosynthesis has two main stages:

the ***Light Stage***

the ***Dark Stage***

The Light Stage; *Photolysis* of water molecules

- Light stage takes place only in the presence of light.
- Light stage occurs in the **grana** of the chloroplasts.
- Light energy is **trapped** by a *chlorophyll* molecule.
- Adenosine triphosphate (ATP) molecules are formed,

Continued

- *In Photolysis* of water molecules occurs when each water molecule is split by light to form a hydroxyl ion (OH^-) and a hydrogen ion (H^+).
  - *In the **Hill reaction** the hydrogen ion from photolysis is taken up by a hydrogen acceptor, e.g. NADP which forms NADPH.*
  - *The hydroxyl ions from photolysis combine to form free **oxygen** molecules.*

The Dark Stage; Carbon IV oxide fixation

- The chemical reactions are in the *Calvin Cycle* and are speeded up by enzymes.
- ATP from the photolysis provides the energy for carbon IV oxide fixation.
- The hydrogen ion is supplied by **$NADPH_2$** from *Light Stage.*

Continued

- The glucose formed is quickly converted to starch and stored within the chloroplast.
- The starch is then converted to sucrose which is transported to other cells.

Photosynthesis process video



Pigments in leaves & light



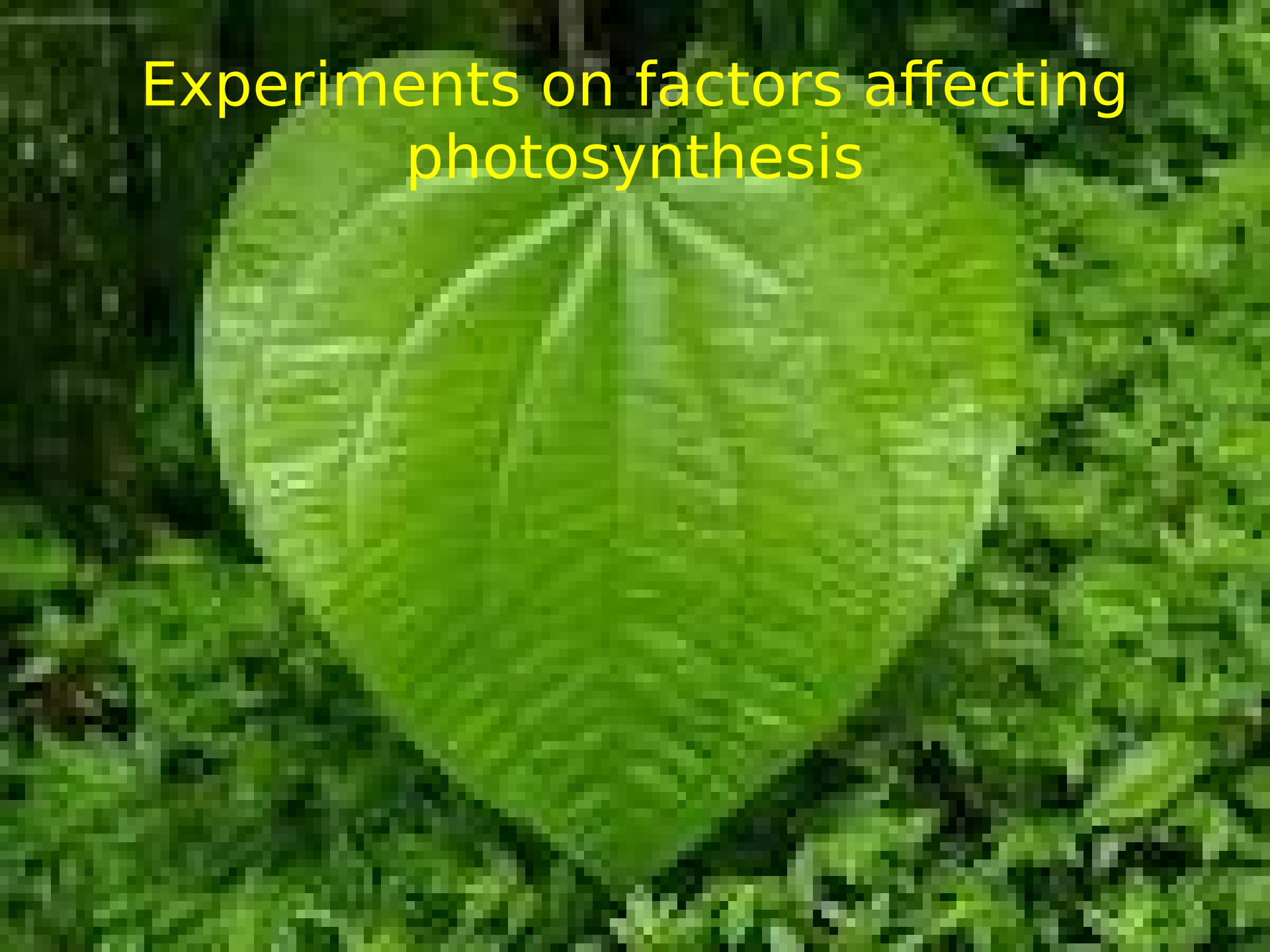
Factors influencing photosynthesis:

- light intensity,
- temperature,
- carbon (IV) oxide concentration,
- Water
- Chlorophyll

Factors affecting Photosynthesis



Experiments on factors affecting photosynthesis




Observe distribution of stomata from plant adapted to different habitats