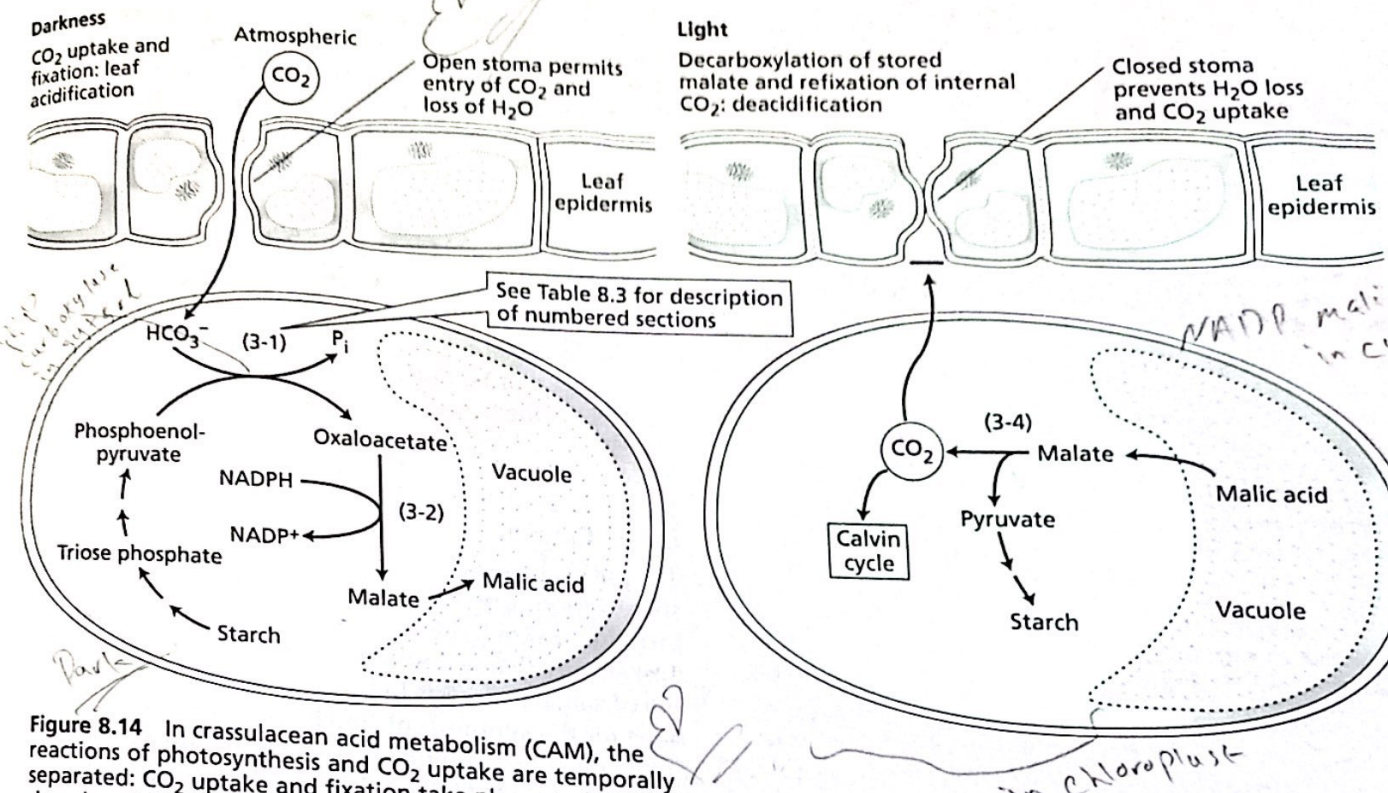

Figure 8.14 In crassulacean acid metabolism (CAM), the reactions of photosynthesis and CO_2 uptake are temporally separated: CO_2 uptake and fixation take place at night, and decarboxylation and refixation of the internally released CO_2 occur during the day. CAM is an adaptation primarily to minimize the quantity of water that is lost when stomata are opened to permit the entry of CO_2. In CAM plants, the stomata are opened in the cool of the night. CO_2 is fixed as malic acid, which is stored in the vacuole. As malic acid accumulates, the leaf vacuoles acidify in the dark. Upon illumination, the stomata close, and the leaf deacidifies. The malic acid is recovered from the vacuole and undergoes decarboxylation. The CO_2 that is released is prevented from escaping by stomatal closure and is assimilated via the Calvin cycle using photochemically generated ATP and NADPH.

CO_2 is captured by PEP carboxylase in the cytosol, and the malate that forms from the oxaloacetate product is stored in the vacuole (Figure 8.14). During the day, the stored malate is transported to the chloroplast and decarboxylated, and the released CO_2 is fixed by the Calvin cycle.

The Stomata of CAM Plants Open at Night and Close during the Day

CAM plants such as cacti achieve their high water use efficiency by opening their stomata during the cool desert nights and