CLUECUB · REVISION NOTES

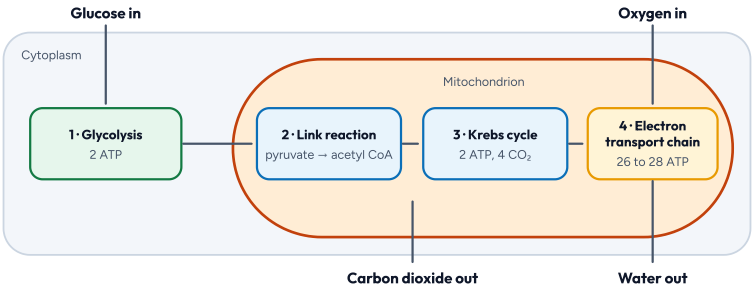
Cellular respiration notes

AEROBIC (WORD)
glucose + oxygen → carbon dioxide + water (energy is released and stored as ATP)

AEROBIC (SYMBOL)
$C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O$

ANAEROBIC, ANIMALS
glucose → lactic acid

ANAEROBIC, YEAST
glucose → ethanol + carbon dioxide (fermentation)



What it is

- Every living cell releases energy from **glucose** to make **ATP**, all the time.
- It is **exothermic**: it gives out energy.
- Respiration is **not breathing**. Breathing just moves air in and out of the lungs.

The four stages (aerobic)

- **Glycolysis** (cytoplasm): glucose → 2 pyruvate. Net **2 ATP** and 2 NADH.
- **Link reaction** (matrix): pyruvate → acetyl CoA, releasing CO_2.
- **Krebs cycle** (matrix): releases CO_2, makes NADH, $FADH_2$ and **2 ATP** per glucose.
- **Electron transport chain** (inner membrane): **oxygen** takes the electrons and forms water. Makes most of the ATP.

Aerobic vs anaerobic

- **Oxygen:** aerobic needs it; anaerobic doesn't.
- **Where:** aerobic finishes in the **mitochondria**; anaerobic stays in the **cytoplasm**.
- **ATP per glucose:** aerobic about **30 to 32**; anaerobic only **2**.
- **Products:** aerobic makes CO_2 and water; anaerobic makes lactic acid (animals) or ethanol and CO_2 (yeast, plants).

Hard exercise and oxygen debt

- When muscles can't get enough oxygen, they respire **anaerobically** and **lactic acid** builds up.
- Afterwards you keep breathing hard to repay the **oxygen debt**. The liver turns lactic acid back into glucose.

What cells use the energy for

- Muscle contraction, **active transport**, building large molecules such as proteins, sending nerve impulses, and keeping mammals and birds warm.

Mistakes that lose marks

- **Plants respire too**, day and night, as well as photosynthesising.
- ATP doesn't *contain* energy you can see. It is a **carrier** that passes energy to where it is needed.
- Anaerobic respiration releases **far less** energy, not none.
- Older books say 36 to 38 ATP per glucose. Most courses now use **about 30 to 32**.

Quick check

1. Where in the cell does glycolysis happen?
2. What is the final electron acceptor in the electron transport chain?
3. What do muscle cells make in anaerobic respiration?
4. About how many ATP does aerobic respiration make per glucose?
5. Which two stages release carbon dioxide?

Answers: 1. In the cytoplasm. 2. Oxygen. 3. Lactic acid. 4. About 30 to 32. 5. The link reaction and the Krebs cycle.