



KWAZULU-NATAL PROVINCE

EDUCATION
REPUBLIC OF SOUTH AFRICA



LIFE SCIENCES GRADE 11

Photosynthesis

TERM 2

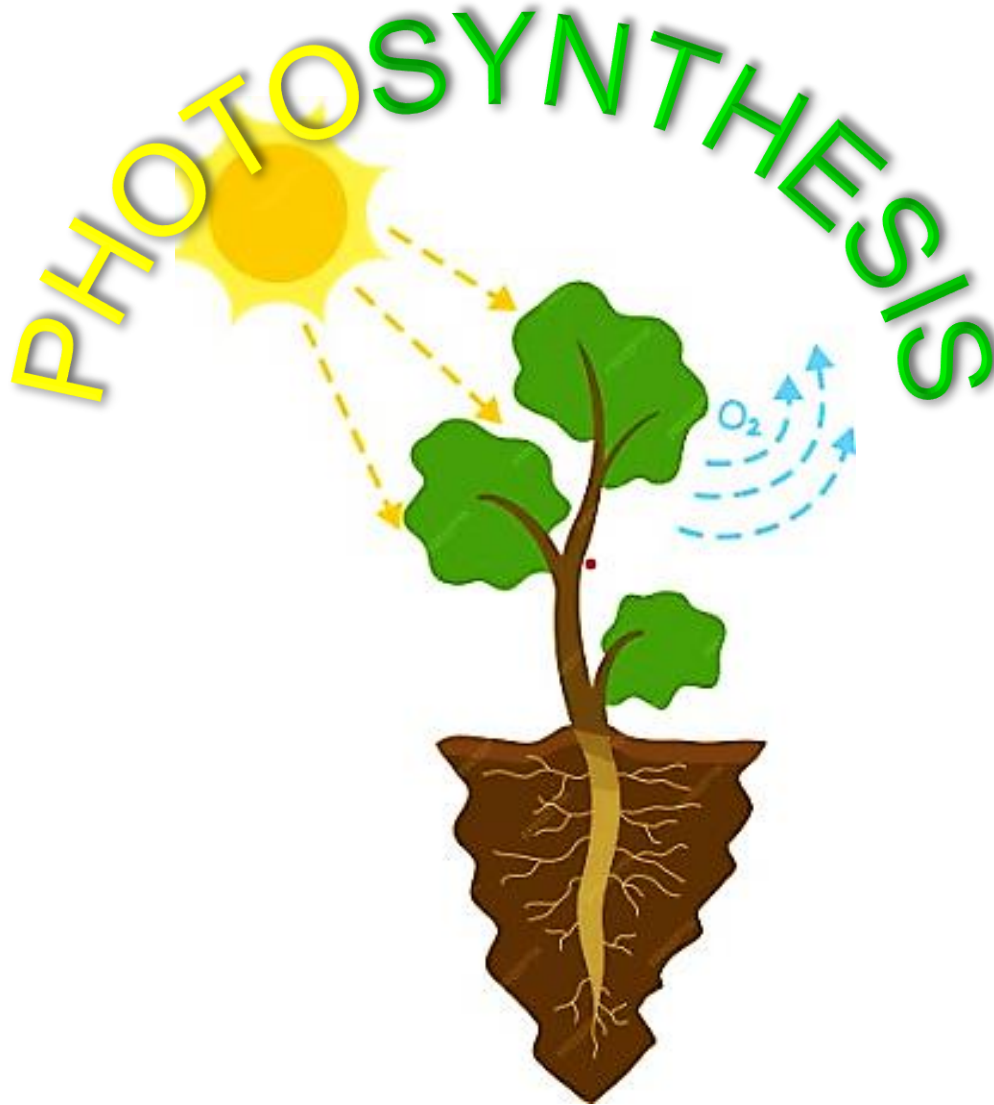
MARCH 2025

GROWING KWAZULU-NATAL TOGETHER



MISCONCEPTIONS: PHOTOSYNTHESIS

- Some learners cannot differentiate between photosynthesis and respiration
- Some learners think plants produce oxygen all day, even when sunlight is not available failing to understand that light is required for oxygen to be produced.
- Some learners ignore the importance of light, believing that photosynthesis can occur without light, not recognising that light is the primary source of photosynthesis.
- Learners believe that water with dissolved substances (organic & inorganic nutrients) is the primary food for the plants, rather than understanding that use water, carbon dioxide and light in photosynthesis to produce sugars.
- Learners also incorrectly relate photosynthesis to plant growth. These learners do not understand that these sugars produced photosynthesis are used as energy for plant growth and other processes.



The term **photosynthesis** is made up of two words
Photo + **Synthesis**

Photo means Light
Synthesis comes from the word **synthesize** which means to make

Photosynthesis is the process through which **plants** use light energy to make their own food

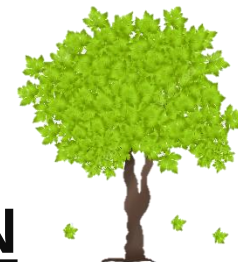


PHOTOSYNTHESIS: VIDEO

<https://www.youtube.com/watch?v=CL9A8YhwUps&t=16s>

OR





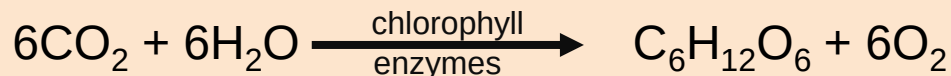
PHOTOSYNTHESIS: DETAILED DESCRIPTION

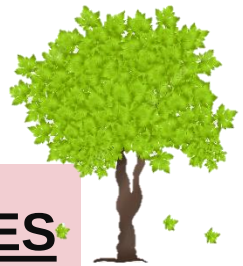
- **Photosynthesis** is the process by which chlorophyll in the chloroplasts of green plants absorbs radiant energy from the sun, carbon dioxide from the atmosphere and water from the soil to produce carbohydrates (e.g., glucose) which is stored in the plant and release oxygen into the atmosphere.
- Enzymes in the cell are also needed for the process. Excess glucose is converted into starch in the plant.

Word equation

carbon dioxide + water + radiant energy $\xrightarrow[\text{enzymes}]{\text{chlorophyll}}$ glucose(Starch) + oxygen

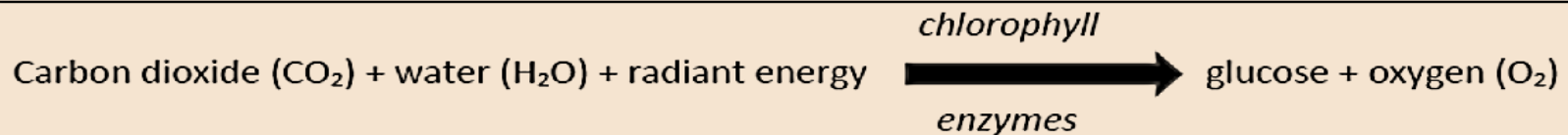
Chemical equation





REQUIREMENTS AND PRODUCTS OF PHOTOSYNTHESIS

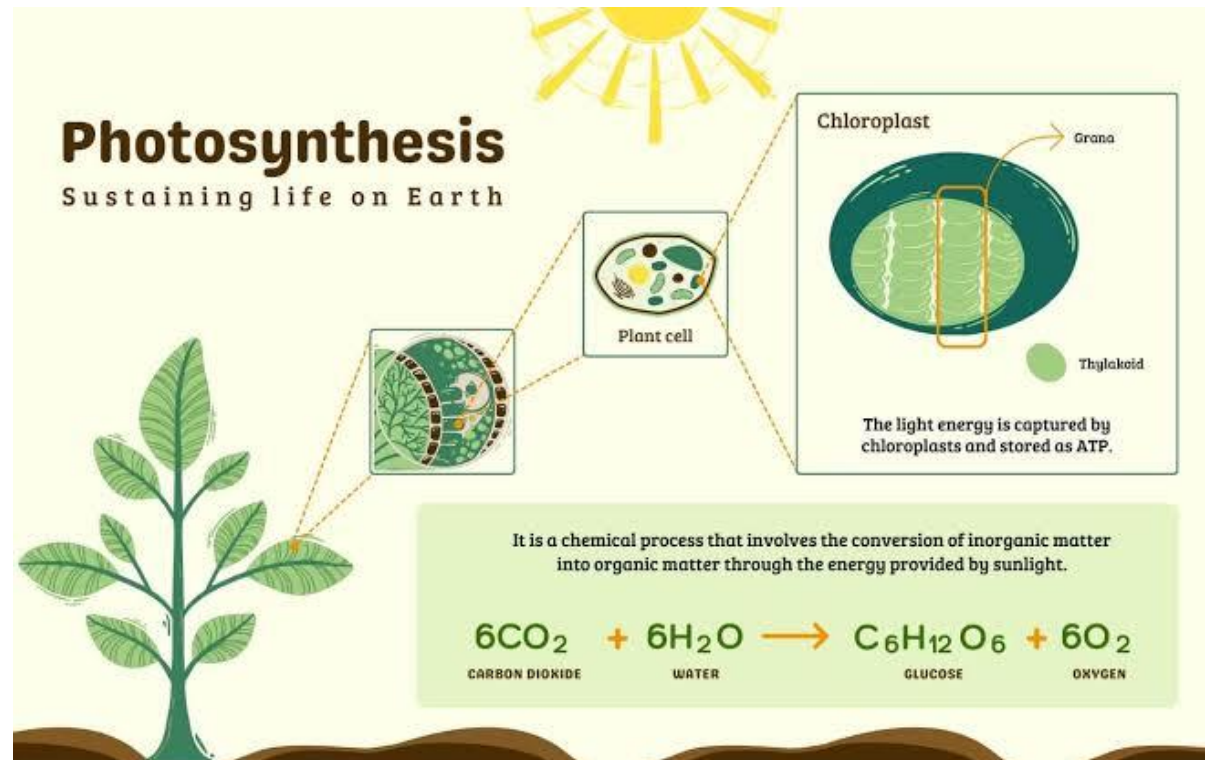
REQUIREMENTS	PRODUCTS
Carbon dioxide – (from atmosphere)	Food in form of glucose/starch
Water – (from soil/ground)	Oxygen – (by-product, released into the atmosphere)
Radiant energy– (from the sun)	
Chlorophyll – (found in the chloroplast)	
Enzymes – (found in the stroma)	





Photosynthesis occurs in chloroplasts

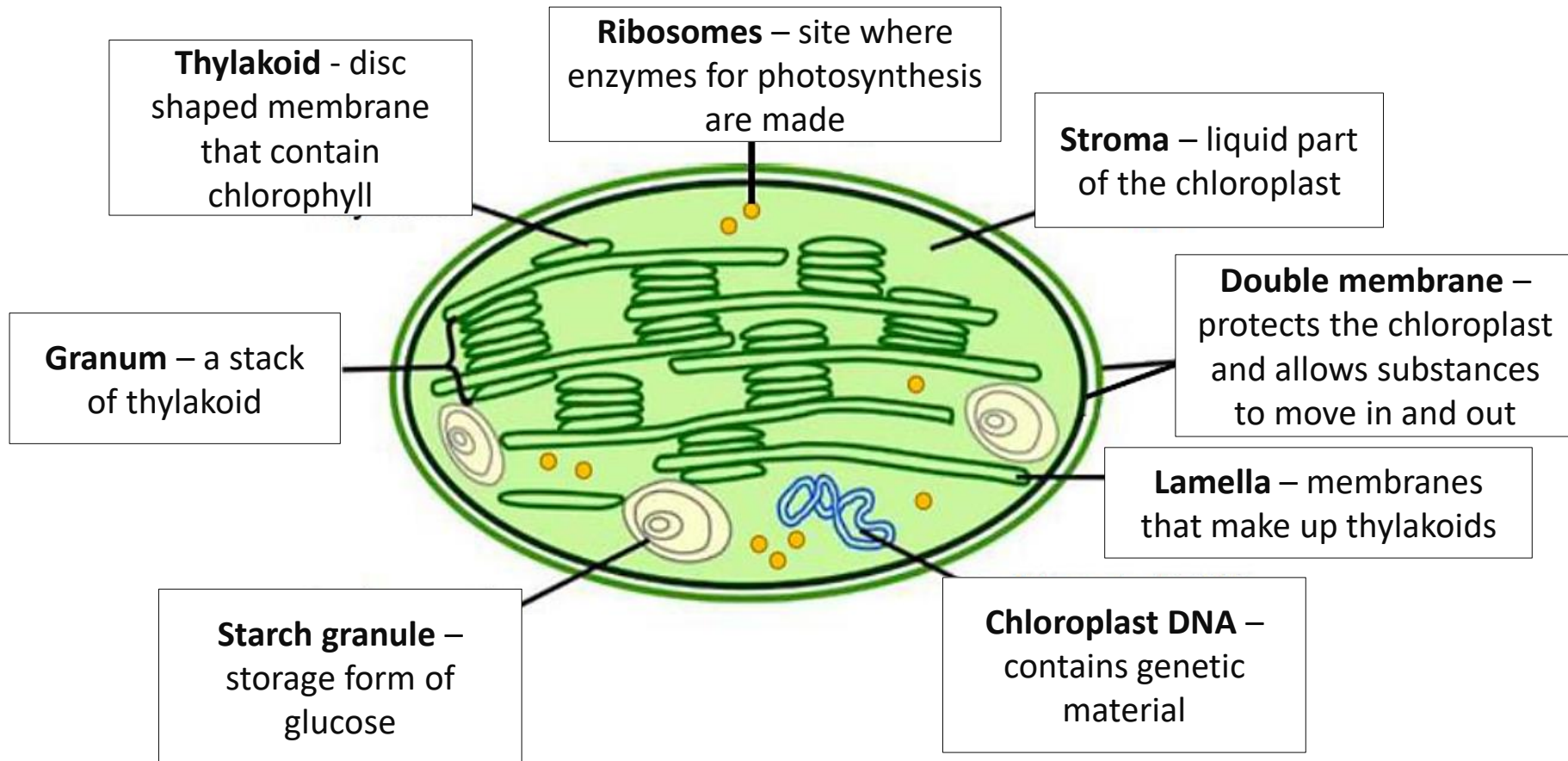
- In most plants, photosynthesis occurs primarily in the **leaves**, in the chloroplasts
- A chloroplast contains:
 - stroma
 - grana
- The thylakoids contain chlorophyll
 - **Chlorophyll** is the green pigment that captures light for photosynthesis





chloroplast

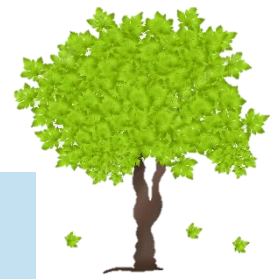
Photosynthesis occurs in the **chloroplast** of plant cells



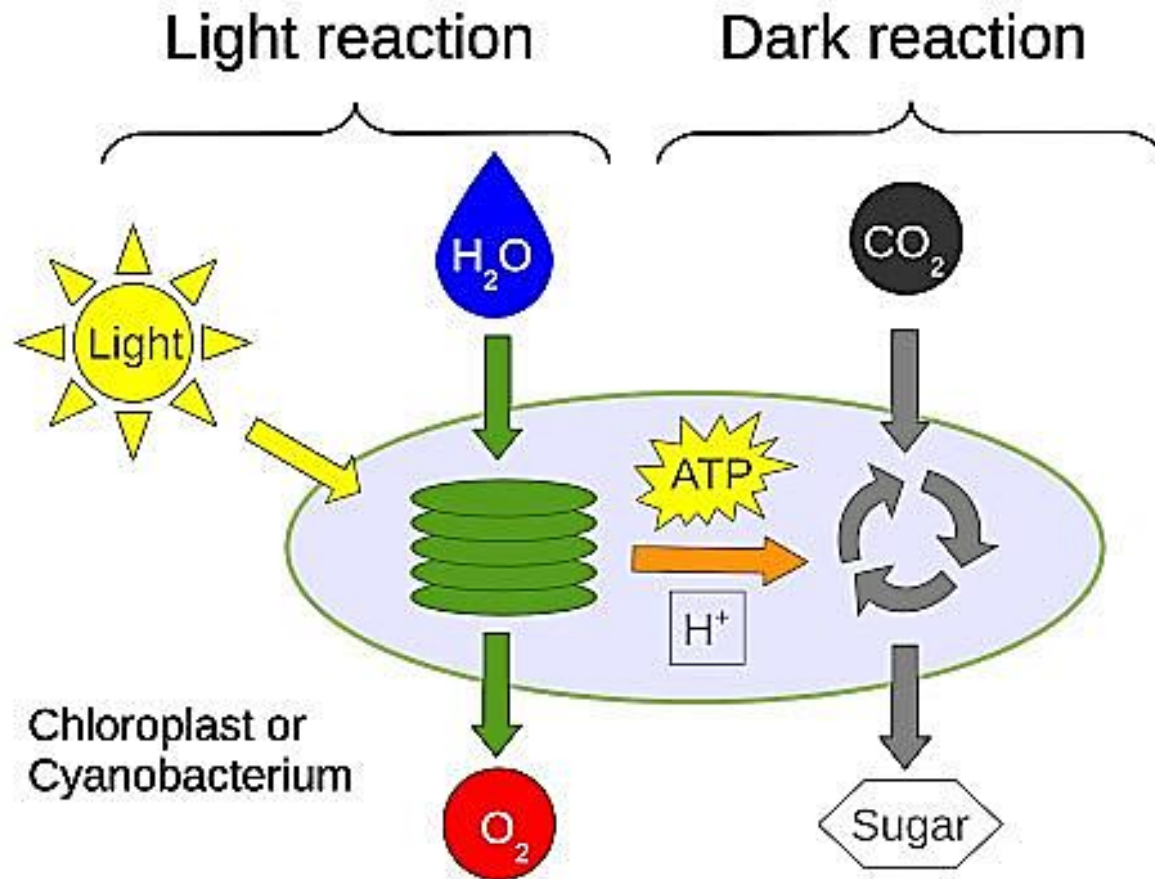


LIGHT PHASE VS DARK PHASE

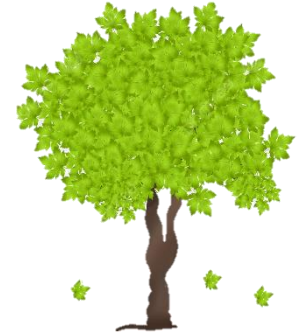
Light dependent phase	Light dependent phase
Occurs in the grana	Occurs in the stroma
Light is required	Light is not required
Radiant energy is absorbed and used for the reactions of photolysis & phosphorylation	Carbon dioxide is absorbed from the atmosphere
Photolysis occurs: hydrogen is released, and oxygen is returned to the atmosphere	Hydrogen and carbon dioxide combine by using ATP to form glucose
Phosphorylation occurs: ATP is produced	Excess glucose is stored as starch



LIGHT PHASE VS DARK PHASE

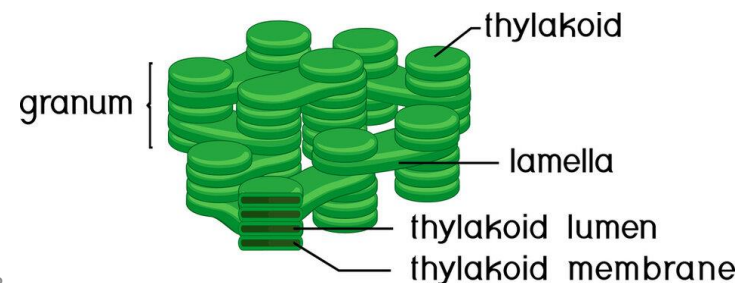


LIGHT PHASE VS DARK PHASE



LIGHT PHASE

- The light phase of photosynthesis takes place in the **grana** of chloroplasts.
- Radiant energy from the sun is absorbed by chlorophyll in the grana and transformed into chemical energy.
- Chemical energy is used to split water molecules (H_2O) into energy -rich hydrogen atoms (H) and oxygen atoms (O). The process is known as **photolysis**.
- Energy rich hydrogen atoms are transferred to the dark phase.
- Oxygen is released into the atmosphere.
- Radiant energy also causes the energy carrier ATP to be formed which will be used in the dark phase.



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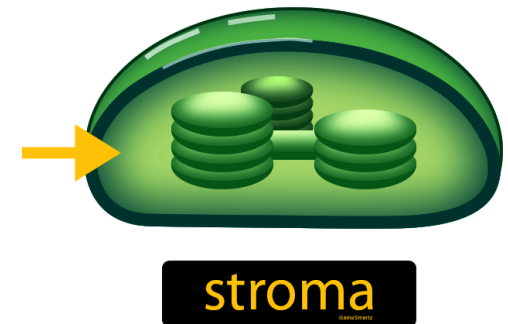


LIGHT PHASE VS DARK PHASE

DARK PHASE

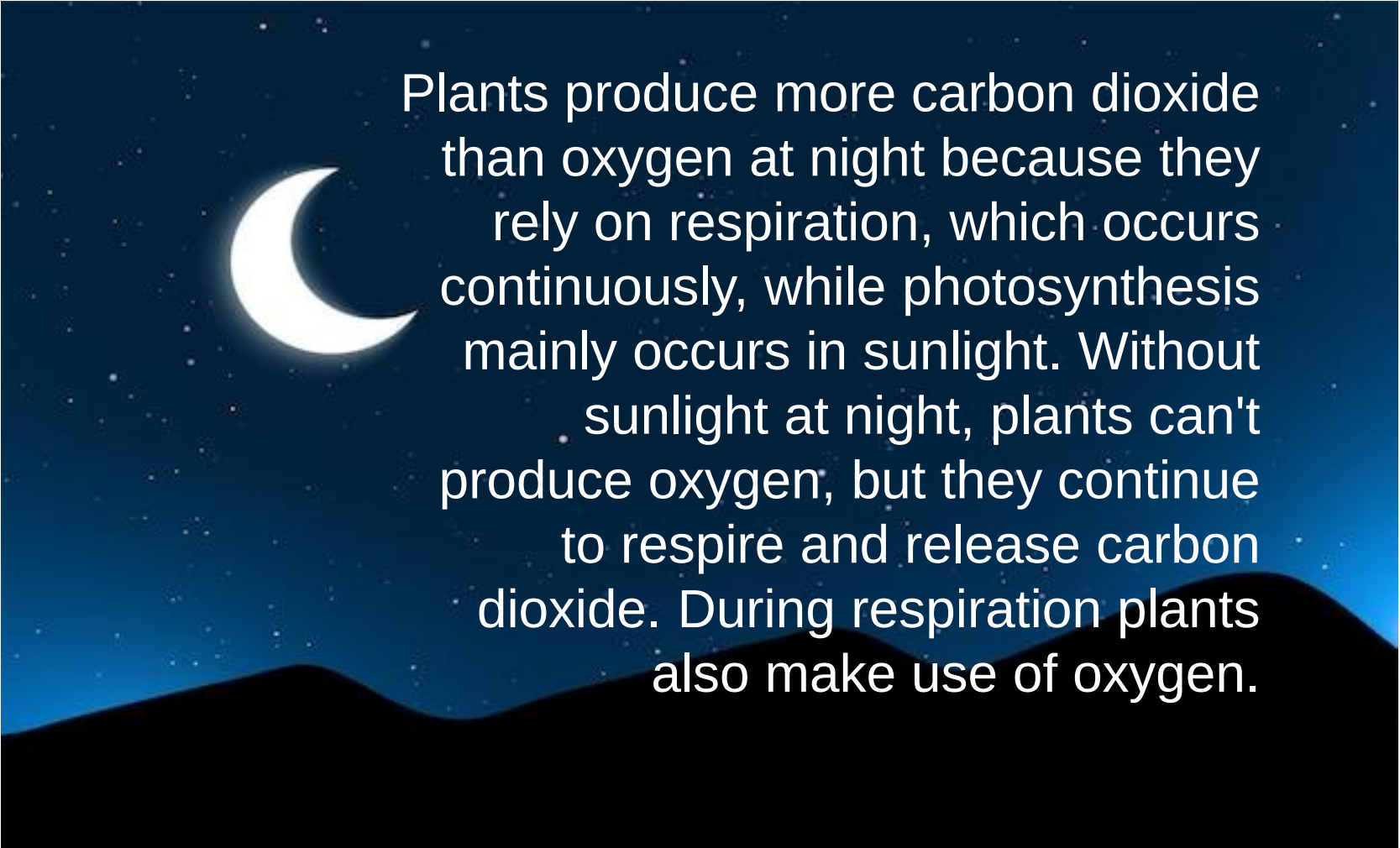
- The dark phase of photosynthesis takes place in the **stroma** of chloroplasts.
- Carbon dioxide is absorbed from the atmosphere and combines with the energy-rich hydrogen atoms from the light phase using the energy that is released from ATP.
- Energy-rich carbohydrates (glucose) are formed.
- Excess glucose is stored as starch.

The fluid portion
of a chloroplast





PHOTOSYNTHESIS AT NIGHT

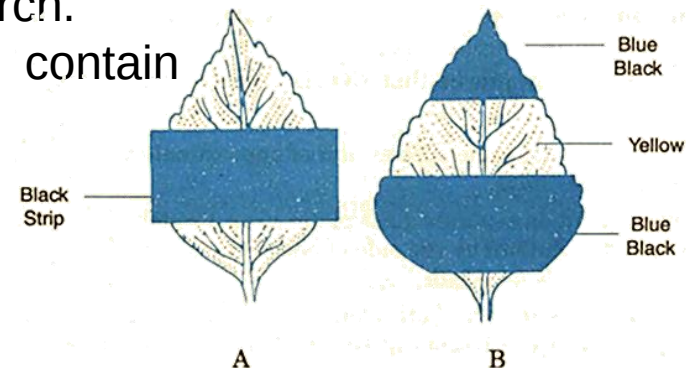


Plants produce more carbon dioxide than oxygen at night because they rely on respiration, which occurs continuously, while photosynthesis mainly occurs in sunlight. Without sunlight at night, plants can't produce oxygen, but they continue to respire and release carbon dioxide. During respiration plants also make use of oxygen.



EXPERIMENT SHOWING THAT LIGHT IS NECESSARY FOR PHOTOSYNTHESIS

- Destarch a potted plant by placing it in a dark cupboard for 48 hours
- Cover a portion of the leaf, still attached to the plant, with tinfoil
- Place the plant in a sunny area for 48 hours
- Pick the leaf and remove the foil
- Test for the presence of starch using iodine.
- The iodine solution remains light brown in the leaf covered with tin foil.
- The iodine solution turns blue-black in the parts that were left uncovered.
- The parts that turn blue-black in colour contain starch.
- The part which remains light brown does not contain starch.





EXPERIMENT SHOWING THAT LIGHT IS NECESSARY FOR PHOTOSYNTHESIS

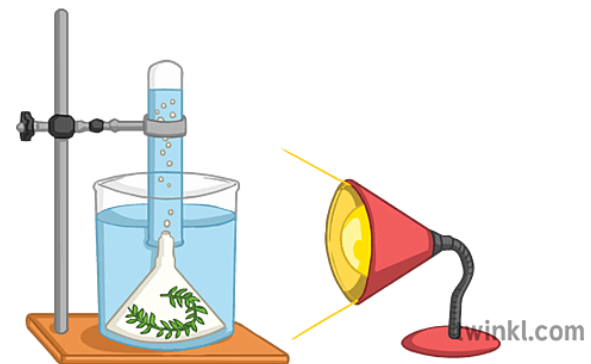
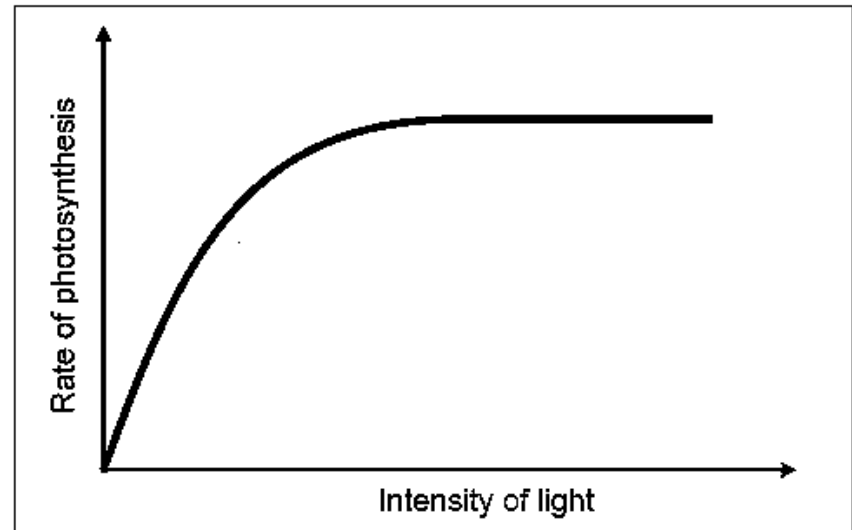




EFFECT OF LIGHT INTENSITY ON THE RATE PHOTOSYNTHESIS

Light intensity

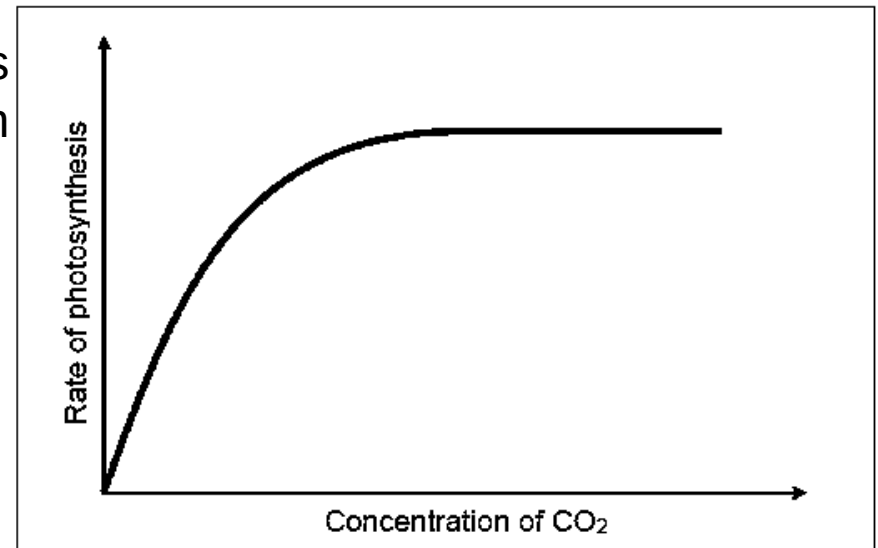
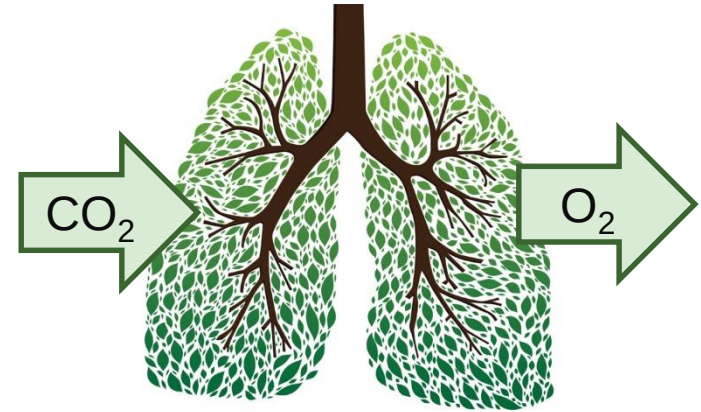
- At low light intensity, the rate of photosynthesis is low.
- As light intensity increases, the rate of photosynthesis also increases. This will happen up to a certain point.
- If light intensity increases above the optimum, the rate of photosynthesis will remain constant.
- Factors such as carbon dioxide become limiting factors which reduces the rate of photosynthesis.



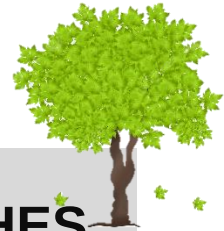
EFFECT OF CARBON DIOXIDE CONCENTRATION ON THE RATE OF PHOTOSYNTHESIS

Carbon dioxide (CO₂) concentration

- At a low carbon dioxide concentration, the rate of photosynthesis is low.
- As the carbon dioxide concentration level increases, the rate of photosynthesis also increases.
- This will happen up to a certain point.
- If the carbon dioxide concentration is higher than the optimum amount, then photosynthesis will remain constant.



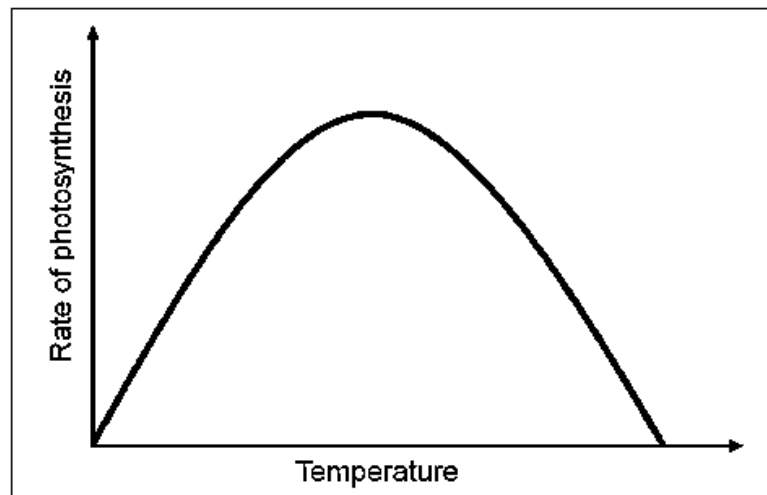
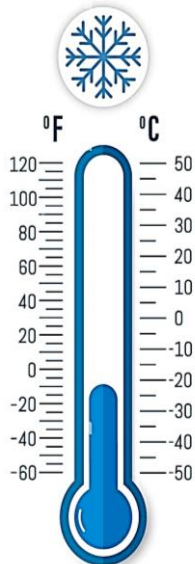
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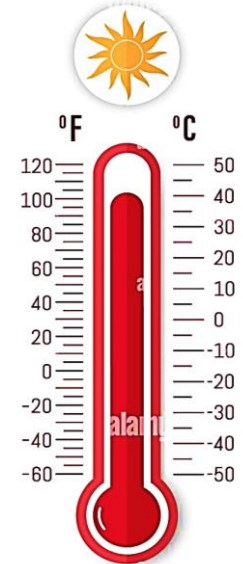
EFFECT OF TEMPERATURE ON THE RATE OF PHOTOSYNTHESIS

Temperature

- When temperature is low, the rate of photosynthesis is low.
- As temperature increases, the rate of photosynthesis also increases.
- If the temperature is higher than the optimum amount, then the rate of photosynthesis will decrease.
- This is because the enzymes used in the process will denature at high temperatures and will no longer function.
- At low temperatures enzymes become inactive.



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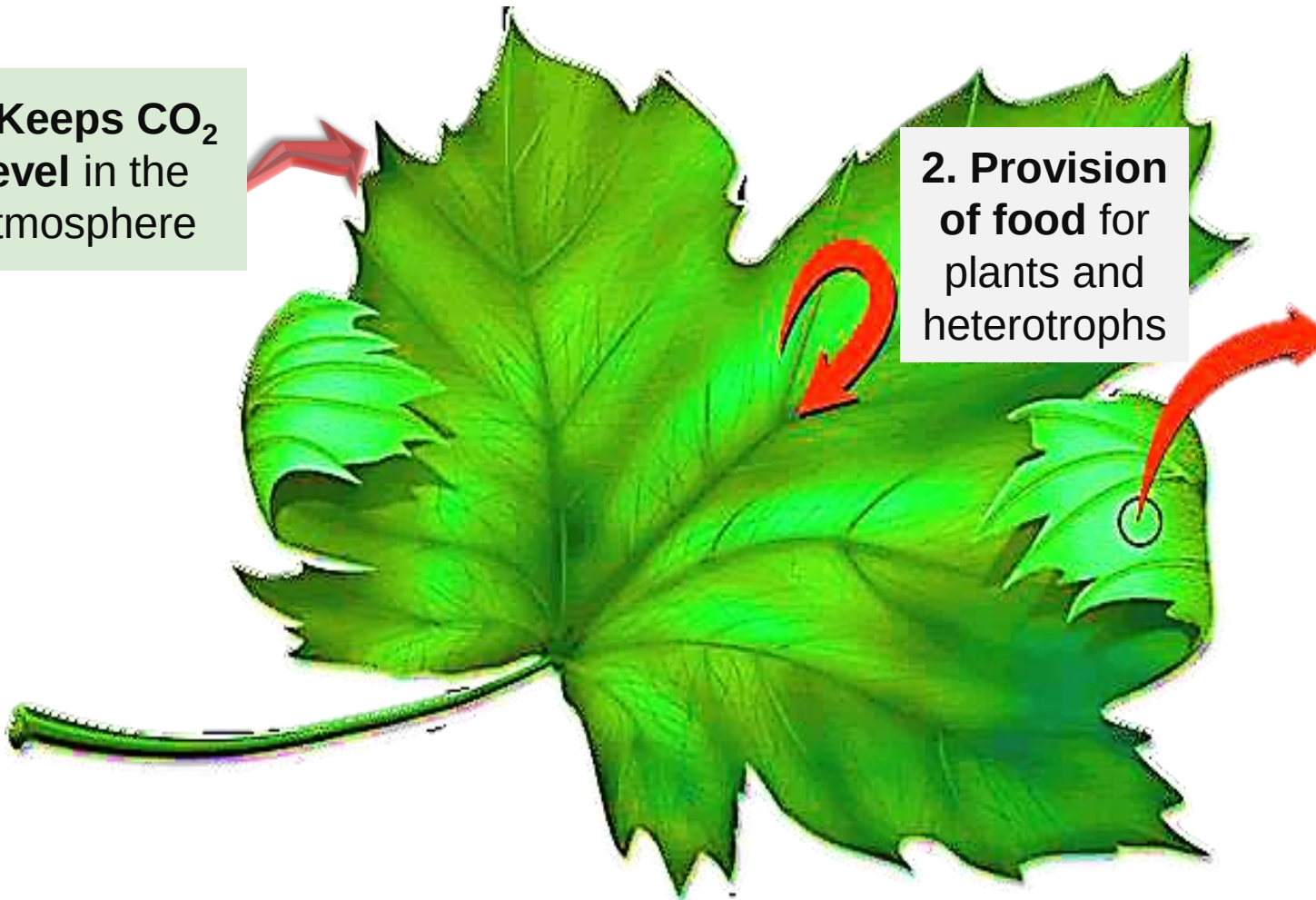
IMPORTANCE OF PHOTOSYNTHESIS



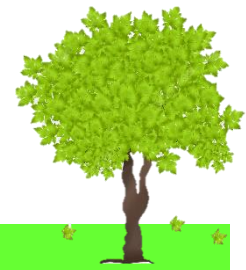
1. Keeps CO₂ level in the atmosphere

2. Provision of food for plants and heterotrophs

3. Keeps O₂ level in the atmosphere



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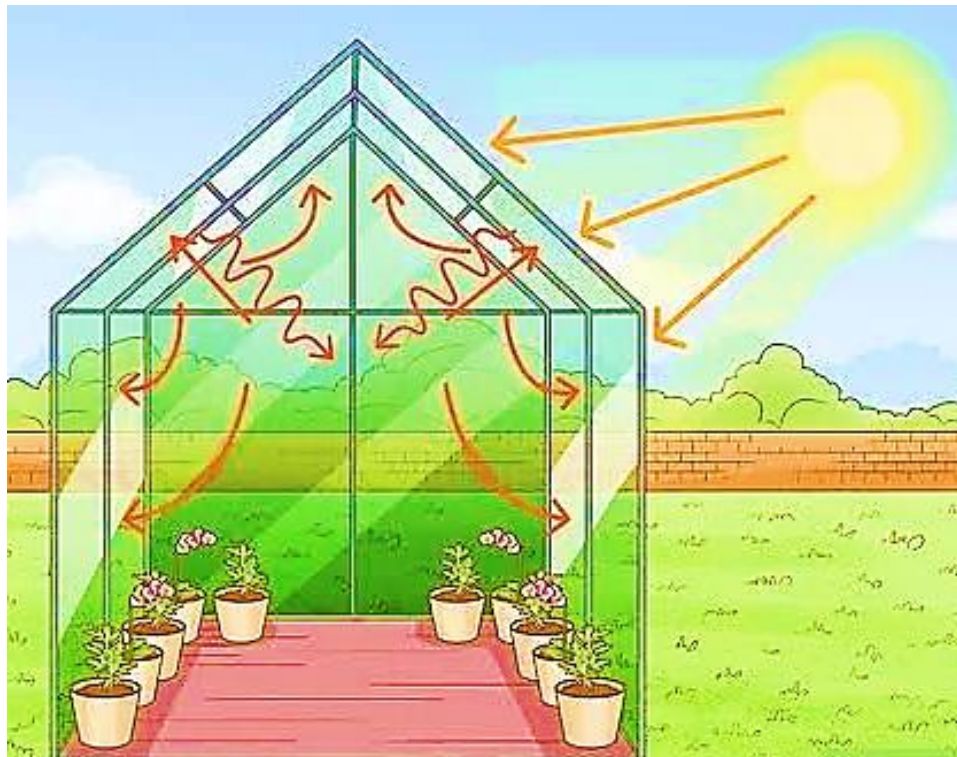


PHOTOSYNTHESIS IN A GREENHOUSE

Greenhouse - A glass or plastic structure that traps heat and allows light to enter, used to grow plants

The conditions can be manipulated in a greenhouse in order to promote photosynthesis:

- Carbon dioxide concentration
- Light intensity
- Temperature



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PHOTOSYNTHESIS: TERMINOLOGY

- **Oxygen** – gas released as a by-product of photosynthesis
- **Carbon dioxide** – gas absorbed by plants, used during photosynthesis
- **Heterotrophs** – organisms that cannot manufacture their own food
- **Autotrophic** – organisms with the ability to manufacture their own food
- **Chloroplast** – organelle found only in plants cells where photosynthesis occurs
- **Chlorophyll** – green pigment found in the chloroplast, traps radiant energy during photosynthesis
- **Destarching** – removal of starch from a leave by placing it in a dark cupboard
- **Greenhouse** – specialised building that traps radiant energy from the sun
- **Iodine** – chemical reagent used to test for the presence of starch
- **Grana** – stacks of thylakoids where light phase of photosynthesis
- **Stroma** – site of light independent reactions of photosynthesis in the chloroplast
- **Greenhouse** – a glass or plastic structure that traps heat and allows light to enter, used to grow plants
- **Greenhouse effect** – phenomenon where heat from the sun is trapped on Earth's atmosphere

THANK YOU

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