WHERE ARE THE ATP AND NADPH USED?

In the intricate choreography of photosynthesis, the products of the light reaction, namely ATP and NADPH, step into the limelight during the assimilation of CO_2 into carbohydrates. This captivating performance unfolds in the stroma of the chloroplast, where an ensemble of enzymes orchestrates the biosynthetic phase of photosynthesis. Unlike the initial phases, this process doesn't hinge directly on the presence of light but relies on the indispensable contributions of ATP and NADPH forged in the light reaction.

- The term "dark reaction" proves misleading, as this biosynthetic spectacle persists for a duration even after light fades away, only to gracefully halt. Yet, with the resurgence of light, the synthesis rekindles its celestial dance. The biosynthetic phase, synonymous with the Calvin cycle, showcases its elegance, while certain plants find support in the C_1 cycle or Crassulacean Acid Metabolism (CAM).

Primary Acceptor of CO_2

The luminary orchestrator of CO_2 fixation is none other than RuBisCO, a ubiquitous enzyme crowned as the most abundant on Earth. This enzyme, Ribulose Bisphosphate Carboxylase Oxygenase, showcases an unparalleled versatility, with its active site accommodating both CO_2 and O_2. The ballet of gases unfolds as a competitive engagement, dictated by the relative concentrations of O_2 and CO_2, determining RuBisCO's binding partner.

Evolutionary Revelation: The Five-Carbon Guardian

In a scientific narrative evolution, the revelation of the primary acceptor, a five-carbon ketose sugar called Ribulose bisphosphate (RuBP), reshaped our understanding. Contrary to the initial belief in a two-carbon compound, the embrace of a five-carbon sentinel marked a paradigm shift in the choreography of carbon assimilation.

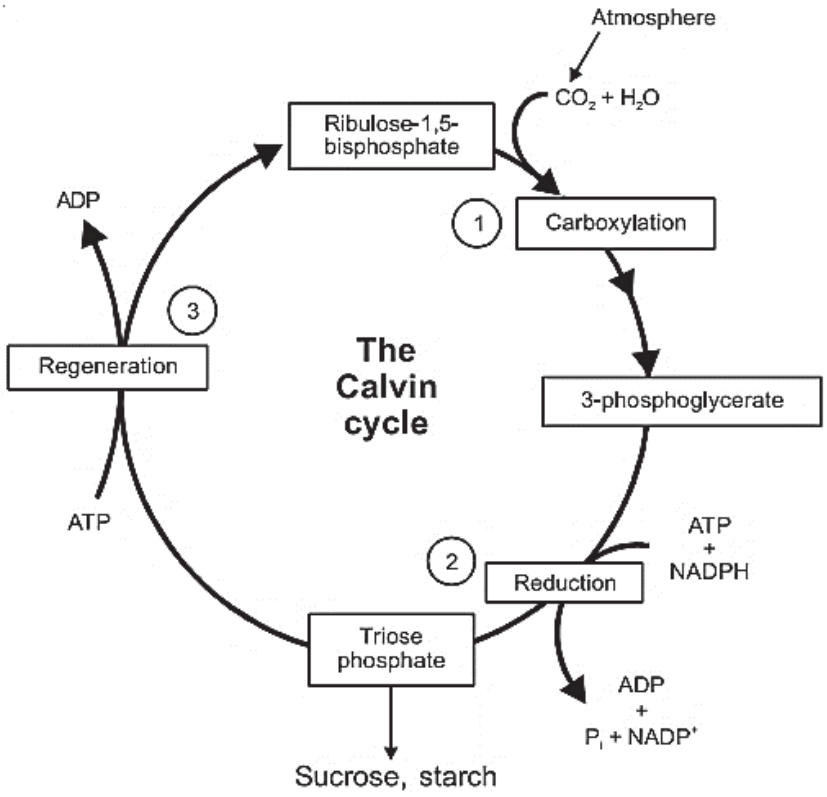
The Calvin Cycle:

Melvin Calvin, a luminary in the realm of algal photosynthesis, unraveled the melody of the Calvin cycle through his ingenious use of radioactive 14C. The discovery that the inaugural CO_2 fixation product was a three-carbon organic acid marked a paradigm shift. Named after its architect, the Calvin Cycle revolves around the primary acceptor molecule, a five-carbon ketose sugar known as Ribulose bisphosphate (RuBP). The protagonist enzyme, RuBisCO (Ribulose Bisphosphate Carboxylase Oxygenase), emerges as the most abundant enzyme on Earth, captivating scientists with its dual affinity for CO_2 and O_2 in a competitive embrace.

Stages of Calvin Cycle:

- **Carboxylation:** The cycle's opening act, carboxylation, witnesses the fixation of CO_2 into the stable organic intermediate, facilitated by RuBisCO. This captivating reaction results in the formation of two enchanting molecules of 3-phosphoglyceric acid (PGA).
- **Reduction:** The second act, reduction, serves as the genesis of glucose, guided by the rhythmic utilization of two ATP molecules for phosphorylation and two NADPH molecules for reduction per CO_2 fixed. To gracefully usher out one molecule of glucose from the pathway, six CO_2 fixations and six turns of the cycle are indispensable.
- **Regeneration:** The final act, regeneration, is a vital encore to ensure the cycle's uninterrupted performance. This step demands one ATP for phosphorylation, sculpting RuBP into its regenerative form. Each molecule of glucose demands eighteen ATP and twelve NADPH molecules, requiring six turns of the cycle. The cyclic phosphorylation takes center stage, harmonizing the difference in the number of ATP and NADPH for each CO_2 molecule entering the Calvin cycle.

In this breathtaking biosynthetic ballet, ATP and NADPH, the maestros of energy transformation, guide the symphony of carbon fixation, weaving the intricate fabric of life through the enchanting Calvin cycle.



Summary of Calvin cycle :

In	Out
6 CO_2	1 Glucose
18 ATP	18 ADP
12 NADPH	12 NADP