

Cellular Respiration

Key words for Cellular Respiration

- Aerobic (Consuming of O₂)
- A reaction that happens in the Mitochondrion
- Exergonic Reaction; The energy released is from the breaking of these chemical molecules. From this we can conclude it's a ^{organic} Catabolic reaction.

The chemical reaction to break down the organic molecules is a ^{Reduction} Red ^{oxidation} ox reaction. In its transfer of e^- comes the the required energy for synthesising ATP.

Glycolysis is a common factor between cellular respiration and fermentation → It happens in the ^{Glycolysis} cytosol without O₂

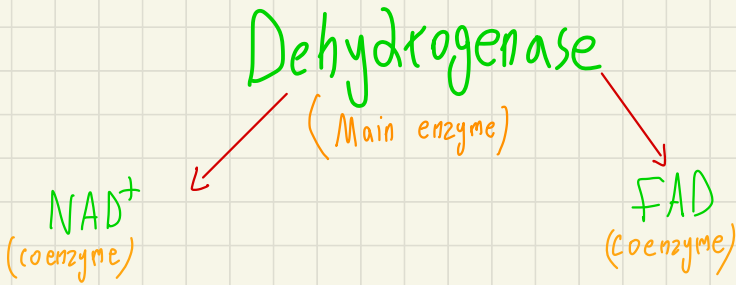
The Krebs cycle's starting molecule is **Acetyl CoA**

Harvesting e^- happens firstly via a main enzyme called **Dehydrogenase**. It strips 2 hydrogens ^{from the main nutrient} at delivers it to one of the main e^- acceptors.

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✳ In harvesting the energy of e^- in the synthesis of ATP, we use 2 major e^- acceptors (The place where the e^- energy is stored):

- 1) NAD^+ (Harvests 2 high energy e^- in $NADH$)
- 2) FAD (Harvests 2 high energy e^- in $FADH_2$)

✳ The 2nd H^+ doesn't get used in neutralizing NAD^+



✳ Phosphorylation ^{via} is a process that ATP is used to add a phosphate group to a molecule $\hat{=}$ the enzyme kinase.

Types of phosphorylation: **direct**

1) Substrate-level phosphorylation: The ^{direct} synthesis of ATP from ADP when coupled with a product that has a phosphate group. (The substrate)

2) Oxidative phosphorylation: ATP is generated here from the energy of oxidizing $NADH$ and $FADH_2$

✳ From here we can understand the full reason it's called a redox reaction \longrightarrow NAD^+ and FAD get reduced to $NADH$ and $FADH_2$ in Glycolysis and Krebs cycle, then they get oxidized in the oxidative phosphorylation stage

Glycolysis $\begin{cases} \rightarrow \text{Energy investment phase} \\ \rightarrow \text{Energy payoff phase} \end{cases}$

~~The beginning of the energy investment phase.~~

1) ATP $\xrightarrow{\text{Hexokinase}}$ Glucose by its 6th carbon

~~Glucose 6-phosphate~~

2) Isomerization

Glucose 6-phosphate \rightarrow Fructose 6-phosphate

3) Fructose 6-phosphate $\xrightarrow{\text{Phospho-Fructokinase}}$ Fructose 1,6 biphosphate
~~Unstable \rightarrow highly unstable~~

~~we can conclude that the purpose of the 3rd stage is to make the Fructose 6-phosphate MORE unstable so we can break it easily in the next stage (The more unstable, the easier it breaks)~~

4) Fructose 1,6 biphosphate $\xrightarrow{\text{Aldolase}}$ 1) Glyceraldehyde 3-phosphate

2) Dihydroxyacetone phosphate
Ketone

5) Dihydroxyacetone phosphate $\xrightarrow{\text{Isomerase}}$ Glyceraldehyde 3-phosphate

~~Dihydroxyacetone has a higher concentration than Glyceraldehyde 3-phosphate, so it gets isomerised to~~

~~This step never reaches equilibrium because Glyceraldehyde 3-phosphate gets used immediately (so it's a 1 way reaction/step)~~

~~The end of the energy investment phase.~~

Decarboxylation: Removal of CO₂ from carboxylic acid

Isomerization: The change of an organic molecule to one of its isomers (like Glucose \rightarrow Fructose)

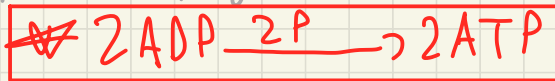
~~One of the reasons we need energy for the addition of a phosphate group is to counteract the repulsion of the phosphate group already in the ADP~~

~~The~~ The beginning of the energy payoff phase.

6) Triose phosphate dehydrogenase comes to Glyceraldehyde 3-phosphate and takes 2 hydrogen from it (It get oxidized) and takes them to NAD^+ to make it NADH (To reduce it)
From the energy of the redox reaction, a phosphate group is added to form 1,3-Biphosphate.

~~2~~ 2NADH
are formed,
Teach

7) 1,3-Bisphosphoglycerate $\xrightarrow{\text{Phosphoglycerate Kinase}}$ 3-Phosphoglycerate.

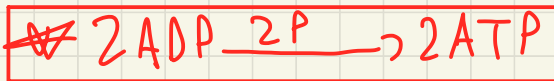


Substrate-level phosphorylation

8) 3-Phosphoglycerate $\xrightarrow{\text{Phosphoglyceromutase}}$ 2-Phosphoglycerate
~~A~~ A simple change in the phosphate group's location.

9) 2-Phosphoglycerate $\xrightarrow{\text{Enolase}}$ Phosphoenolpyruvate
Enolase removes H_2O

10) Phosphoenolpyruvate $\xrightarrow{\text{Pyruvate Kinase}}$ Pyruvate



Substrate-level phosphorylation

~~The~~ The end of the energy payoff phase.