

## Subtopics

- 13.0 Introduction
- 13.1 Formation of ATP
- 13.2 Anaerobic respiration
- 13.3 Aerobic respiration
- 13.4 Utility of stepwise oxidation

## Mitochondria

Mitochondria are known as "Power houses of the cell". They take in nutrients, break them down and create energy for the cell. Most of the chemical reactions involved in cellular respiration take place in the mitochondria.



## Quick Review

➤ Various steps involved in glycolysis:

No.	Step(s)	Substrate	Enzyme	End product(s)
i.	Phosphorylation	Glucose + ATP	Hexokinase	Glucose - 6 - Phosphate + ADP
ii.	Isomerisation	Glucose -6-Phosphate	Phosphohexose isomerase	Fructose - 6 - Phosphate
iii.	Phosphorylation	Fructose -6-Phosphate + ATP (Phosphate donor)	Phosphofructokinase	Fructose 1,6-Diphosphate + ADP
iv.	Cleavage	Fructose -1, 6- Diphosphate	Aldolase	3 - Phosphoglyceraldehyde + Dihydroxy acetone phosphate

[Note: 3-PGAL and Dihydroxy acetone phosphate are interconvertible in presence of triose-phosphate isomerase.]

v.	Phosphorylation and Dehydrogenation	3-PGAL + $H_3PO_4$ + $NAD^+$	Triose phosphate dehydrogenase	1, 3 Diphosphoglyceric acid + $NADH + H^+$
vi.	Dephosphorylation	1, 3-DPGA + ADP	Diphosphoglycerate kinase ( $Mg^{2+}$ )	ATP + 3-Phosphoglyceric acid
vii.	Rearrangement	3-PGA	Phosphoglycerate mutase	2-Phosphoglyceric acid
viii.	Dehydration	2-PGA	Enolase	Phosphoenol Pyruvic acid + $H_2O$
ix.	Dephosphorylation	Phosphoenol Pyruvic acid + ADP	Pyruvate kinase	Pyruvic acid + ATP

Various steps involved in Krebs cycle:

No.	Step(s)	Substrate	Enzyme	End product(s)
i.	Condensation	Acetyl-CoA + Oxalo-acetic acid + $H_2O$	Citrate synthase	Citric acid (6C) + Coenzyme-A
ii.	Dehydration Hydration	It is again completed in two steps: a. Citric acid b. Cis-Aconitic acid + $H_2O$	Aconitase Aconitase	Cis-Aconitic acid + $H_2O$ Iso-citric acid(6C)
iii.	Oxidative decarboxylation	a. Isocitric acid + $NAD^+$ b. Oxalosuccinic acid	Isocitrate dehydrogenase Isocitrate dehydrogenase	Oxalo succinic acid(6C) + $NADH + H^+$ $\alpha$ - ketoglutaric acid(5C) + $CO_2$

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iv.	Oxidative Decarboxylation, (-2H) (-CO <sub>2</sub> )	$\alpha$ -Ketoglutaric acid + H <sub>2</sub> O + NAD <sup>+</sup> + Coenzyme A	$\alpha$ -Ketoglutarate dehydrogenase complex	Succinyl-CoA(4C) + NADH + H <sup>+</sup> + CO <sub>2</sub>
v.	Substrate level phosphorylation	Succinyl-CoA + GDP + iP	Succinyl CoA synthetase	Succinic acid (4C) + Coenzyme-A + GTP
vi.	Dehydrogenation (-2H)	Succinic acid + FAD (H-acceptor)	Succinate dehydrogenase	Fumaric acid (4C) + FADH <sub>2</sub>
vii.	Hydration(+H <sub>2</sub> O)	Fumaric acid + H <sub>2</sub> O	Fumarase	Malic acid (4C)
viii.	Dehydrogenation (-2H)	Malic acid + NAD <sup>+</sup> (H-acceptor)	Malate dehydrogenase	Oxaloacetic acid + NADH + H <sup>+</sup> (4C)

Respiratory Quotient (R.Q.)

- Carbohydrates (= 1)
- Fats (< 1)
- Organic acid (> 1)
- Succulents (= 0)
- Proteins (< 1)
- Anaerobic respiration (= ∞)