

OCR (B) Biology A-level

4.1.1 - Cellular respiration

Flashcards

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Name the 4 main stages in aerobic respiration and where they occur.



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Glycolysis: cytoplasm

Link reaction: mitochondrial matrix

Krebs cycle: mitochondrial matrix

Oxidative phosphorylation via electron transfer chain: membrane of cristae



Outline the stages of glycolysis.



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Enzyme-catalysed metabolic pathway.

1. Glucose is phosphorylated to hexose biphosphate by $2 \times$ ATP
 2. Hexose biphosphate splits into $2 \times$ triose phosphate (TP)
 3. Dehydrogenase oxidises $2 \times$ TP to $2 \times$ pyruvate
- Net gain of $2 \times$ reduced NAD and $2 \times$ ATP per glucose.

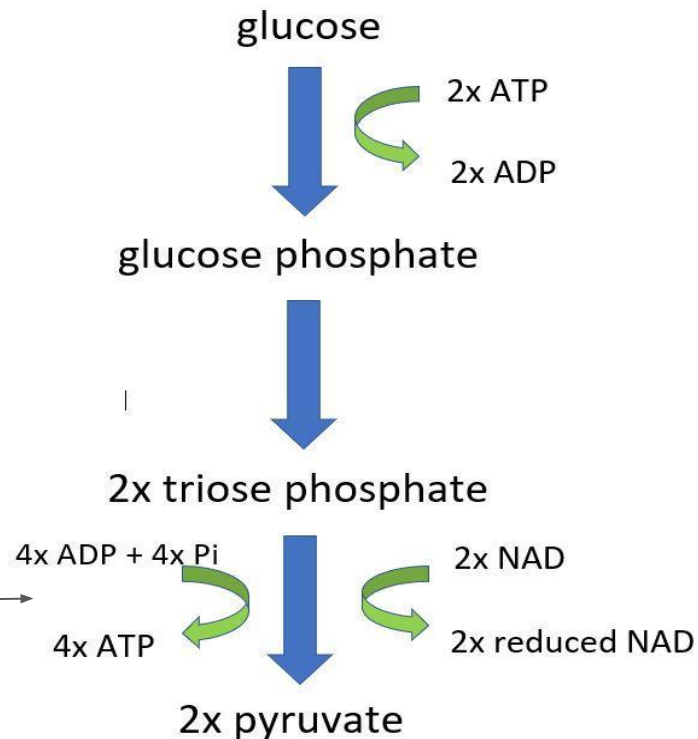


Draw a flowchart to represent what happens during glycolysis.



Draw a flowchart to represent what happens during glycolysis.

substrate-level phosphorylation catalysed by dehydrogenase enzymes



How does pyruvate from glycolysis enter the mitochondria?



How does pyruvate from glycolysis enter the mitochondria?

Via active transport



What happens during the link reaction?



What happens during the link reaction?

1. Oxidation of **pyruvate to acetate.**

per pyruvate molecule: net gain of $1 \times \text{CO}_2$
(decarboxylation) and 2H atoms (used to **reduce**
 $1 \times \text{NAD}$)

2. Acetate combines with coenzyme A (CoA) to
form **Acetyl coenzyme A.**



Give a summary equation for the link reaction.



Give a summary equation for the link reaction.

pyruvate + NAD + CoA



Acetyl CoA + reduced NAD + CO₂



What happens in the Krebs cycle?



What happens in the Krebs cycle?

Series of redox reactions produces:

- ATP by substrate-level phosphorylation
- reduced coenzymes
- CO₂ from decarboxylation

Begins when acetyl group from Acetyl CoA (2C) reacts with oxaloacetate (4C). The cycle regenerates oxaloacetate.



Outline the stages of the Krebs cycle.

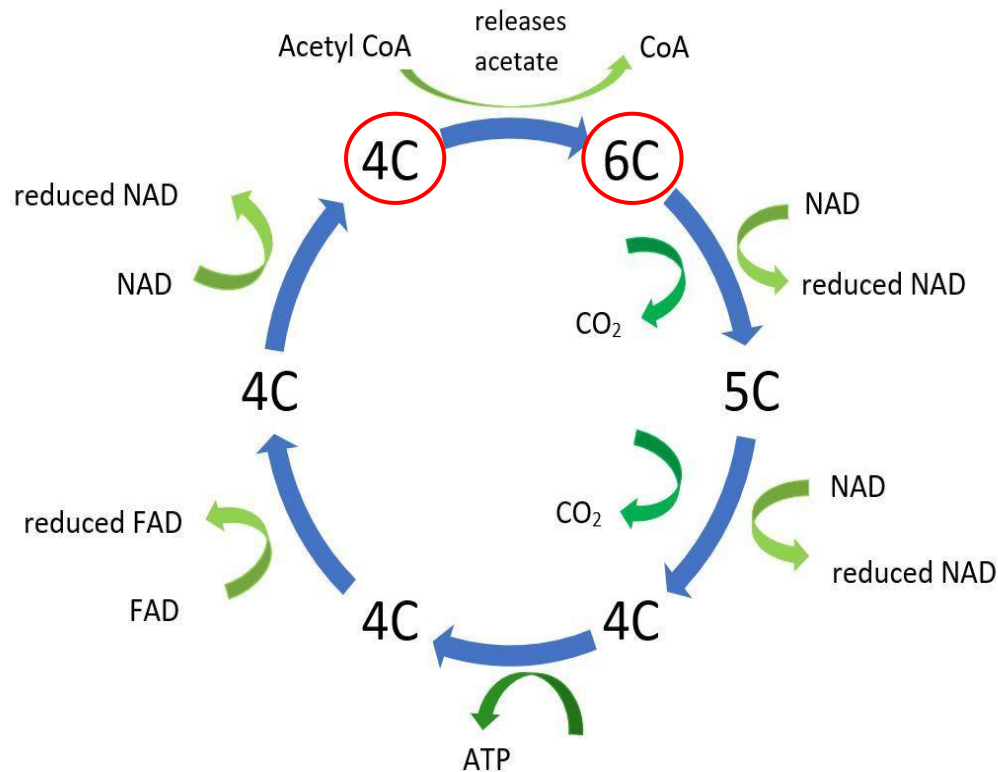


Outline the stages of the Krebs cycle.

Names of the circled compounds:

4C: oxaloacetate

6C: citrate



What is the electron transfer chain (ETC)?



What is the electron transfer chain (ETC)?

Series of carrier proteins embedded in membrane of the cristae of mitochondria.

Produces ATP through oxidative phosphorylation via chemiosmosis during aerobic respiration.



What happens in the electron transfer chain (ETC)?



What happens in the electron transfer chain (ETC)?

Electrons released from reduced NAD and FAD undergo successive redox reactions.

The energy released is used to maintain the proton gradient or released as heat.

Oxygen acts as the final electron acceptor.



How does chemiosmosis produce ATP during aerobic respiration?



How does chemiosmosis produce ATP during aerobic respiration?

Some energy released from the ETC is coupled to the active transport of H^+ ions (protons) from the mitochondrial matrix into the intermembrane space.

H^+ ions move down their concentration gradient into the mitochondrial matrix via the channel protein ATP synthase.

ATP synthase catalyses $ADP + P_i \rightarrow ATP$



State the role of oxygen in aerobic respiration.



State the role of oxygen in aerobic respiration.

Final electron acceptor in electron transfer chain.

(produces water as a byproduct)



Name the stages in respiration that produce ATP by substrate-level phosphorylation.



Name the stages in respiration that produce ATP by substrate-level phosphorylation.

- Glycolysis (anaerobic)
- Krebs cycle (aerobic)



What happens during anaerobic respiration in muscle cells?



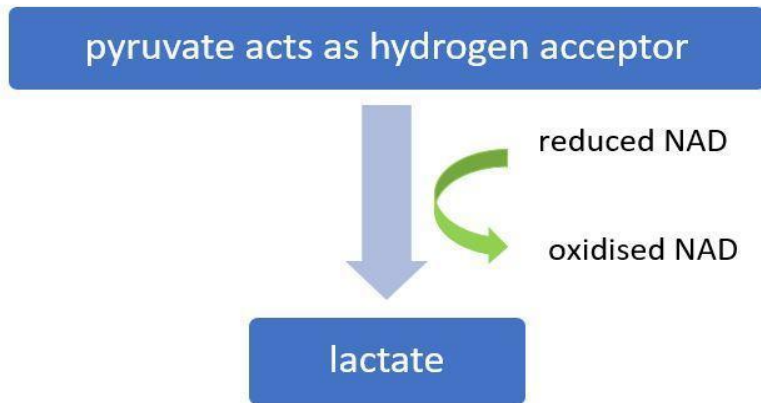
What happens during anaerobic respiration in muscle cells?

Only glycolysis continues.

reduced NAD + pyruvate



oxidised NAD (for further glycolysis) + lactate



What happens during anaerobic respiration in some microorganisms e.g. yeast and some plant cells?



What happens during anaerobic respiration in some microorganisms e.g. yeast and some plant cells?

Only glycolysis continues, so much less ATP is produced compared to aerobic respiration.

Pyruvate is decarboxylated to form ethanal.

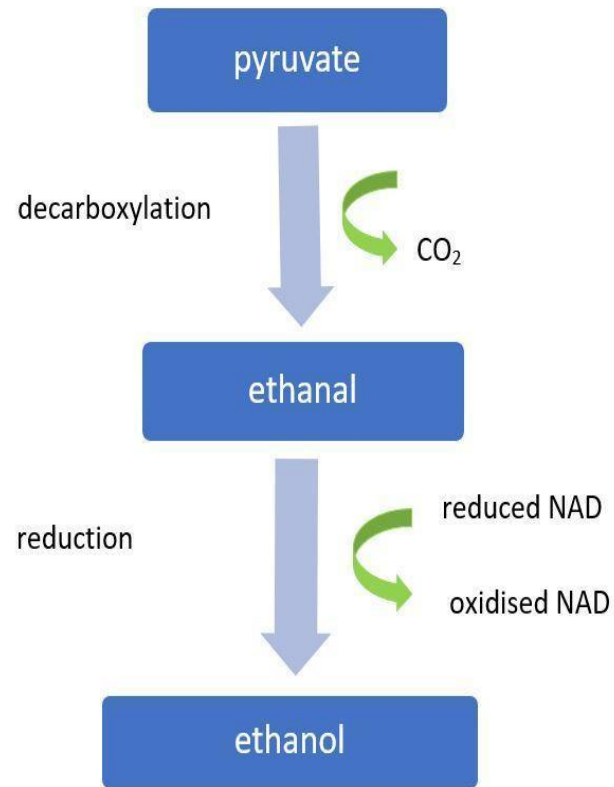
Ethanal is reduced to ethanol using reduced NAD to produce oxidised NAD for further glycolysis.



Draw a flowchart to show how ethanol is produced during anaerobic respiration.



Draw a flowchart to show how ethanol is produced during anaerobic respiration.



Name 2 types of molecules that can be used as alternative respiratory substrates.



Name 2 types of molecule that can be used as alternative respiratory substrates.

- (amino acids from) proteins
- (glycerol and fatty acids from) lipids



What is the respiratory quotient (RQ)?



What is the respiratory quotient (RQ)?

$RQ = \text{carbon dioxide produced} / \text{oxygen consumed}$

Can be used to determine:

- respiratory substrate being used (carbohydrates: 1.0, lipids: 0.8, proteins 0.9)
- if organism is undergoing anaerobic respiration (anaerobic values are larger)



Why do different respiratory substrates have different relative energy values?



Why do different respiratory substrates have different relative energy values?

Depends on the number of hydrogens in the structure which are oxidised to water e.g. the number of hydrogens is greater in fatty acids than carbohydrates.



Suggest how a student could investigate the effect of a named variable on the rate of respiration of a single-celled organism.



Suggest how a student could investigate the effect of a named variable on the rate of respiration of a single-celled organism.

1. Use respirometer (pressure changes in boiling tube cause a drop of coloured liquid to move)
2. Use a dye as the terminal electron acceptor for the ETC



How could a student calculate the rate of respiration using a respirometer?



How could a student calculate the rate of respiration using a respirometer?

volume of O₂ produced or CO₂ consumed/ time ×
mass of sample

volume = distance moved by coloured drop ×
(0.5 × capillary tube diameter)² × π



How does temperature affect rate of respiration?



How does temperature affect rate of respiration?

As temperature increases, the rate of respiration increases to an optimum. This is because the rate of enzyme activity increases.

Beyond the optimum, enzyme activity decreases as enzymes denature at high temperatures.



How does substrate concentration affect rate of respiration?



How does substrate concentration affect rate of respiration?

Enzyme-controlled metabolic pathway, so rate increases proportionally to substrate concentration.

Rate levels off when maximum number of enzyme-substrate complexes form at any given time.



How does atmospheric oxygen concentration affect rate of respiration?



How does atmospheric oxygen concentration affect rate of respiration?

As oxygen concentration decreases, rate of respiration gradually decreases.

Below 10% oxygen concentration, rate of respiration declines significantly.



How do different carbohydrate substrates affect the rate of respiration of microorganisms?



How do different carbohydrate substrates affect the rate of respiration of microorganisms?

The simpler the sugar, the faster the rate.

Can be investigated using the Smith fermentation tube method.

