

### 12.1 ENERGY

#### Use of energy in organism?

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

#### Why ATP is universal energy currency?

stable,recyclable, small, water-soluble, quick hydrolysis(30.5kJmol<sup>-1</sup>), 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

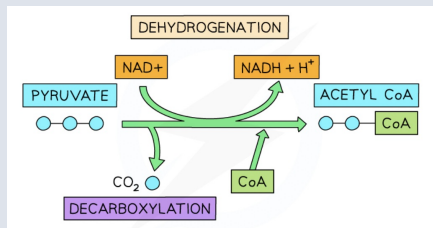
#### Define Respiratory Quotient (RQ)

ratio of carbon dioxide released over oxygen used

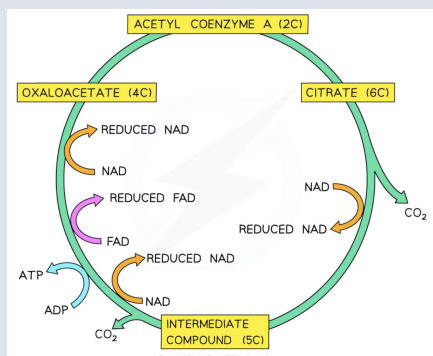
#### RQ of different substrates

Carb=1, Lipid=0.7, Protein=0.9

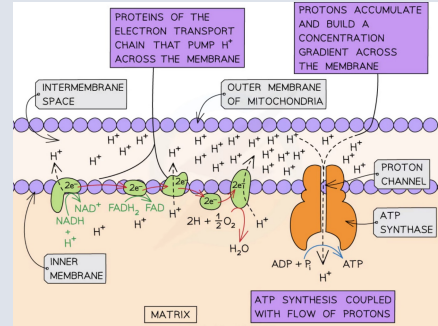
### Link reaction



### 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.

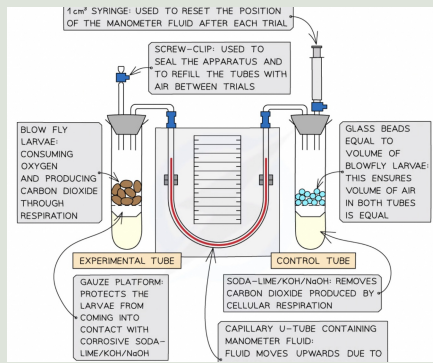
#### Energy yield comparison between aerobic and anaerobic

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

### 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, CO<sub>2</sub> 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, oxaloacetate 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, FADH<sub>2</sub>=3ATP)

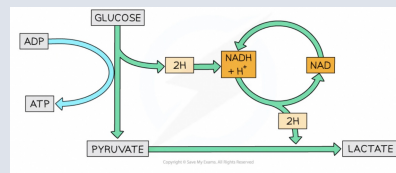
#### Outline oxidative phosphorylation

NADH/FADH<sub>2</sub> 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.

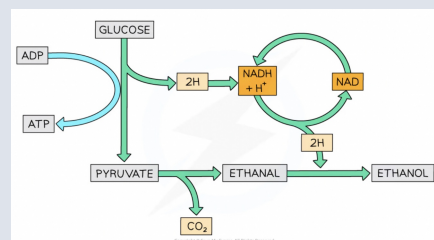
#### Role of oxygen in oxidative phosphorylation

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

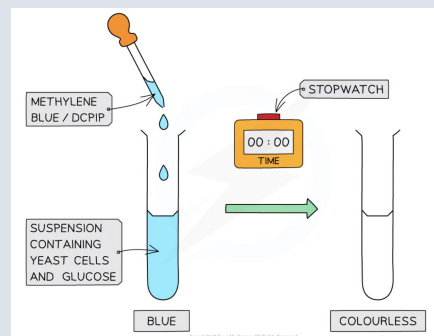
### Lactate fermentation



### Ethanol fermentation



### Methylene blue (measure rate of respiration)





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Published 8th April, 2022.  
Last updated 8th April, 2022.  
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