12.1 ENERGY

Use of energy in organism?

photosynthesis, anabolic reactions(DNA replication, protein synthesis), active transport, homeostasis, muscle contraction, exocytosis, bioluminecence

Why ATP is universal energy currency?

stable,recyclable, small, water-soluble, quick hydrolysis(30.5kJmol-1), energy wastage low,

Synthesis of ATP?

transfer of phosphate in substrate-linked reaction, chemiosmosis in cristae/grana membrane

Compare relative energy values...

highest to lowest, carb, lipid, protein, more hydrogen atoms, more H atom transported by NAD/FAD, greater proton gradient, more ATP formed via chemiosmosis

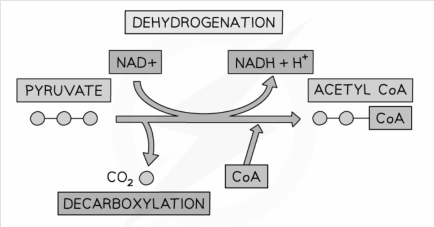
Define Respiratory Quotient (RQ)

ratio of carbon dioxide released over oxygen used

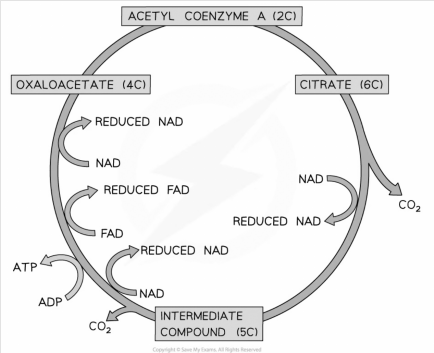
RQ of different substrates

Carb=1, Lipid=0.7, Protein=0.9

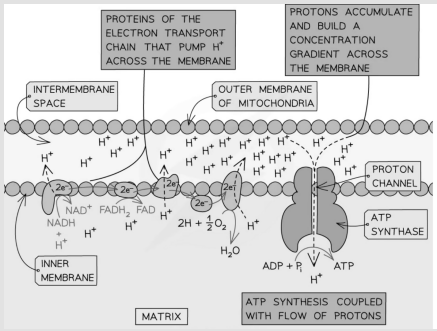
Link reaction



Krebs cycle



Oxidative phosphorylation



12.2 RESPIRATION

Adaptations of mitochondria

large surface area -able to hold many ETC and ATP synthase,

Outline lactate fermentation

one step process, after glycolysis, pyruvate is the hydrogen acceptor to form lactate. Lactate can be oxidized back to pyruvate or stored as glycogen in liver.

Outline ethanol fermentation

2 step process, after glycolysis, pyruvate is decarboxylated to ethanal, then reduced by alcohol dehydrogenase to form ethanol.Ethanol cannot be further metabolised, it is toxic.

Energy yield comparison between aerobic and anaerobic

oxidation of glucose in anaerobic is incomplete. Only 2 ATP formed in glycolysis. Large amount of ATP form in stages in mitochondria.

Rice adaptation to grow under water

Ethanol stimulates production of gibberellin, growth regulator. Rice has high tolerance to ethanol as they produce ethanol dehydrogenase. Development of aerenchyma which is a specialised plant tissue that has lots of air spaces that allow storing of gas even underwater

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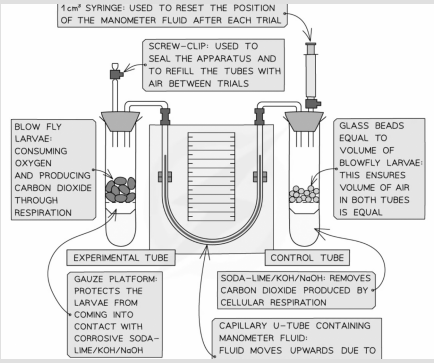
Respirometer (investigate RQ)



12.2 RESPIRATION

4 stages of aerobic respiration

glycolysis-cytoplasm, link reaction and Krebs cycle-mitochondrial matrix, oxidative phosphorylation-cristae

Outline glycolysis

phosphorylation of glucose, splitting of fructose 1,6-bisphosphate into 2 triose phosphate, oxidation of triose phosphate and dephosphorylation of intermediate substrates into pyruvate

Product of glycolysis

used 2 ATP in phosphorylation, form 2NADH and 4 ATP during oxidation (nett 2 ATP, 2 NADH, 2 pyruvate)

When does pyruvate enter mitochondrial matrix

when oxygen is available to take part in link reaction

Outline Link reaction

decarboxylation and dehydrogenation of pyruvate

Product of Link reaction

acetate, CO2 and NADH

Role of Coenzyme A

carrier,binds to acetate to form acetyl coA, transport and supply acetate to Krebs cycle

Outline Krebs cycle

enzyme controlled reactions, oxoloacetate accepts acetate from acetyl coA-forms citrate, oxaloacetate reformed by decarboxylation, dehydrogenation and reduction of NAD and FAD

12.2 RESPIRATION (cont)

Role of NAD and FAD

coenzymes to dehydrogenase, transports hydrogen to electron transport chain for oxidative phosphorylation (NADH=3ATP, FADH2=3ATP)

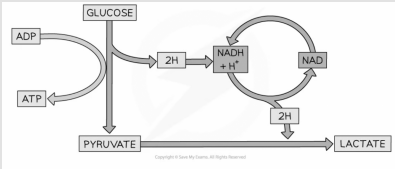
Outline oxidative phosphorylation

NADH/FADH2 oxidise at electron carriers, H atom splits into proton and energetic electron. Electron travels through electron transport chain which supplies energy for proton pumps. Proton pumped from matrix to intermembrane space and proton gradient formed. Proton facilitated diffusion by ATP synthase, moves down gradient into matrix, energy for ATP synthesis.

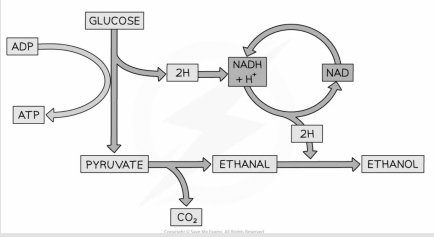
Role of oxygen in oxidative phosphorylation

final electron acceptor to form water. if no oxygen, electrons and hydrogen have nowhere to go, ETC stops and NAD/FAD unable to regenerate.

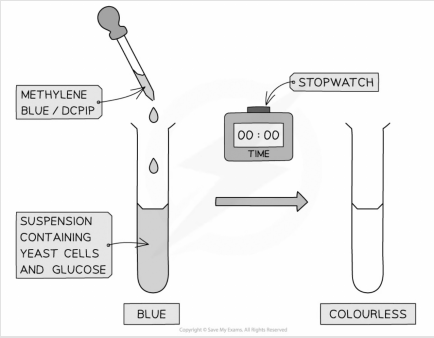
Lactate fermentation



Ethanol fermentation



Methylene blue (measure rate of respiration)



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