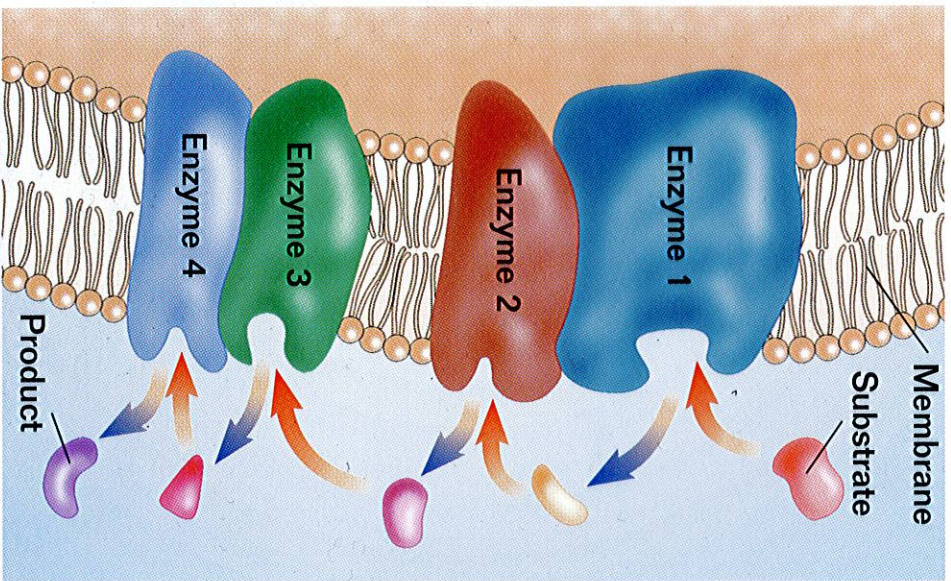


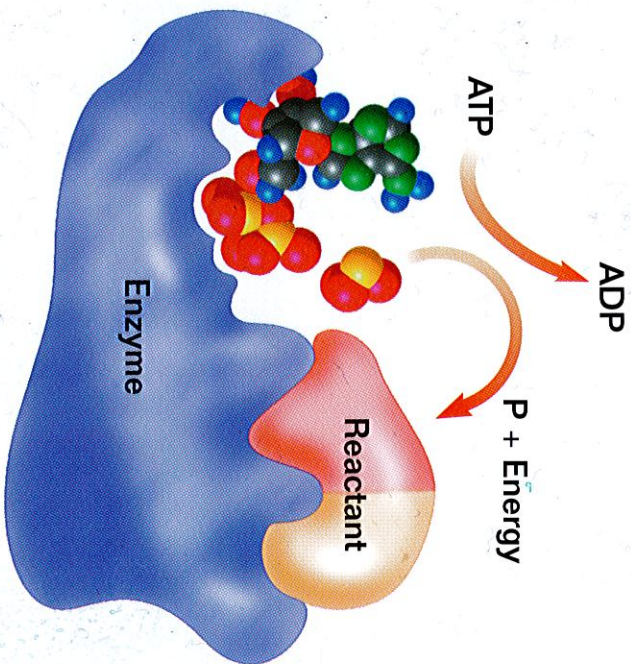
ATP  $\leftarrow$  ADP + energy + P  $\rightarrow$  ATP

*Biochemical Pathway and Coupled Reaction*



**Biochemical pathway**

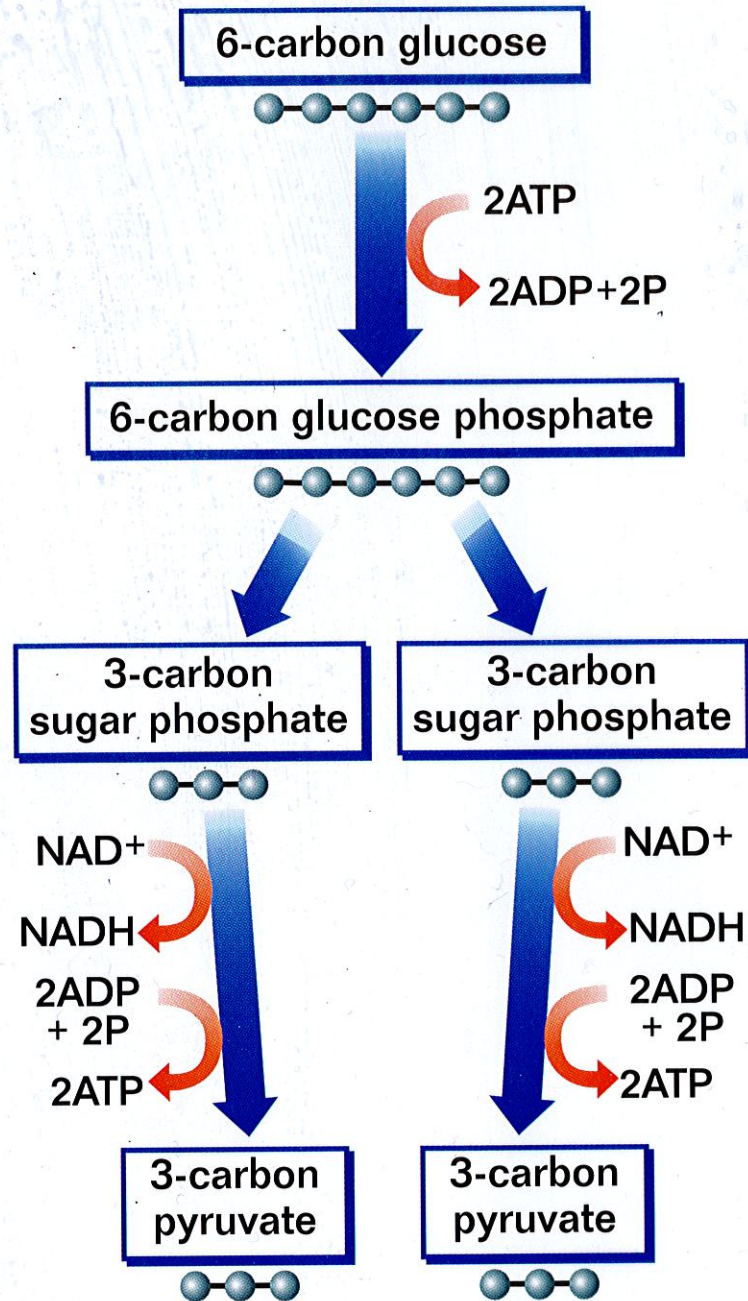
A biochemical pathway consists of a series of enzyme-catalyzed chemical reactions. The product of each reaction in a pathway becomes the reactant of the next reaction in the pathway.



**Coupled reaction**

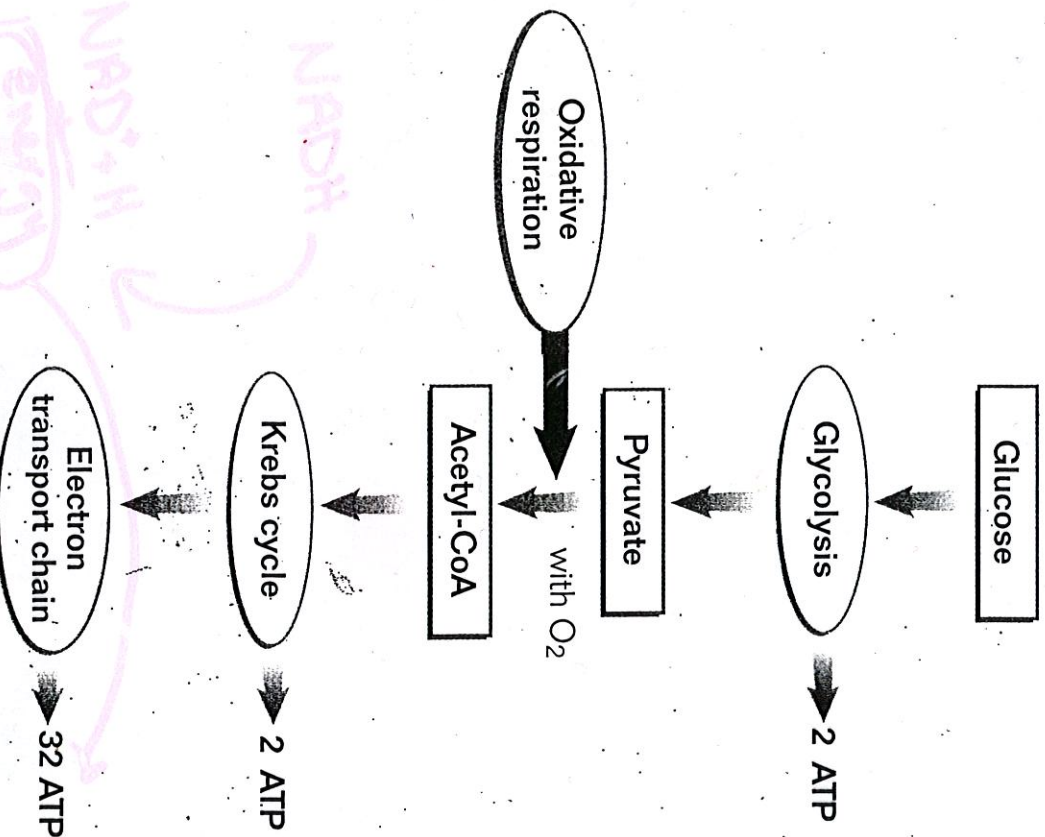
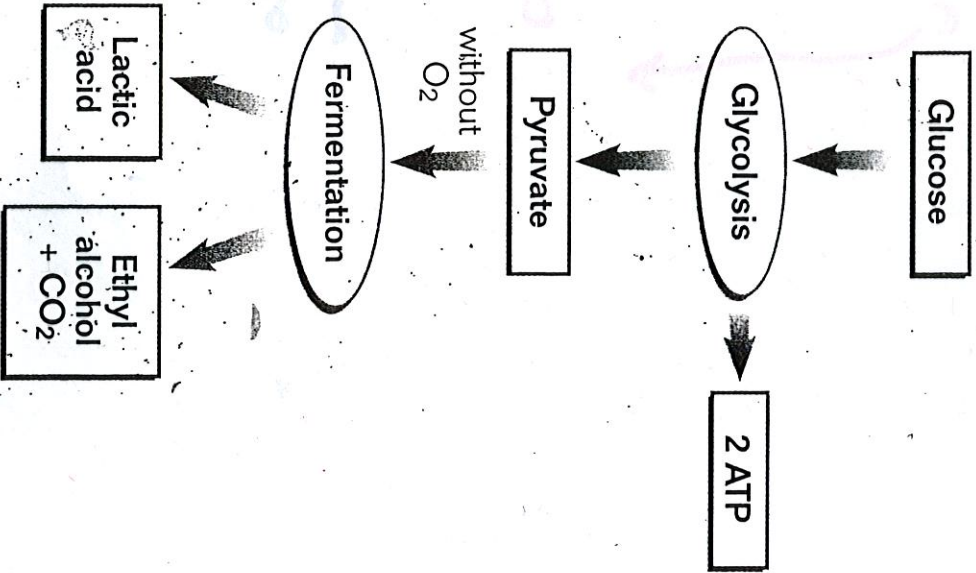
Coupling energy-requiring reactions with the splitting of ATP molecules is one of the key processes that help cells manage energy. The two parts of a coupled reaction (ATP-splitting and the endergonic reaction) take place in concert, separate parts of a single process.



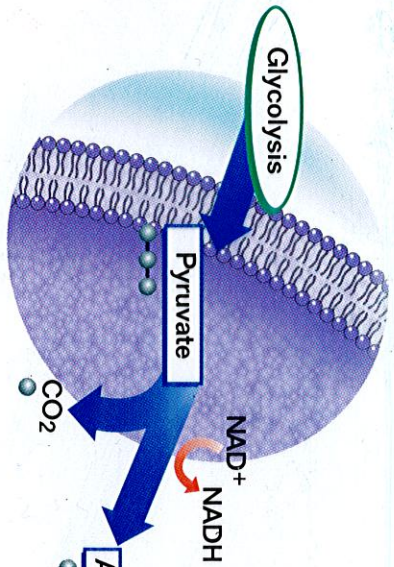


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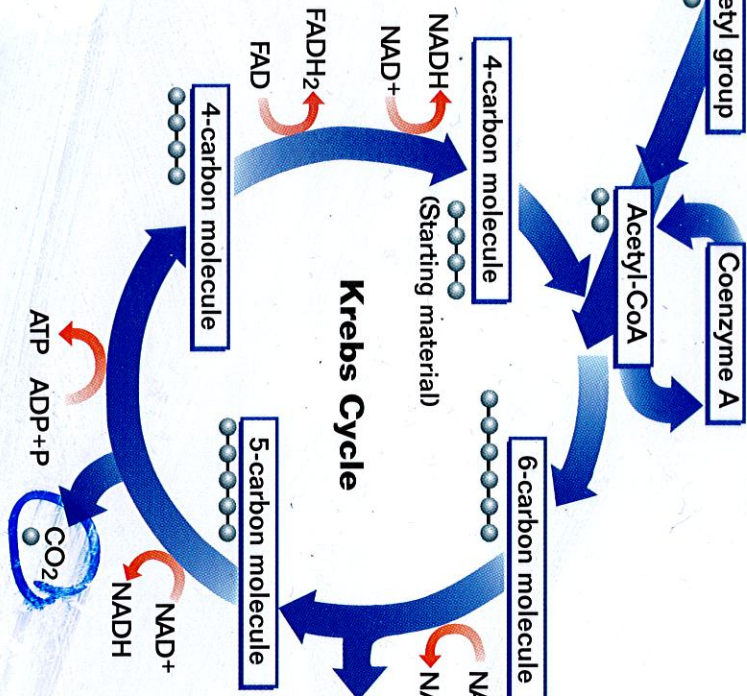
Two Pathways of Respiration







**1** The Krebs cycle begins when the two-carbon fragment of an acetyl-CoA is attached to a four-carbon molecule (the starting material).



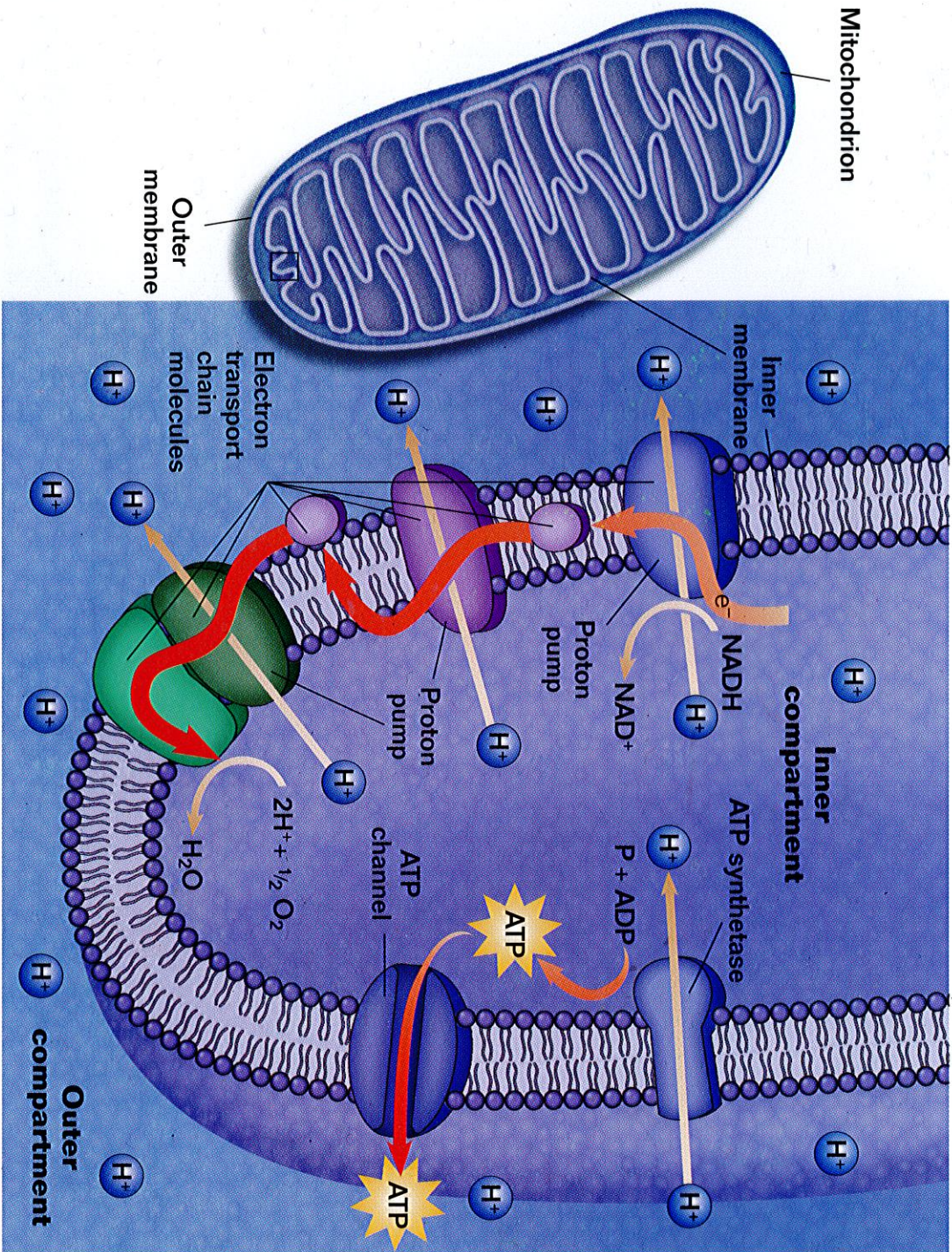
**2** The resulting six-carbon molecule is then oxidized as an  $\text{NAD}^+$  is reduced, forming  $\text{NADH}$ .  $\text{CO}_2$  is formed, removing a carbon atom.

**3** Next, the resulting five-carbon molecule is oxidized as another  $\text{NAD}^+$  is reduced, forming  $\text{NADH}$ . Another  $\text{CO}_2$  is formed, removing another carbon atom, and a coupled reaction generates ATP from ADP and P.

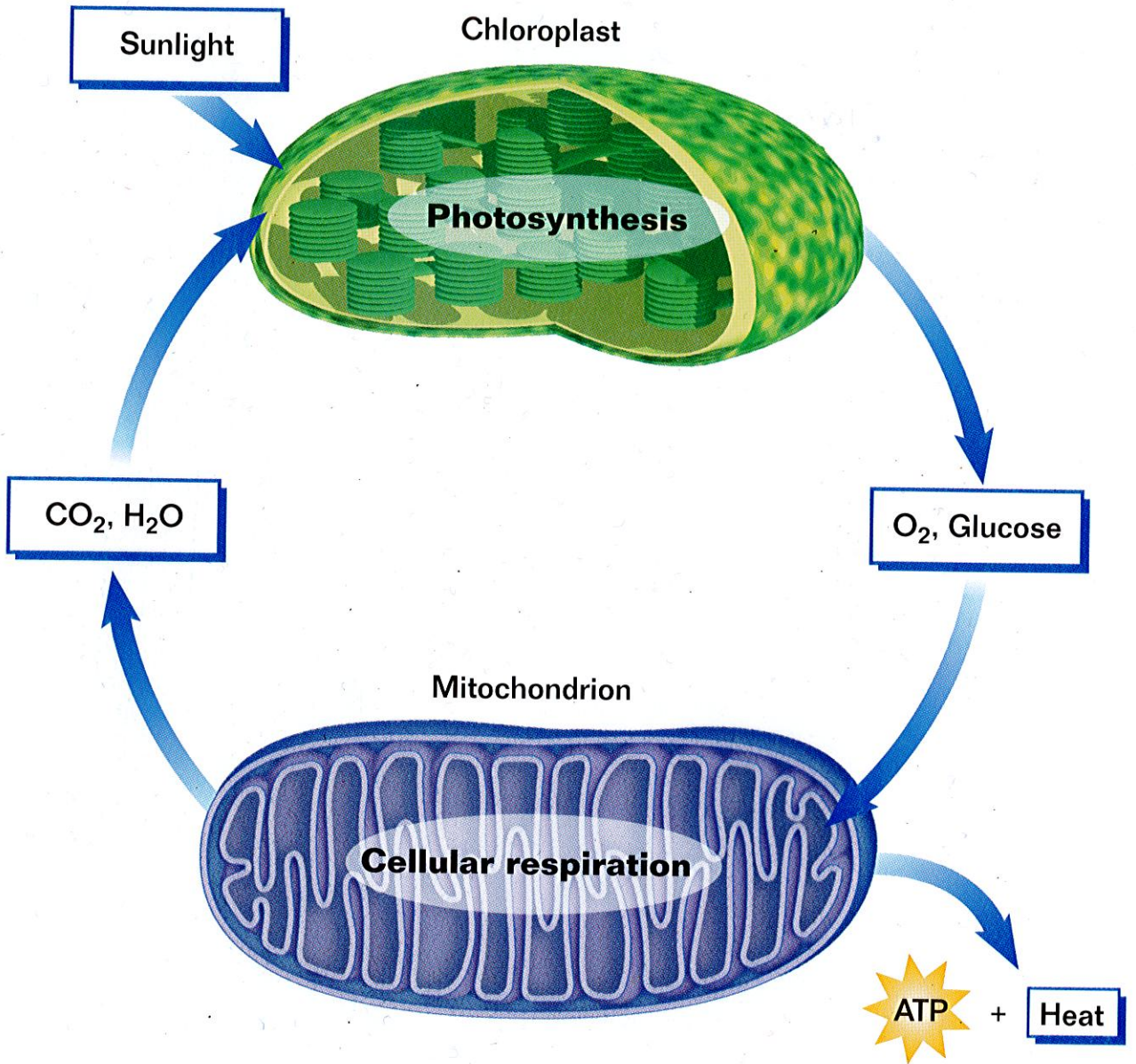
**4** Then, the resulting four-carbon molecule is oxidized as an  $\text{FAD}$  and an  $\text{NAD}^+$  are reduced, forming  $\text{FADH}_2$  and  $\text{NADH}$ . As a result, the four-carbon starting material is regenerated, completing the cycle.



Electron Transport Chain in Mitochondria

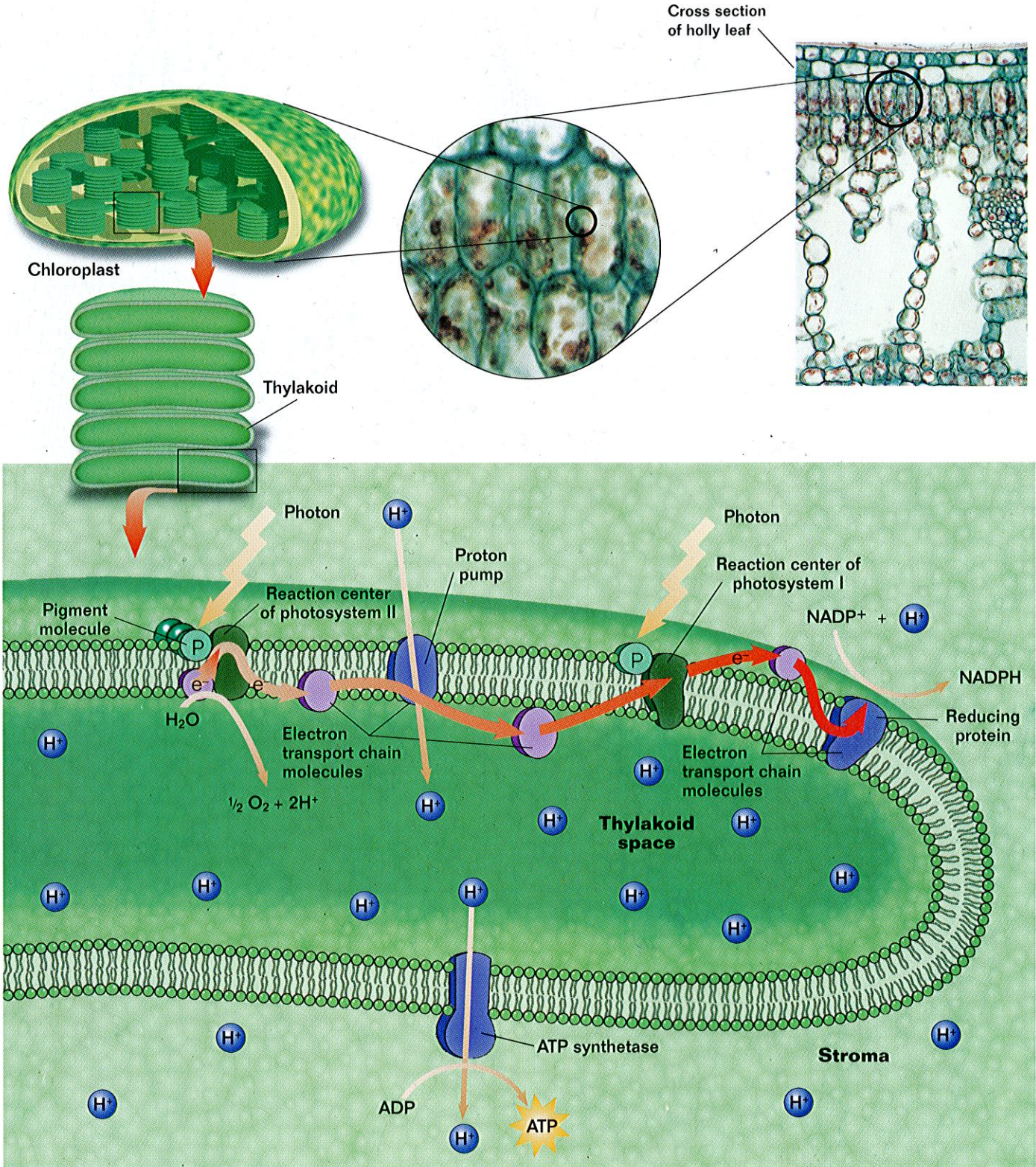






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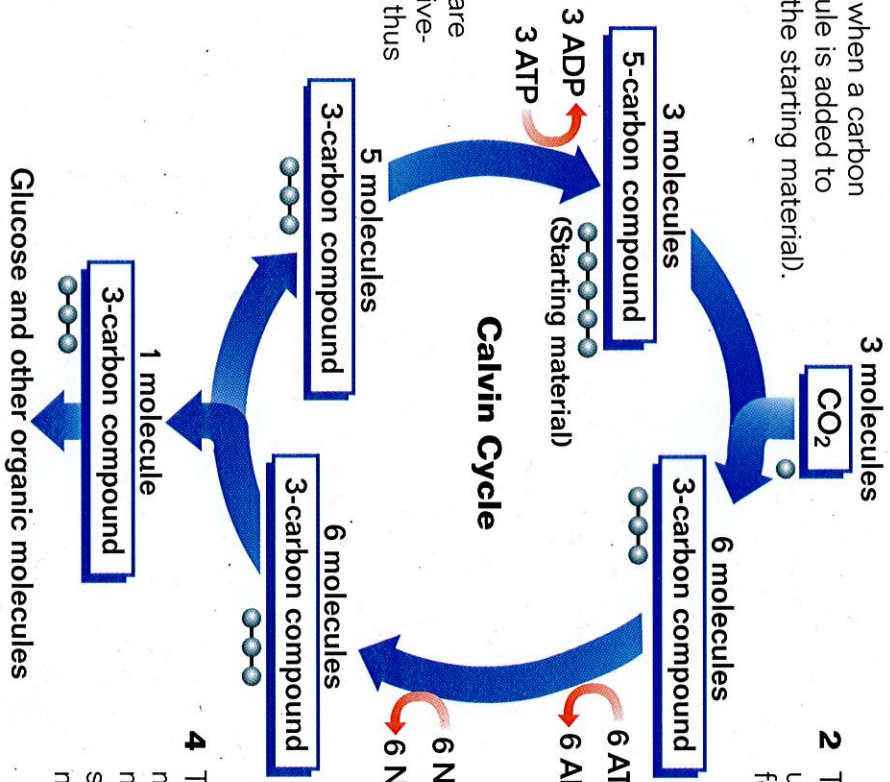
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**1** The Calvin cycle begins when a carbon atom from a CO<sub>2</sub> molecule is added to a five-carbon molecule (the starting material).

**2** The resulting six-carbon molecule is unstable and immediately splits, forming two three-carbon molecules.

**5** Most of the reduced three-carbon molecules are used to regenerate the five-carbon starting material, thus completing the cycle.



**3** Then, through a series of reactions, energy in the form of a phosphate group from ATP is added to the three-carbon molecules, and they are reduced by the addition of hydrogen from NADPH.

**4** The reduced three-carbon molecules may combine to make glucose, a six-carbon sugar, or may be used to make other organic molecules.