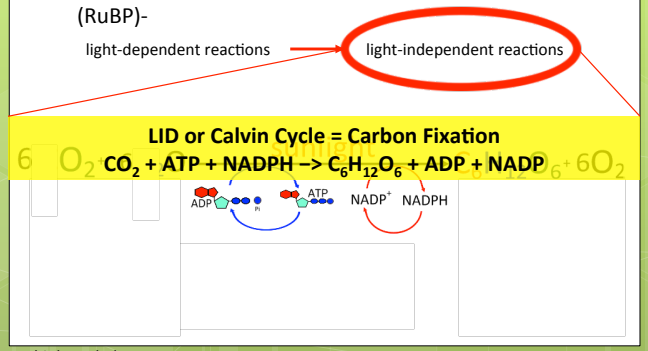
VIII. Carbon Fixation

A. In the light-independent reactions a carboxylase catalyzes the carboxylation of ribulose bisphosphate (RuBP)-



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VIII. Carbon Fixation

B. Carbon dioxide is the source of carbon for carbon fixation.
   1. Occurs in the stroma with large amounts of the enzyme rubisco which catalyzes the reaction
   2. Carbon dioxide is carboxylated with a 5 C ribulose bisphophate (RuBP)
   3. RuBP breaks down to two 3 C molecules called glycerate 3-phosphate (G3P)

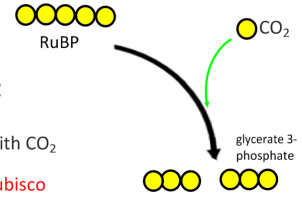
IX. The Role of Reduced NADP and ATP in the Calvin Cycle

A. Glycerate 3-phosphate is reduced to triose phosphate using reduced NADP and ATP-
   1. In order to make carbohydrates and continue the Calvin cycle G3P must be reduced by adding hydrogen
   2. G3P is reduced by ATP and NADPH produced by the LDR
   3. The product is 3 C triose phosphate

X. The Fate of Triose Phosphate & RuBP Regeneration

A. Triose phosphate is used to regenerate RuBP and produce carbohydrates
B. Ribulose bisphophate is reformed using ATP-
   1. The 3 C triose phosphate is the first carbohydrate of the LDR
   2. Two triose phosphate can be combined to form a 6 C hexose phosphate
   3. Hexose phosphate, through condensation, can be formed into starch
   4. In general, 6 turns of the Calvin cycle are needed to produce one hexose sugar
   5. Using enzymes and ATP, triose phosphate is converted to RuBP
   6. Five triose phosphates are needed to regenerate RuBP to continue the Calvin cycle

Stroma



Carbon Fixation:

RuBP is carboxylated with CO_2

Catalysed by enzyme rubisco

The 6C product immediately splits into 2x glycerate 3-phosphate

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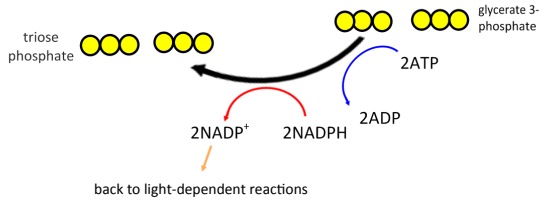
Reduction of glycerate 3-phosphate

Stroma



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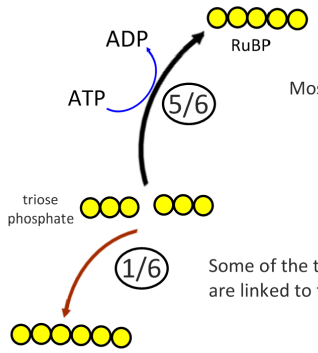
Stroma



Most of the triose phosphate produced is used to regenerate RuBP.

Some of the triose phosphate molecules are linked to form glucose phosphate.

starch (by condensation)

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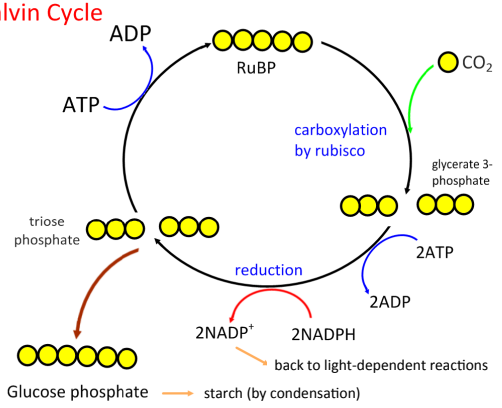
Calvin Cycle

Stroma



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Calvin's experiment used Chlorella algae which was placed in a thin glass vessel (called the lollipop vessel).

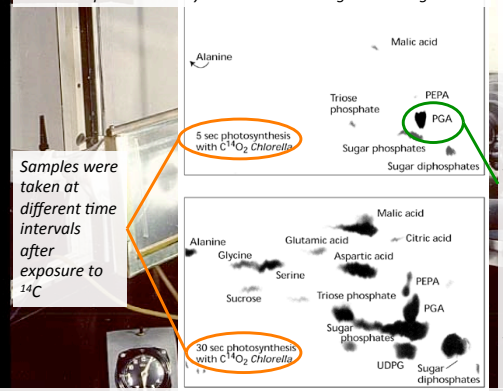
The Algae was given plenty of light, carbon dioxide (CO_2) and hydrogen carbonate (HCO_3^-) containing normal carbon (^{12}C).

At the start of the experiment the carbon compounds were replaced with compounds containing radioactive carbon (^{14}C).

Samples of algae were taken at different time intervals.

The carbon compounds were separated by chromatography and the compounds containing ^{14}C identified by autoradiography.

Calvin's experiment analyzed the results using autoradiograms



Samples were taken at different time intervals after exposure to ^{14}C

After only 5 seconds there is more labelled glycerate 3-phosphate than any other compound. This indicates that glycerate 3-phosphate is the first product of carbon fixation

After 30 seconds a range of different labeled compounds occur showing the intermediate and final products of the light-independent reactions

Calvin's experiment and discoveries were only possible due to improvements in technology.

- *The discovery of ^{14}C in 1945 by Kamen and Ruben*
- *The use of Autoradiography to produce patterns of radioactive decay emissions (autoradiograms)*

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