NAME: UMIOM FAVOUR VICTOR

MATRIC NUMBER: 18/MHS06/053

DEPARTMENT: MEDICAL LABORATORY SCIENCE

LEVEL: 200

COURSE: MCB 202

1. Describe the mechanism in aerobic respiration

**ANSWER**

Cellular respiration is divided into two; aerobic and anaerobic respiration. In aerobic respiration, oxygen is its final electron acceptor. It is the breaking down of glucose to yield oxygen, water and energy. The mechanism of aerobic respiration involves three stages which are;

* Glycolysis
* Krebs cycle AND
* Electron Transport Chain

**GLYCOLYSIS**

Glycolysis also known as Embden-Meyerhoff Parnas pathway is the breakdown of glucose to molecules of pyruvic acid through a series of enzyme related reactons releasing some energy (as ATP) and reducing power (as NADH2). This process occurs in the cytoplasm and has two phases; PREPARATORY AND PAYOFF PHASE. The preparatory phase involves 5 sub steps which are;

* **Phosphorylation**: Glucose is phosphorylated to glucose-6-phosphate by ATP in the presence of the enzyme hexokinase.

Glucose + ATP🡪Glucose-6-phosphate + ADP

* **ISOMERIZATION:** Glucose-6-phosphate is isomerized to Fructose-6-phospahte in the presence of the enzyme Phosphohexose isomerase. This is a reversible reaction.

Glucose-6-phospahte🡪Fructose-6-phosphate

* **PHOSPHORYLATION:** Fructose-6-phosphate is then phosphorylated to Fructose 1,6-biphosphate by means of ATP and in the presence of the enzyme Phospho-fructokinase.

Fructose-6-phosphate+ ATP🡪Fructose 1,6-biphosphate

* **SPLITTING:** Fructose 1,6-biphosphate splits up to form one molecule each of 3 carbon compounds; Glyceraldehyde 3-phosphate and Dihydroxyacetone phosphate.
* Dihydroxyacetone phosphate is further isomerized to a second molecule of Glyceraldehyde 3-phosphate by the enzyme Triose phosphate isomerase. This is a reversible reaction.

Dihydroxyacetone🡪 Glyceraldehyde 3-phospahte

The next phase which is the PAYOFF PHASE also has 5 sub steps. This phase involves the oxidative conversion of glyceraldehyde 3-phosphate to pyruvate and the coupled formation of ATP and NADH. The sub steps are;

* **PHOSPHORYLATION AND DEHYDROGENATION:** Each molecule of Glyceraldehyde 3-phosphate is oxidized and by inorganic phosphate to form 1,3-biphosphoglycerate in the presence of the enzyme Glyceraldehyde 3-phosphate dehydrogenase.

Glyceraldehyde 3-phosphate + NAD+🡪1, 3-biphosphoglycerate+NADH + H+

* **FORMATION OF ATP:** One of the two phosphate of the biphosphoglycerate synthesize ATP and form 3-phosphoglyceric acid. The enzyme used is Phosphoglycerate kinase.

1, 3-biphosphoglycerate + ADP🡪 3-phosphoglyceric + ATP

3-phosphoglyceric acid is then changed to its isomer 2-phosphoglyceric acid by the enzyme phosphoglycerate mutase. Through the enzyme Enolase, 2-phosphoglyceric acid is converted to phosphoenolpyruvate. A molecule of water is removed in the process.

2-phosphoglyceric acid🡪 Phosphoenol pyruvate

Net products of glycolysis:

Glucose + 2NAD+ + 2ADP +2Pi🡪 2pyruvate+ 2NADH + 2H+ + 2ATP +2H2O

**KREBS CYCLE**

Krebs cycle also known as Citric Acid Cycle is the second stage or step in the mechanism of aerobic respiration. This cycle is a sequence of reactions which occurs in the mitochondria that oxidizes the acetyl-CoA to CO2 and reduces coenzymes that are re-oxidized through the electron transport chain linked to the formation of ATP.

Pyruvate enters the mitochondria and is decarboxylated oxidatively to form CO2 and NADH which then combines with a Sulphur containing coenzyme A to form acetyl CoA. The steps of krebs cycle are;

* **CONDENSATION:** Acetyl CoA combines with oxaloacetate in the presence of the enzyme citrate synthase to form a tricarboxylic 6-carbon compound called citric acid. CoA is liberated.

Acetyl CoA + oxaloacetate + H2O🡪 Citrate + CoA

* **DEHYDRATION:** Citrate undergoes reverse transformation in the presence of Aconitase to form cis-aconitate and releasing water.

Citrate🡪 cis-aconitate + H2O

* **HYDRATION:** Cis-aconitate is converted to isocitrate with the addition of water in the presence of iron containing enzyme aconiatate.

Cis-aconitate + H2O🡪 Isocitrate

* **DEHYDROGENATION:** Isocitrate is dehydrogenated to oxalosuccinate in the presence of isocitrate dehydrogenase.

Isocitrate + NAD+🡪 Oxalosuccinate + NADH + H+

* **Decarboxylation**: Oxalosuccinate is decarboxylated to form alpha-ketoglutarate through the enzyme decarboxylase. Carbon dioxide is released.

Oxalosuccinate🡪 alpha-ketoglutarate + CO2

* **DEHYDROGENATION AND DECARBOXYLATION:** Alpha-ketoglutarate is both dehydrogenated and decarboxylated by an enzyme alpha-ketoglutarate dehydrogenase. The product combines with CoA to form succinyl-CoA.

Alpha-ketoglutarate + CoA + NAD+🡪 Succinyl CoA + NADH + H+

* **FORMATION OF ATP/GTP:** Succinyl CoA reacted with succinyl-CoA synthase to form succinate.
* **DEHYDROGENATION:** Succinate undergoes dehydrogenation to form fumerate with the help of a dehydrogenase. FADH2 is produced.
* **HYDRATION:** A molecule of water gets added to fumerate to form malate. The enzyme is called FUMERASE
* **DEHYDROGENATION:** Malate is oxidized through the enzyme malate dehydrogenase to produce oxaloacetate.

Malate + NAD(P)+🡪 Oxaloacetate+ NAD(P)H +H+

Oxaloacetate picks up another molecule of activated acetate to repeat the cycle.

A molecule of glucose yields two molecules of NADH2, 2ATP and 2 pyruvate while undergoing glycolysis. The two molecules of pyruvate are then completely degraded in krebs cycle to form two molecules of ATP, 8NADH2, and 2FADH2.

**ELECTRON TRANSPORT CHAIN**

An electron transport chain is a series of coenzymes that take part in the passage of electrons from a chemical to its ultimate acceptor. The passage of electrons from one enzyme to the next is a downhill journey with a loss of energy at each step. The final electron acceptor in aerobic respiration is oxygen which is located in the mitochondria. At each step the electron carriers include flavins, iron Sulphur complexes, quinones and cytochromes.