

Cell Respiration

Cell respiration is the controlled release of energy from glucose to produce ATP

ATP is composed of a ribose sugar and a adenine base, connected to 3 phosphate groups

When 1 phosphate group is removed via hydrolysis, the energy stored in the bond is released

Anaerobic vs Aerobic Respiration

Anaerobic

NO oxygen required

Only glucose used

2 ATP produced

ANIMAL: Lactic Acid

PLANTS: ethanol + CO₂

in Mitochondria

Aerobic

Oxygen IS required

Carbohydrates + Lipids used

36 (ish) ATP produced

CO₂ + H₂O

Waste product

in Cytoplasm + Mitochondria

Hydrogen Carriers

NAD and FAD

The Main role of hydrogen carriers is to transport hydrogen atoms to electron transport chain

This can change ADP to ATP by adding 1 phosphate during metabolic processes (eg. respiration)

They happen during chemical processes such as oxidation (loss electrons) and reduction (gain electrons)

Anaerobic Respiration

After Glycolysis

CO₂ removed from pyruvate via decarboxylation (producing ethanol)

2H transferred from reduced NAD to ethanol, creating ethanol

NAD's then regenerated to do anaerobic respiration again (Glycolysis)

Glycolysis

Phosphorylation

The addition of a phosphate to a molecule (2x ATP → ADP)

Requires energy

Makes molecule more unstable

Glucose now split to form 2 triose phosphate

Oxidation

Each Triose phosphate oxidised (remove H atoms)

Hydrogen is accepted by NAD, becoming reduced NAD

Energy released by ox. causes 2nd phosphate group to attach

Forming a 2x 3C compound with 2 phosphate groups

ATP Formation

ADP is phosphorylated by phosphate groups on 3C compound

Forming 2x ATP per 3C compound

Glycerate converted to other organic acid

Pyruvate is formed

SUMMARY

- 1 glucose (6C) form 2x Pyruvate (3C)
- 2 NAD molecules converted to reduced-NAD
- Net gain of 2x ATP, so 2 ATP per glucose
- In Cytoplasm

Link Reaction

Pyruvate transferred from cytosol to mitochondrial matrix via carrier proteins in mitochondrial membrane

Pyruvate decarboxylated forming CO₂

2C compound loses H forming reduced NAD

2C Compound now forms an acetyl group

Acetyl compound combines with coenzyme A

Forming acetyl coenzyme A (acetyl CoA)

SUMMARY

1. Glycolysis forms 2 pyruvate, so link

Electron Transport Chain (ETC)

Proton Motive Force

H carriers are oxidised, releasing high energy electrons + protons

e⁻ transferred to ETC

e⁻ pass through chain, losing energy

energy used to pump H⁺ ions from out of matrix

accumulation of H⁺ ions in intermembrane space creates high conc.

ATP Synthesis

High H⁺ conc creates gradient

H⁺ ions diffuse back to matrix

Diffusion is called chemiosmosis

Facilitated by ATP synthase

Movement triggers rotation of enzyme, phosphorylating ADP, creating ATP

Oxygen Reduction

De-energise electrons need to be removed from chain to prevent blockage

O binds with H⁺ in matrix & e⁻ to form H₂O

Removal of H⁺ maintains gradient

No O = H carriers cannot transfer e⁻

So ATP production would be halted

Location of Each Step

GLYCOLYSIS: Cytoplasm of the cell

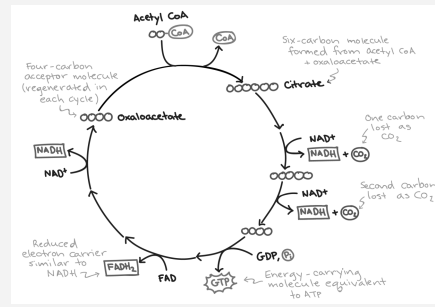
LINK REACTION: Mitochondrial Matrix

KREBS CYCLE: Mitochondrial Matrix

ETC: Matrix + Inter membrane Space

reaction occurs 2x per glucose molecule
2. Per glucose molecule = 2x acetyl CoA,
2x NADH, 2x CO₂

Krebs Cycle



SUMMARY

Per glucose molecule = 4x CO₂, 2x ATP,
2x FADH, 6x NADH



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Page 1 of 2.

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