

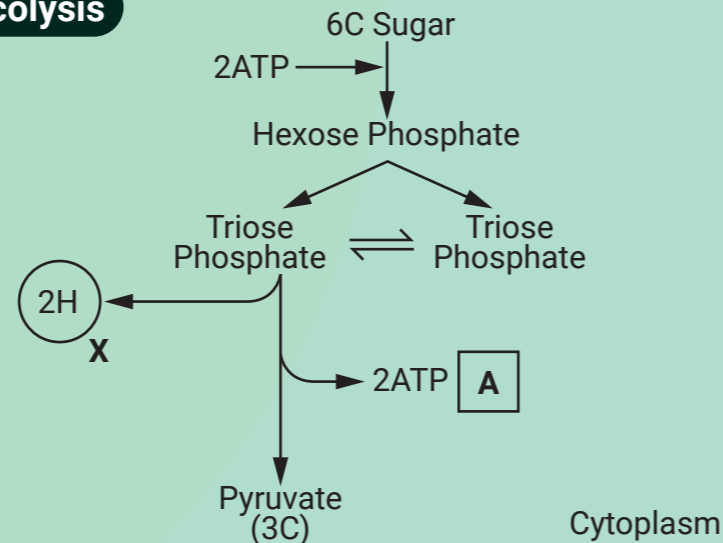
Unit 3: A Level Biology

Aerobic Respiration

Respiration - All living organisms carry out respiration.

- A catabolic, enzyme-controlled reaction inside cells to provide energy.
- Energy rich respiratory substrates, such as glucose or fatty acids, are broken down to release energy.
- High energy bonds, C-C, C-H and C-OH are broken, and lower energy bonds are formed.
- The excess energy released is used to phosphorylate ADP to form ATP or released as heat energy.

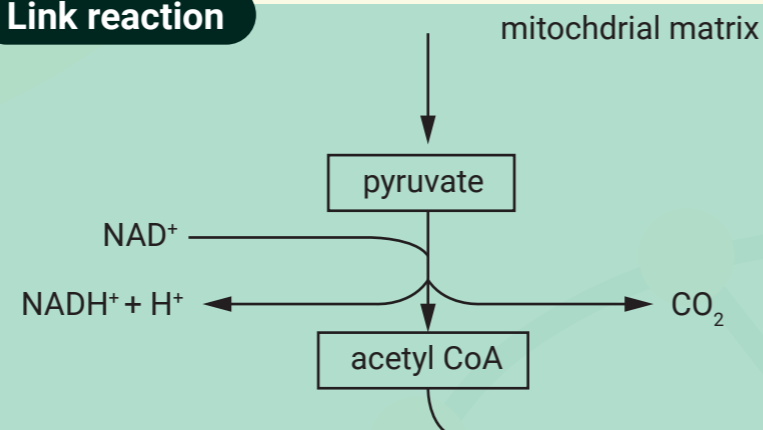
Glycolysis



Glycolysis - in cytoplasm

1. Glucose is phosphorylated using 2ATP into hexose phosphate.
2. The hexose phosphate splits into two triose phosphate molecules.
3. The oxidation of these triose phosphates yields 2ATP by **substrate level phosphorylation**. Dehydrogenation releases 2 Hydrogen that are picked up by NAD. The resulting 2x 3C pyruvates diffuse into the mitochondria.

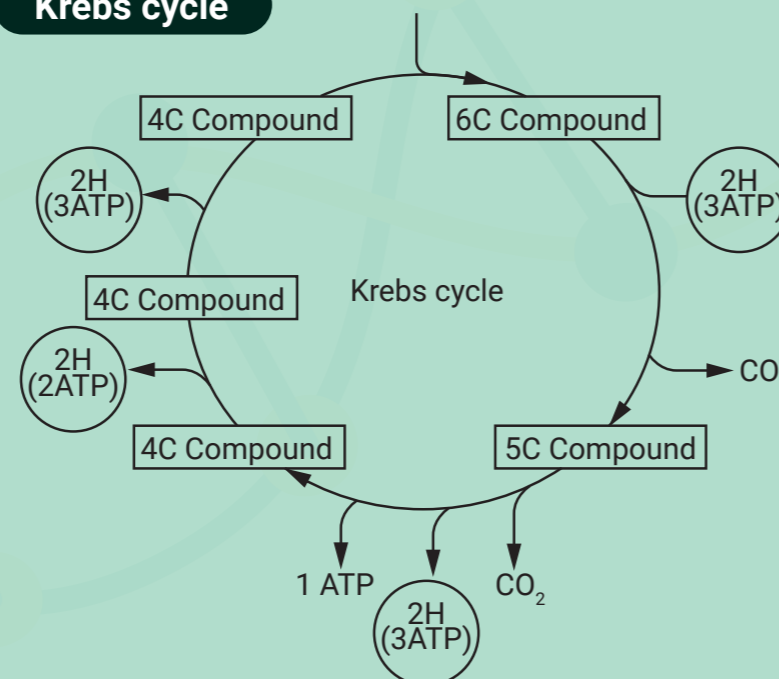
Link reaction



Link reaction - in mitochondrial matrix

4. Oxidative decarboxylation of pyruvate catalysed by decarboxylase releases carbon dioxide.
5. Dehydrogenation catalysed by dehydrogenase releases pairs of hydrogen atoms converting NAD to reduced NAD.
6. The addition of coenzyme A forms acetyl CoA (2C) which enters the Krebs cycle.

Krebs cycle



Krebs cycle - in mitochondrial matrix

7. The acetate from acetyl CoA combines with a 3C compound to form a 6C compound.
8. Decarboxylation forms a 5C compound and dehydrogenation occurs reducing NAD.
9. Decarboxylation forms a 4C compound and dehydrogenation to reduce NAD. There is also substrate level phosphorylation giving 1 ATP.
10. Dehydrogenation forming reduced FAD.
11. Dehydrogenation forming reduced NAD.

Electron transport chain - on inner mitochondrial membrane

12. Reduced NAD and reduced FAD deliver pairs of hydrogen atoms to the ETC.
13. They are oxidised, delivering protons (H⁺) and high energy electrons (e⁻) to proton pumps on the inner mitochondrial membrane.
14. Reduced NAD utilises all 3 proton pumps and so 3xATP are released. Reduced FAD utilises only 2 proton pumps and only 2x ATP are released.
15. The method of ATP production can be found on the sheet "The importance of ATP".

Respiratory substrates other than glucose

Lipids

- Glycerol is converted into triose phosphate for use in glycolysis.
- Fatty acids are split into 2C acetate fragments which feed into the Krebs cycle as acetyl CoA.

Proteins

- Amino acids are deaminated in the liver into ammonia and keto acids, one of which is pyruvate that is used in the link reaction and others are fed into the Krebs cycle.