

Unit 3: A Level Biology

Photosynthesis 2

The light independent reaction

- The Calvin cycle

1. In the stroma, the 5C compound ribulose biphosphate takes up carbon dioxide to form an unstable 6C compound. This reaction is catalysed by the enzyme RUBISCO.

2. The carbon dioxide can be described as 'fixed' as it has been converted from a gas into a solid carbohydrate compound.

3. The unstable 6C compound immediately breaks down into 2x 3C compounds called glycerate-3-phosphate.

4. Glycerate-3-phosphate is reduced by reduced NADP and using energy from ATP (both received from the light dependent cycle) the 2x 3C glycerate-3-phosphate are converted into 2x 3C carbohydrates called triose phosphate.

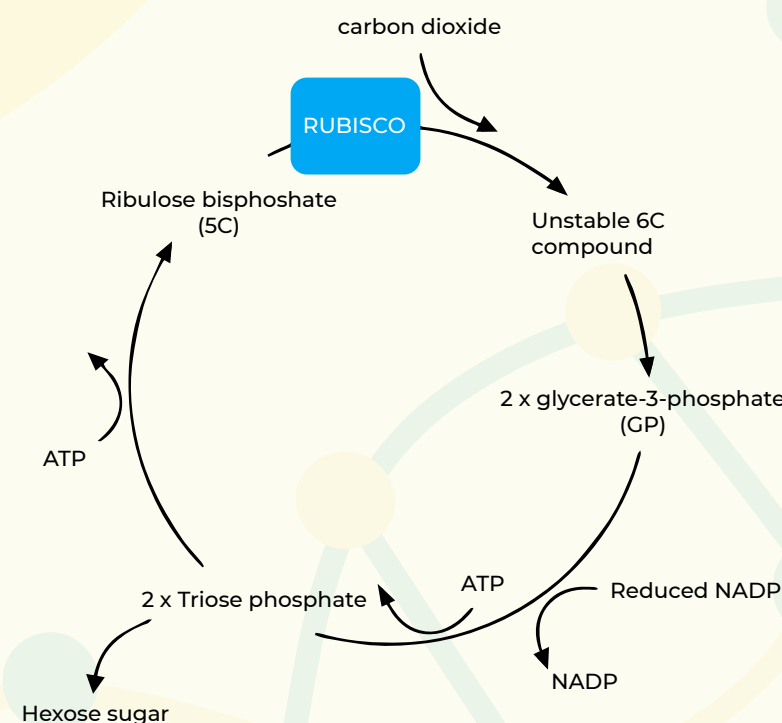
5. 1C from the triose phosphates will be used to create a hexose sugar, the other 5C form ribulose phosphate which is regenerated to ribulose biphosphate using ATP, and the cycle begins again.

Products of the Calvin cycle

The hexose sugar produced is glucose (actually fructose biphosphate).

Lipids are also produced from triose phosphate.

Amino acids are produced using nitrogen from nitrates.



Essential minerals

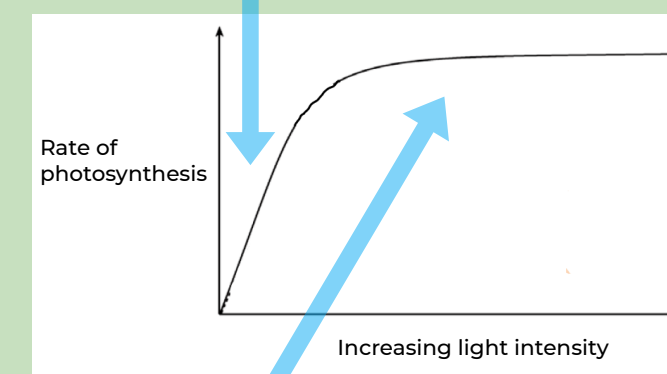
Mineral	Function	Deficiency
Nitrogen	Synthesis of proteins, nucleic acids and chlorophylls	Reduced growth of all organs and yellowing of leaves (chlorosis)
Magnesium	Chlorophyll production	Yellowing of the leaves (chlorosis)

Limiting factors

The rate of a physiological process will be **limited** by the factor in shortest supply.

Light intensity

Light intensity is limiting the rate here as when the light intensity increases, the rate also increases.



Another factor is limiting the rate of photosynthesis as no further increase in light intensity has an effect.

Carbon dioxide

Carbon dioxide can be described as a limiting factor as when in short supply the process of photosynthesis is limited. Any increase in this factor will increase the rate of photosynthesis until a different factor becomes limiting.

Temperature

As there are enzymes involved in the process (ATP synthetase, ATPase, Rubisco) and any increase in temperature leading to an increase in kinetic energy of molecules will lead to increased successful collisions and an increased rate of reaction. Therefore, low temperatures will limit the reaction and increases in temperature above the optimum can cause denaturation of enzymes that similarly limits the rate.