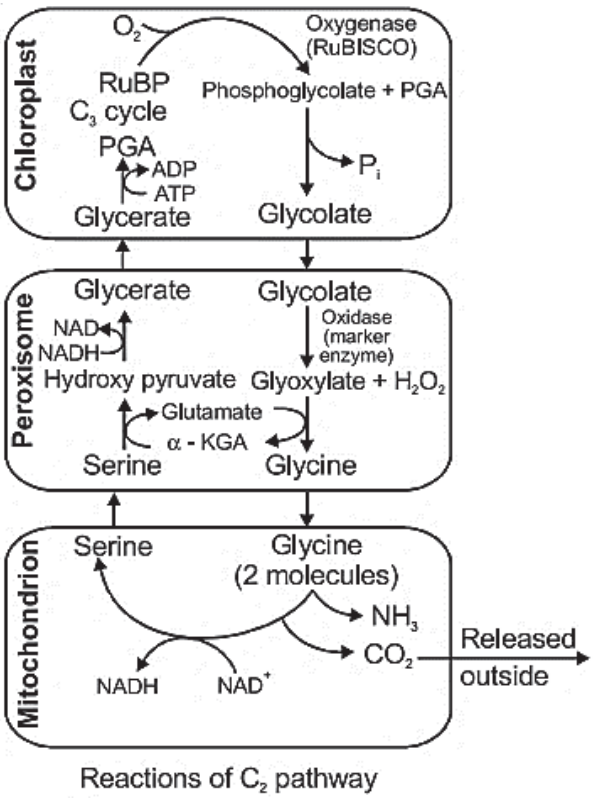
PHOTORESPIRATION:

- Photorespiration, a paradoxical dance within the chloroplasts of plants, unfolds as a process that siphons off fixed carbon as CO_2 in the presence of light. Despite its initiation within the chloroplasts, this intricate ballet lacks the grace of ATP or NADPH production, rendering it a conspicuously wasteful endeavor.
- The choreography of photorespiration typically ensues in environments characterized by elevated oxygen concentrations. In such conditions, RuBisCO, the pivotal enzyme orchestrating the carboxylation of Ribulose-1, 5-bisphosphate (RuBP) during the initial phase of the Calvin cycle, takes an unintended detour, acting as an oxygenase. As a consequence, a fraction of O_2 binds to RuBisCO, diminishing the efficiency of CO_2 fixation. This diversion prompts RuBP to join forces with O_2, yielding one molecule of phosphoglycolate (a 2C compound) and phosphoglycerate (a 3C compound) along the convoluted path of photorespiration. Alas, this intricate detour does not usher in the synthesis of sugar or ATP; instead, it exacts a toll by releasing CO_2 and consuming ATP. The toll is a hefty one, resulting in a 25 percent loss of the painstakingly fixed CO_2. The oxygen initially engages in the chloroplast before finding its way to the peroxisomes.



Reactions of C_2 pathway

- The intricate ballet of photorespiration, often referred to as the C_2 cycle, unfolds across three distinct organelles – chloroplasts, peroxisomes, and mitochondria. The final loss of CO_2 culminates in the mitochondria.
- In the realm of C_1 plants, a remarkable exemption unfolds, as they are immune to the nuances of photorespiration. This immunity emanates from a mechanism inherent in these plants, a mechanism that elevates the concentration of CO_2 at the enzyme site. As the C_4 pathway unfurls, with the breakdown of the C_1 acid in bundle sheath cells, CO_2 is liberated, bolstering the intracellular

concentration of CO_2. This strategic elevation ensures that RuBisCO predominantly acts as a carboxylase, minimizing its unwarranted oxygenase activity.

- The ramifications of this exemption are profound, with C_1 plants exhibiting superior productivity and yields compared to their C_3 counterparts. Furthermore, the resilience of C_4 plants extends to their capacity to endure higher temperatures, painting a portrait of adaptive brilliance in the intricate canvas of photosynthesis.