A. VOCABULARY

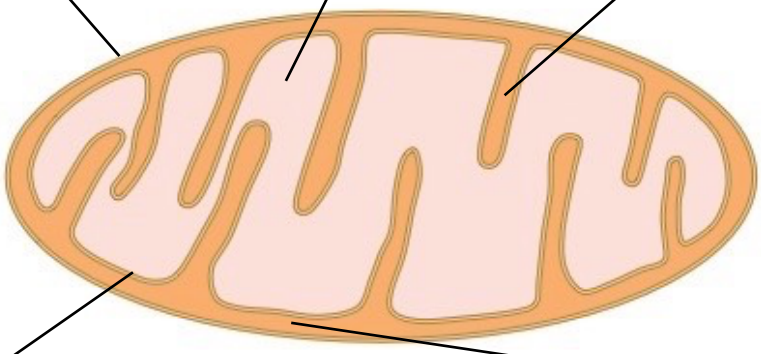
WORD	MEANING
PHOSPHORYLATION	**Adding** a **PHOSPHATE** group This makes a molecule **more reactive** and **less stable**.
OXIDATION	**Removing HYDROGEN**
REDUCTION	**Adding HYDROGEN**
DECARBOXYLATION	**Removing CARBON DIOXIDE**
NAD **FAD**	**Are co-enzymes that can pick up and release HYDROGEN** **NADH = reduced NAD (picked up H)** **NAD = oxidised NAD (released H)**

B. A MITOCHONDRION

Outer membrane
- Contains **transport proteins** for moving **pyruvate** into the **mitochondrion**

Matrix
- Has an **optimum pH** and **enzymes** for the **Kreb's cycle**

Cristae
- **Highly folded** to give a **high SA:VOL** for **oxidative phosphorylation**



Inner membrane
- Contains **electron transport chains** and **ATP synthase** for **oxidative phosphorylation**

Intermembrane space
- Small space that **accumulates protons** (H^+) to give a **high proton concentration gradient**.

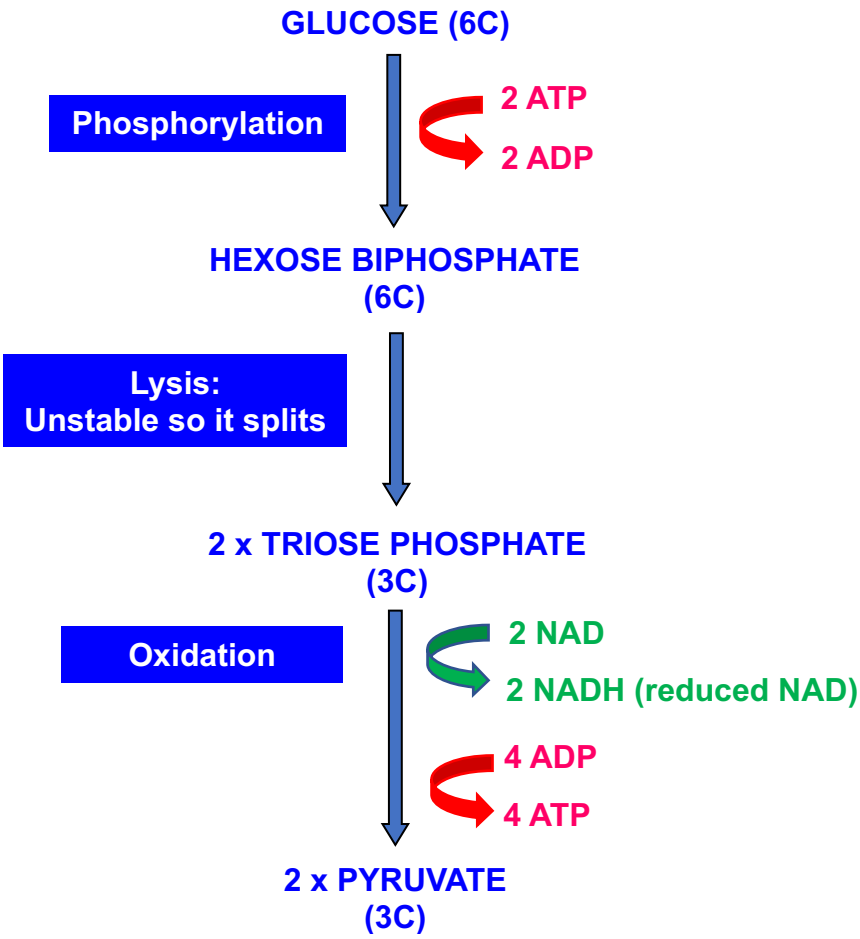
C. THE POINT OF EACH STAGE

Stage	Where It Occurs	The Point Of It
Glycolysis	**Cytoplasm**	To get glucose into a form that can **enter mitochondria**
Link Reaction	**Matrix**	To get the substance into a form that can **enter Kreb's cycle**
Kreb's Cycle	**Matrix**	To **produce lots** of **NADH** and **$FADH_2$**
Oxidative Phosphorylation	**Cristae**	To **use the 'H'** from **NADH** and **$FADH_2$** to **produce ATP**

D. AEROBIC RESPIRATION

Stage 1: Glycolysis (Cytoplasm)

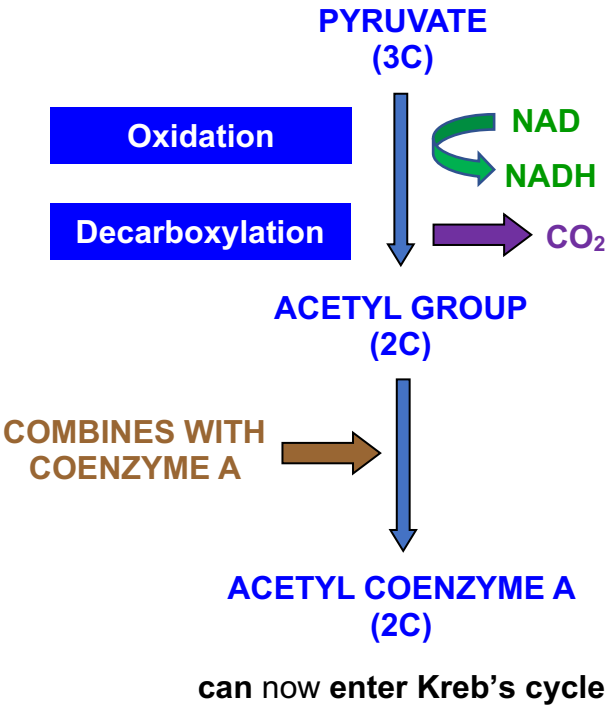
- Converts **glucose** to **pyruvate** so it can enter a **mitochondrion**.



can now **enter** a **mitochondrion**

Stage 2: Link Reaction (Matrix)

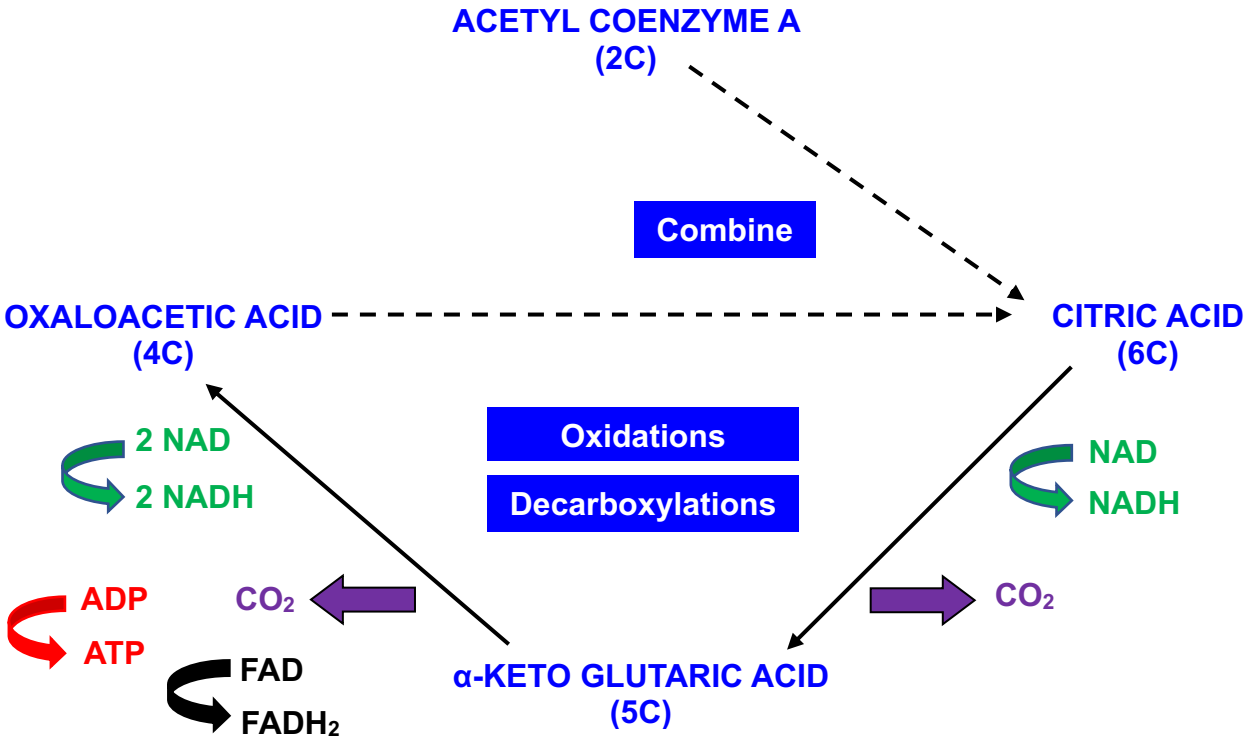
- **Oxidation** and **decarboxylation** to convert **pyruvate** to **acetyl coenzyme A** that can enter **Kreb's cycle**.



can now **enter Kreb's cycle**

Stage 3: Kreb's cycle (Matrix)

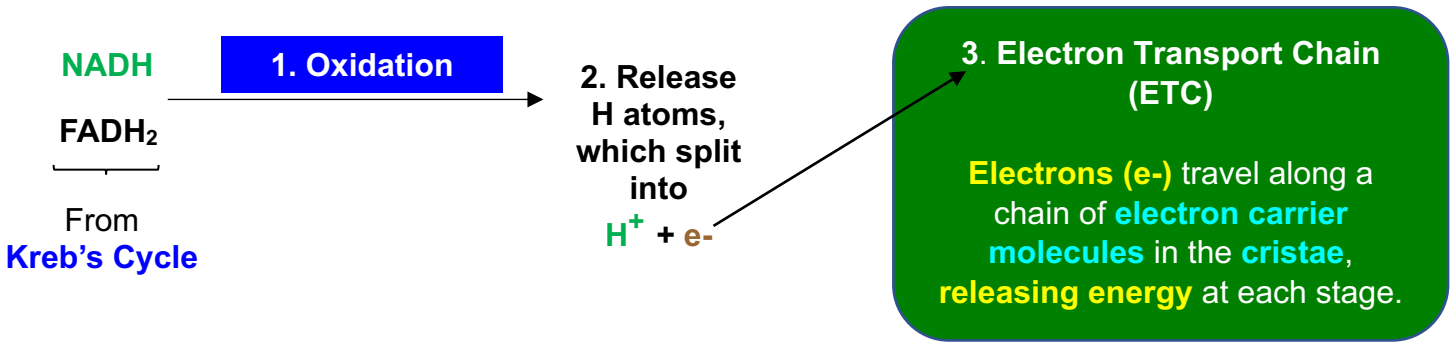
- **Oxidations** and **decarboxylations** occur to produce lots of **NADH** and **$FADH_2$.**

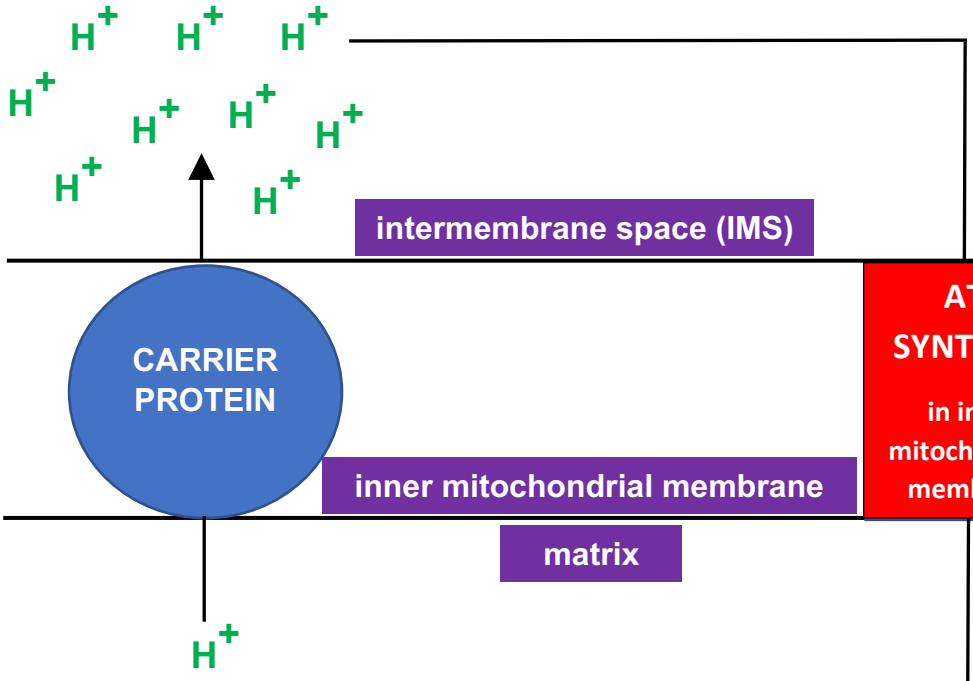


- **NADH** and **$FADH_2$** are needed in **oxidative phosphorylation** to produce **ATP** molecules.

Stage 4: Oxidative phosphorylation (Cristae)

- All about **oxidising NADH** and **$FADH_2$** so that **energy** can be used to make **ATP** molecules .





5. H^+ accumulate in the **intermembrane space** so they **diffuse back** into the **matrix** through **ATP synthase down** the **proton concentration gradient**

4. The **energy released** from the **electrons** is used to **pump H^+** (**protons**) from the **matrix** to the **intermembrane space** through a **carrier protein**

6. **Energy** in this **H^+ (proton) concentration gradient** is used by **ATP synthase (enzyme)** to **build up molecules** of **ATP** from **ADP + Pi**

$2H^+ + ½ O_2 + 2e^- \rightarrow H_2O$

7. **H^+** and **e^-** (from carriers) **combine with O_2** to form **H_2O.**

O_2 is the **'terminal electron acceptor'** in the electron transport chain (ETC).

- **ATP** is made by **chemiosmosis** – using **energy** in the **proton concentration gradient.**
- **Chemiosmosis couples** (links) **ATP production** with the **movement** of **electrons** and **H^+** (**protons**).

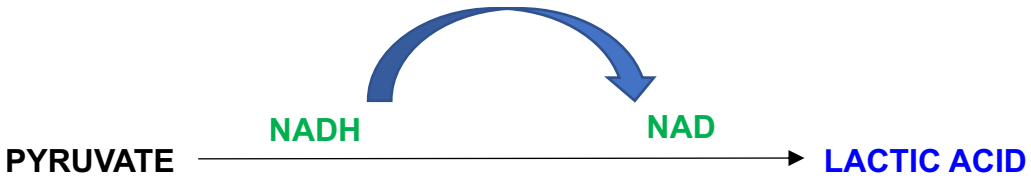
E. ANAEROBIC RESPIRATION

- **No oxygen**
- Oxygen is the **terminal electron acceptor** in the **electron transport chain** (**ETC**).
- (So) **electron flow** along the electron transport chain **stops**.
- (So) **NADH cannot** be **oxidised/converted back** to **NAD**.
- (So) supplies of **NAD run out** in the mitochondrion so the **link reaction** and **Kreb's cycle cannot continue**.
- The **body** must have another way of **producing ATP**, otherwise **death** could occur.
- This is achieved by **regenerating NAD** for **glycolysis**, so that it can continue to produce a **small amount** of **ATP** 'to keep us going'.

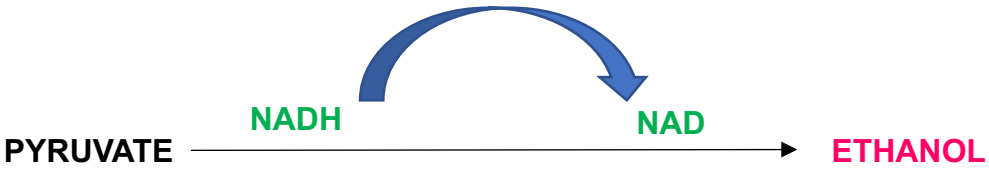
How NAD is regenerated for glycolysis

- By **reducing pyruvate**

Animals



Plants & Yeast



- By **reducing pyruvate**, **NAD** is **again made available** to **oxidise triose phosphate** to **pyruvate**. This reaction **produces ATP**.