OCR (A) Biology A-level

5.2.2 - Respiration

Flashcards

Why do organisms need to respire?

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- Produces ATP as energy currency for:

a) active transport against concentration gradients e.g. to absorb nutrients from small intestine/soil.

b) metabolic reactions e.g. to form peptide bonds in protein synthesis.

c) muscle contraction.

- Releases heat energy for thermoregulation.

Describe the structure of a mitochondrion.

Describe the structure of a mitochondrion.

surrounded by double membrane.

folded inner membrane forms **cristae**: site of electron transport chain.

fluid **matrix**: contains mitochondrial DNA, respiratory enzymes, lipids, proteins.

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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1. Glucose is phosphorylated to hexose bisphosphate by 2x ATP.
2. Hexose bisphosphate splits into 2x triose phosphate (TP).

2. 2x TP is oxidised to 2x pyruvate.

Net gain of 2x reduced NAD & 2x ATP per glucose.

Draw a flowchart to represent what happens during glycolysis.

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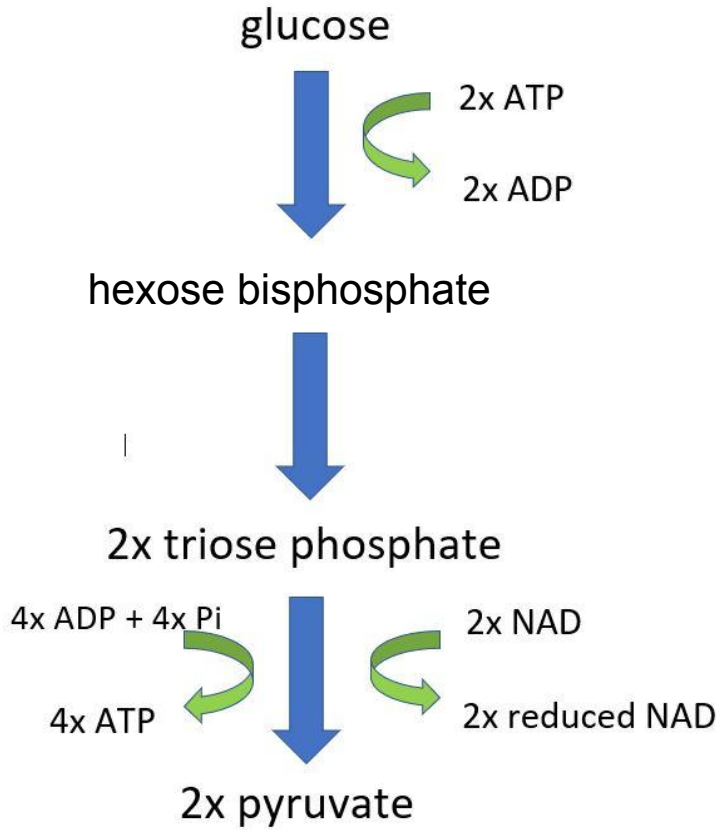

How does pyruvate from glycolysis enter the mitochondria?

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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 **1xCO_2** (decarboxylation) & 2H atoms (used to **reduce 1xNAD**).

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

Give a summary equation for the link reaction.

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pyruvate + NAD + CoA

$\longrightarrow$

Acetyl CoA + reduced NAD + CO_2

What happens in the Krebs cycle?

What happens in the Krebs cycle?

series of redox reactions produces:

- ATP by substrate-level phosphorylation
- reduced coenzymes
- CO_2 from decarboxylation

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

Outline the stages of the Krebs cycle.

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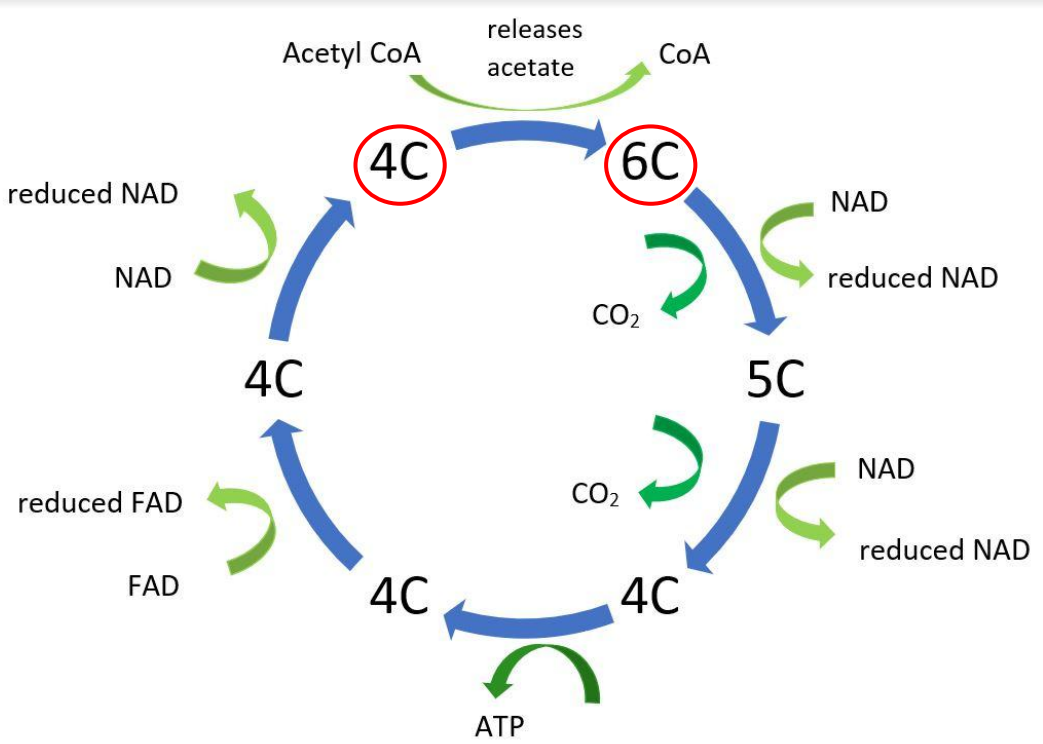
names of the circled compounds:

4C: oxaloacetate
6C: citrate



What is the electron transfer chain (ETC)?

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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 & FAD undergo successive redox reactions.

The energy released is coupled to maintaining proton gradient or released as heat.

Oxygen acts as 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 active transport of H^+ ions (protons) from mitochondrial matrix into intermembrane space.

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

ATP synthase catalyses ADP + Pi → ATP

State the role of oxygen in aerobic respiration.

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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 mammals?

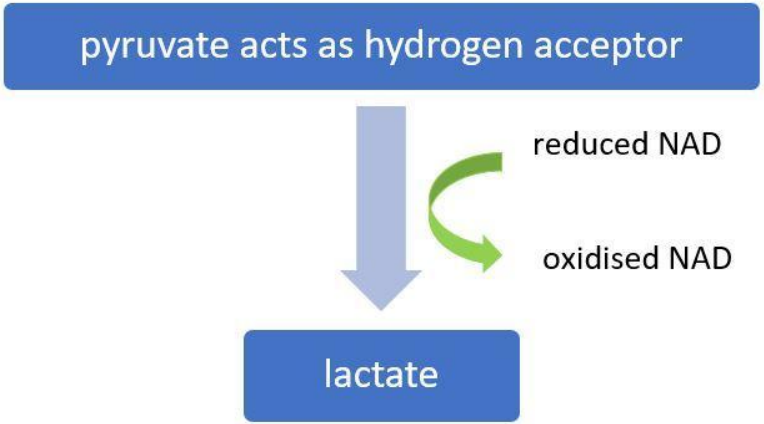
What happens during anaerobic respiration in animals?

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.

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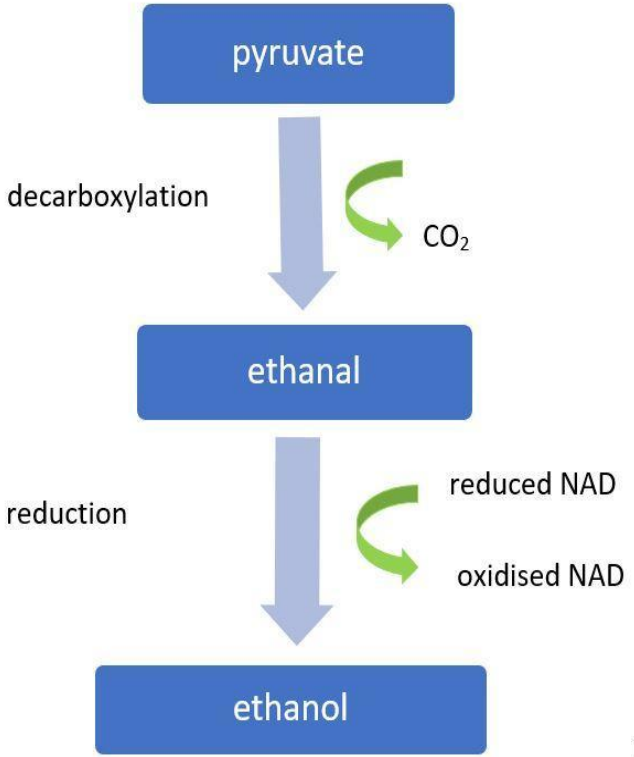

What are the benefits of being able to respire anaerobically?

What are the benefits of being able to respire anaerobically?

ATP production for vital metabolic processes continues.

Production of ethanol/ lactate converts reduced NAD back into NAD so glycolysis can continue = maximum yield of ATP in the conditions.

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

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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.

What is the purpose of sodium hydroxide solution in a respirometer set up to measure the rate of aerobic respiration?

What is the purpose of sodium hydroxide solution in a respirometer set up to measure the rate of aerobic respiration?

Absorbs CO_2 so that there is a net decrease in pressure as O_2 is consumed.

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 O_2 produced or CO_2 consumed/ time x mass of sample.

Volume = distance moved by coloured drop x (0.5 x capillary tube diameter)^2 x π.

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

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

What is the respiratory quotient (RQ)?

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RQ = carbon dioxide produced / 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.