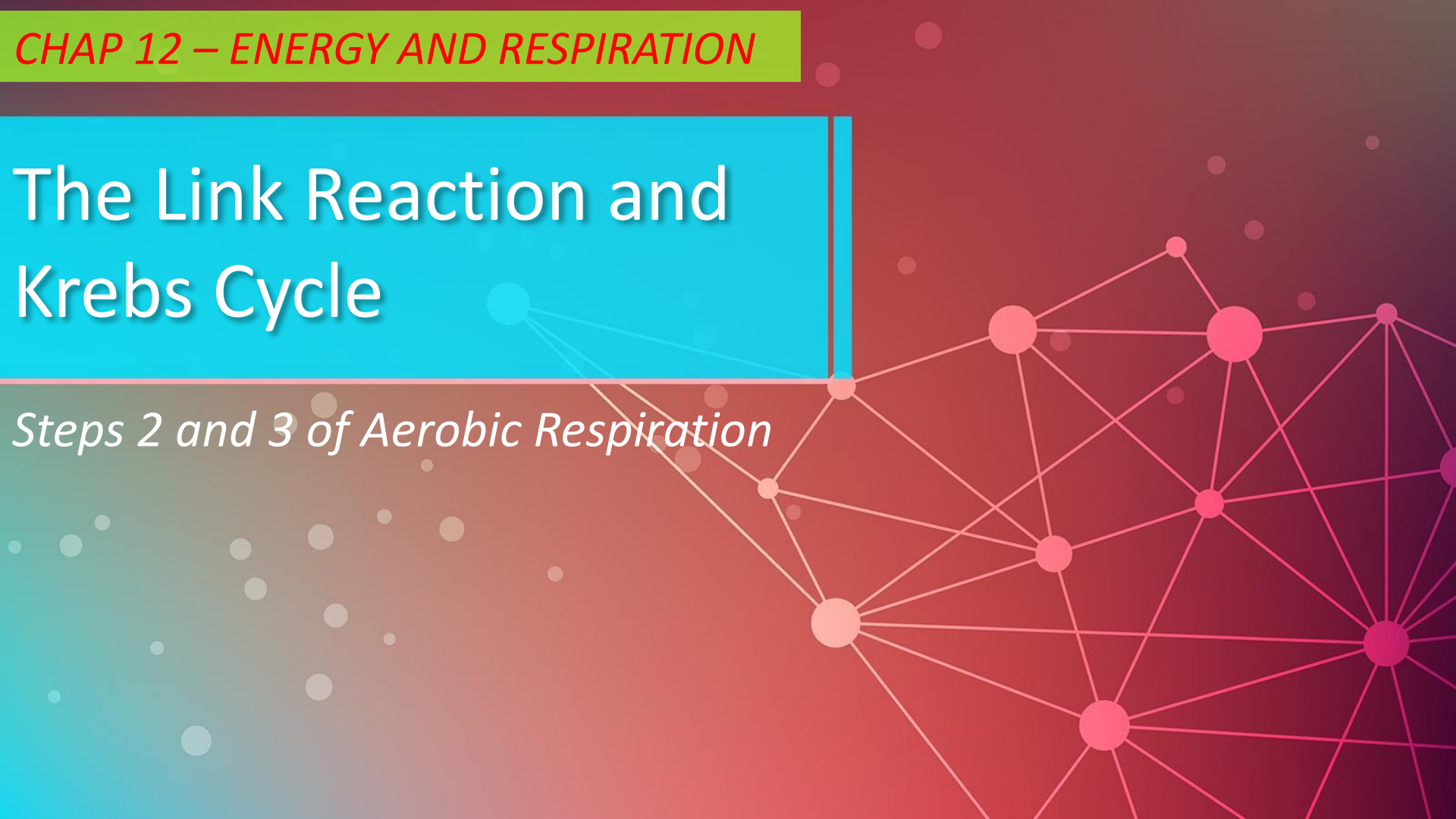
The Link Reaction and Krebs Cycle

Steps 2 and 3 of Aerobic Respiration



Terms to keep in mind:

Link Reaction

- Decarboxylation
- Dehydrogenation
- Coenzyme A (CoA)
- Acetyl coenzyme A (2C)
- NAD reduction
- CO2

Krebs Cycle

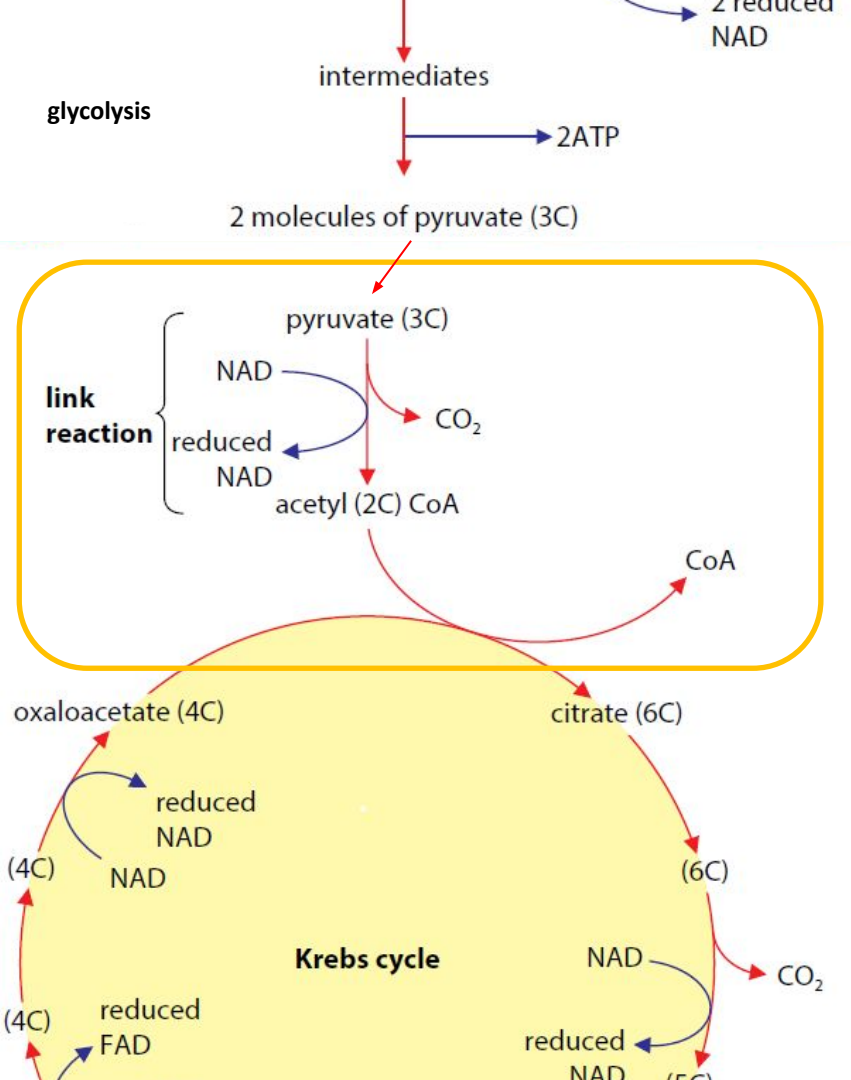
- Citric acid cycle (other name of krebs cycle)
- Oxaloacetate (4C)
- Citrate (6C)
- Decarboxylation & dehydrogenation
- CO2
- NAD and FAD (hydrogen acceptors)

The Link Reaction

- Happens only when there is oxygen in cell environment
- Connects glycolysis to Krebs Cycle
- No net ATP is produced here.

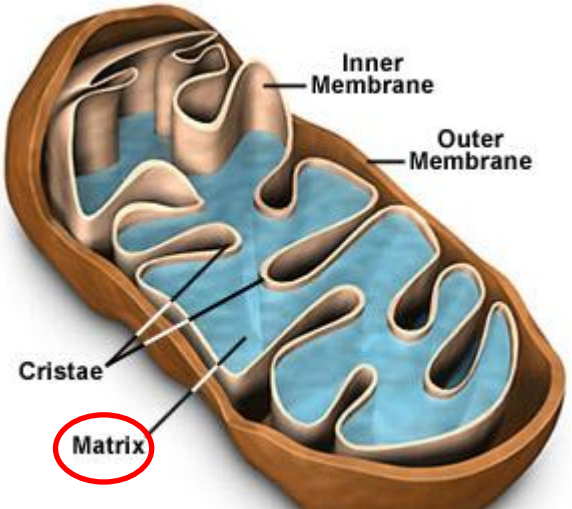
Events occurring:

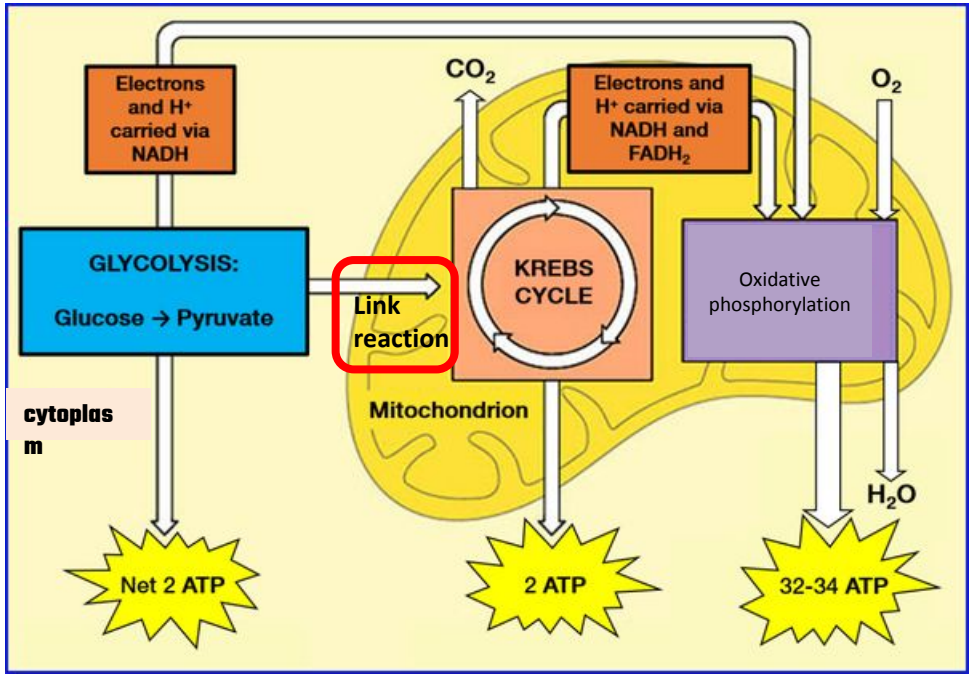
- *NAD reduction (gaining hydrogen)*
- *Pyruvate (3C) loses one carbon and becomes acetyl (2C) CoA*
- *Lost carbon binds with oxygen – forming CO2*



Where is link reaction happening?

- Link reaction occurs in the ***mitochondrial matrix***





Events occurring in link reaction

1. Dehydrogenation of pyruvate

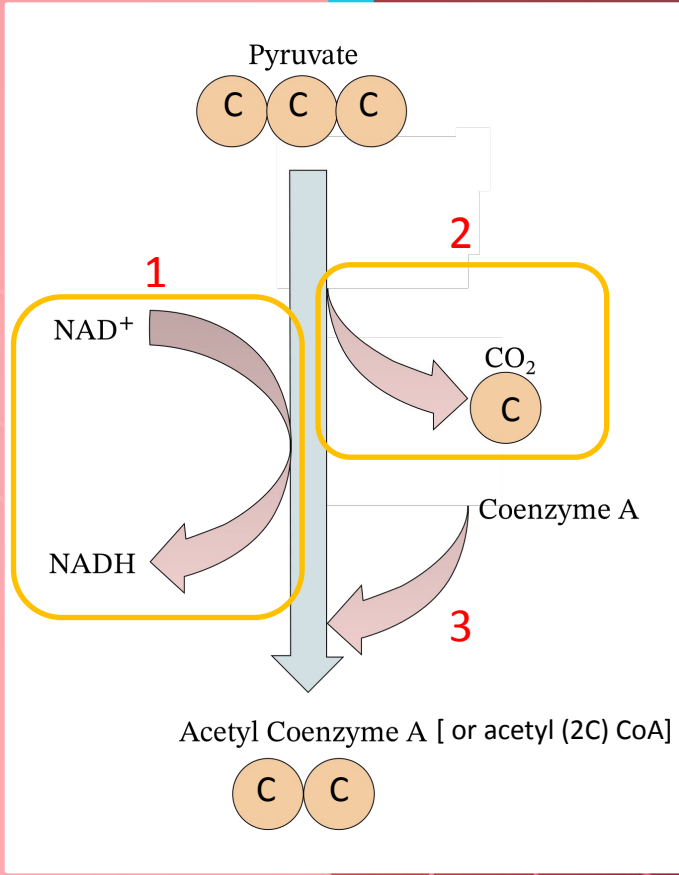
- *NAD takes one hydrogen from pyruvate (2C)*
- *NAD is reduced (gains hydrogen)*
- *Pyruvate is oxidized (loses hydrogen)*

2. Carboxylation of pyruvate

- *One carbon removed from pyruvate and bind with O2 to form CO2*
- *Pyruvate (3C) becomes acetyl (2C)*

3. Addition of Coenzyme A (CoA) to acetyl

- *Acetyl binds to CoA to form Acetyl (2C) CoA*

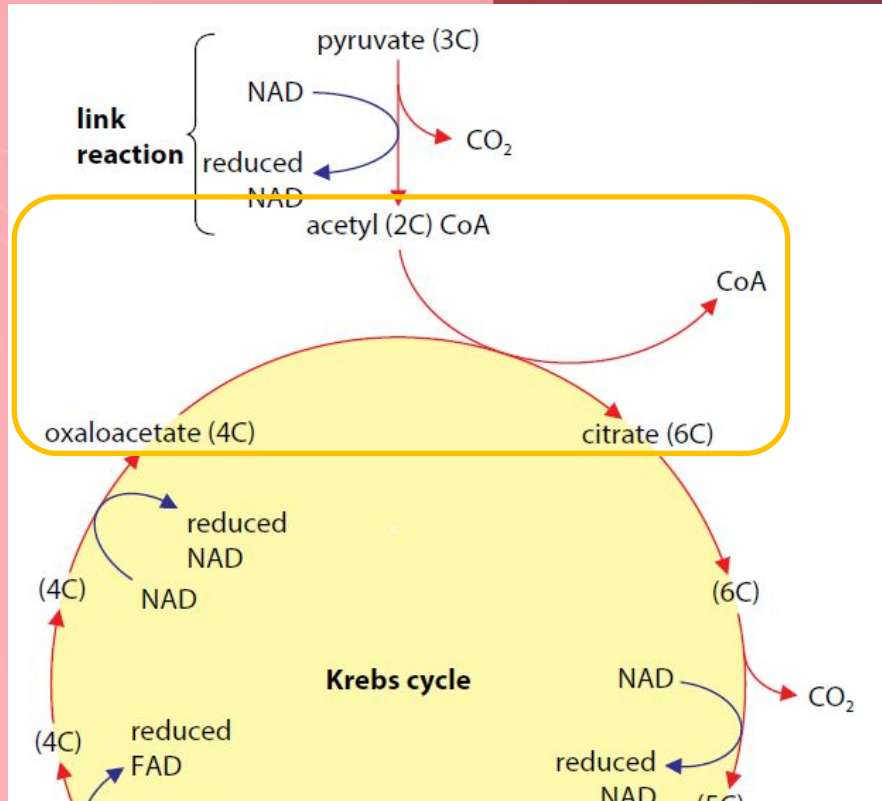


Role of Coenzyme A (CoA)

- It helps an enzyme to catalyse a reaction but it's not part of that reaction.
- *It carries acetyl molecules to the Krebs cycle – to transform oxaloacetate (4C) to citrate (6C)*

Link reaction equation:

Pyruvate + CoA + NAD → acetylCoA + CO2 + NADH

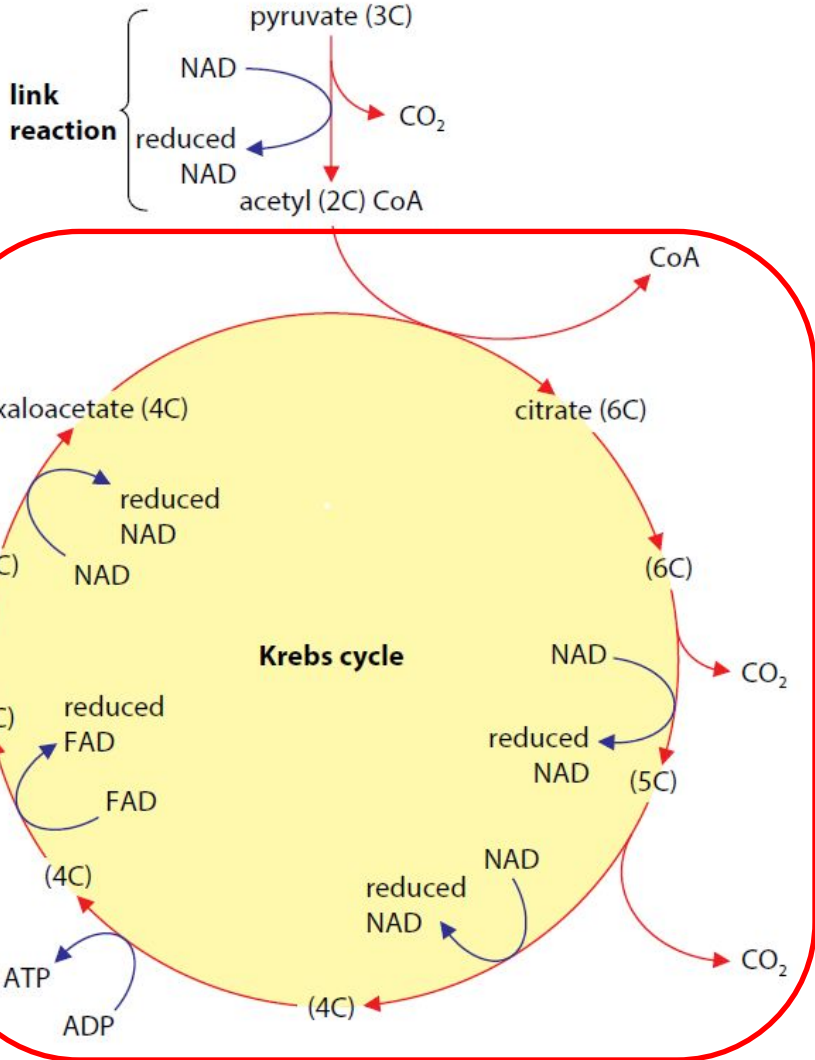


Krebs Cycle

- Also known as “citric acid cycle”
- Produces net 2 ATP

Events involved:

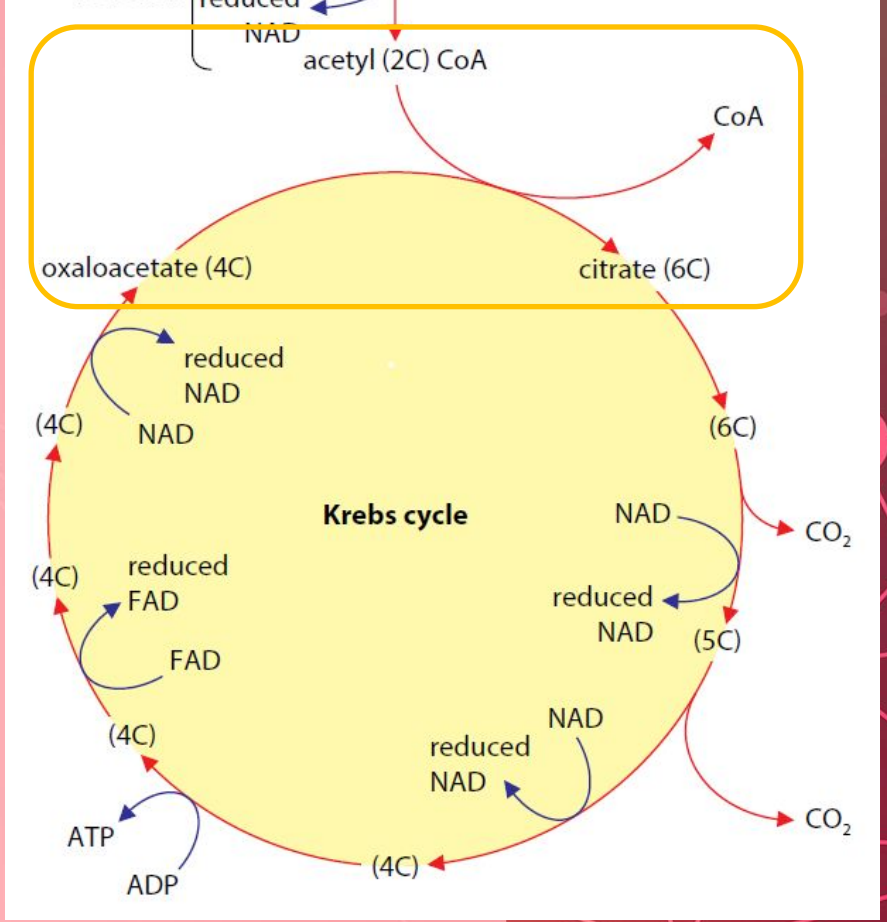
- *Transformation of citrate (6C) to oxaloacetate (4C)*
- *Creation of CO2*
- *NAD reduction*
- *FAD reduction*
- *ATP production*



Krebs Cycle Events

1. Oxaloacetate (4C) to citrate (6C)

- *2 carbons of acetyl (2C) CoA will attach to oxaloacetate (4C) – forming citrate (6C)*
- *Coenzyme A (CoA) is removed to be used again for another link reaction*

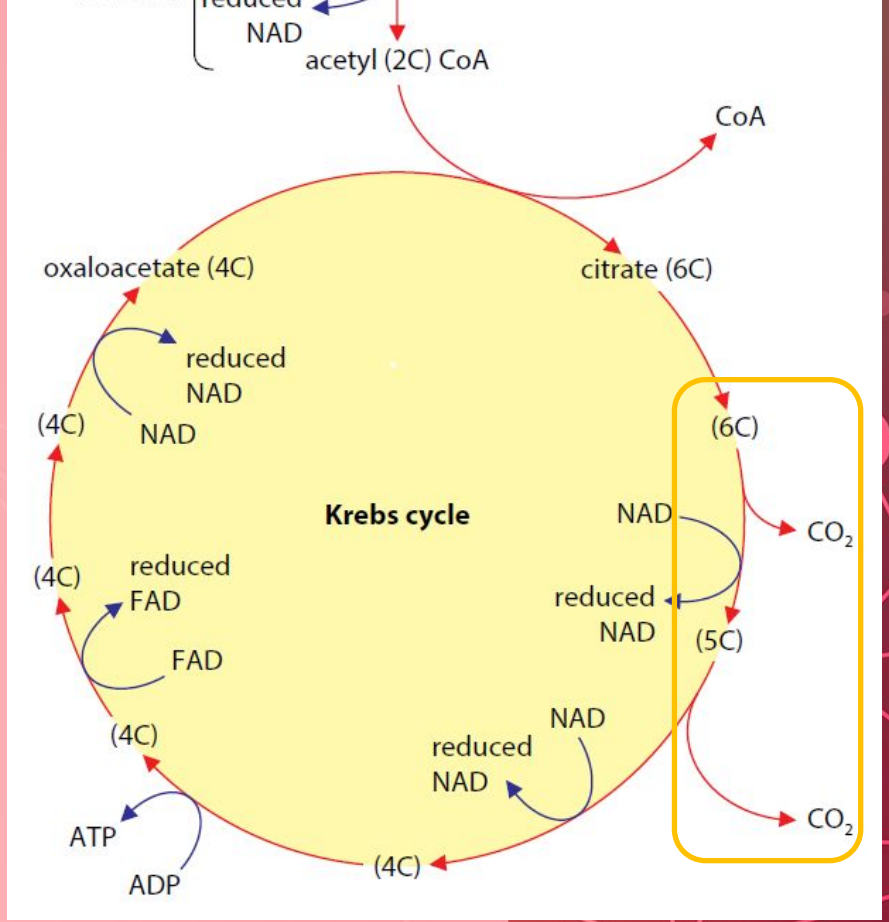


oxaloacetate (4C) + acetyl (2C) CoA → citrate (6C) + CoA

Krebs Cycle Events

2. Decarboxylations of citrate

- *Citrate transforms from 6C to 4C intermediates.*
- *Along the process, 2 carbons are removed from citrate and bind to O2 – forming CO2*
- *Net CO2 produced by 1 cycle:* 2



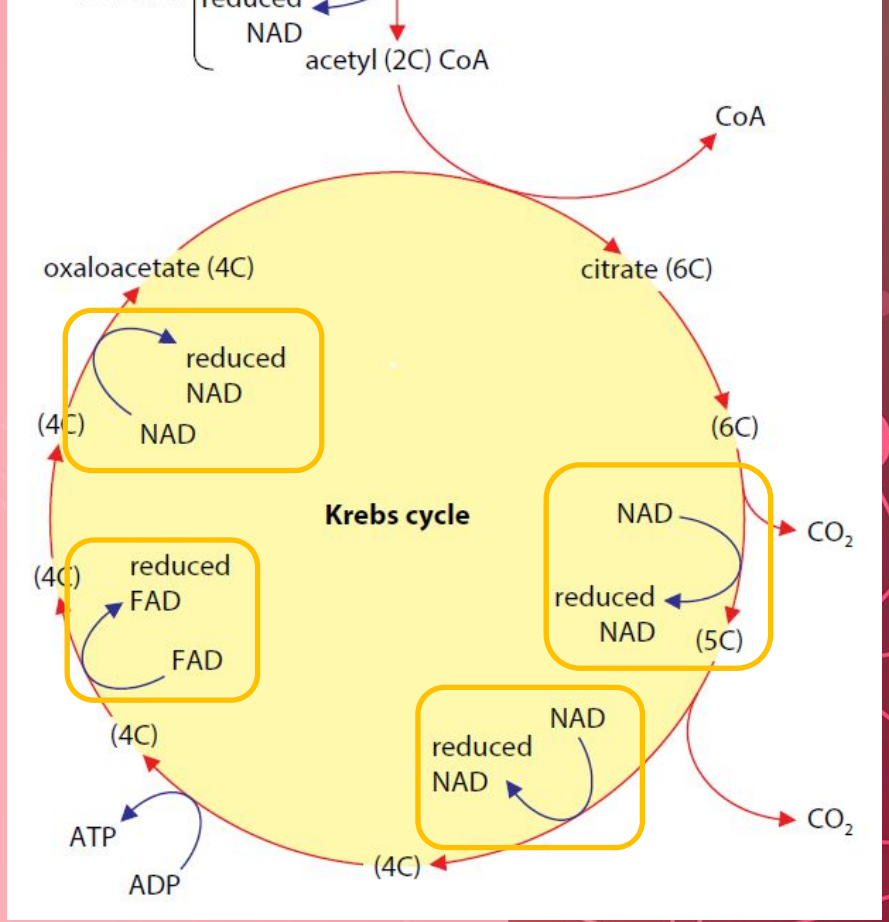
oxaloacetate (4C) + acetyl (2C) CoA → citrate (6C) + CoA

Krebs Cycle Events

3. Dehydrogenations of citrate

- *Along the process, NAD and FAD molecules take away hydrogens from citrate intermediates.*

- *3 NAD molecules are reduced to NADH (gain hydrogen)*
- *1 FAD to FADH is reduced (gains hydrogen)*

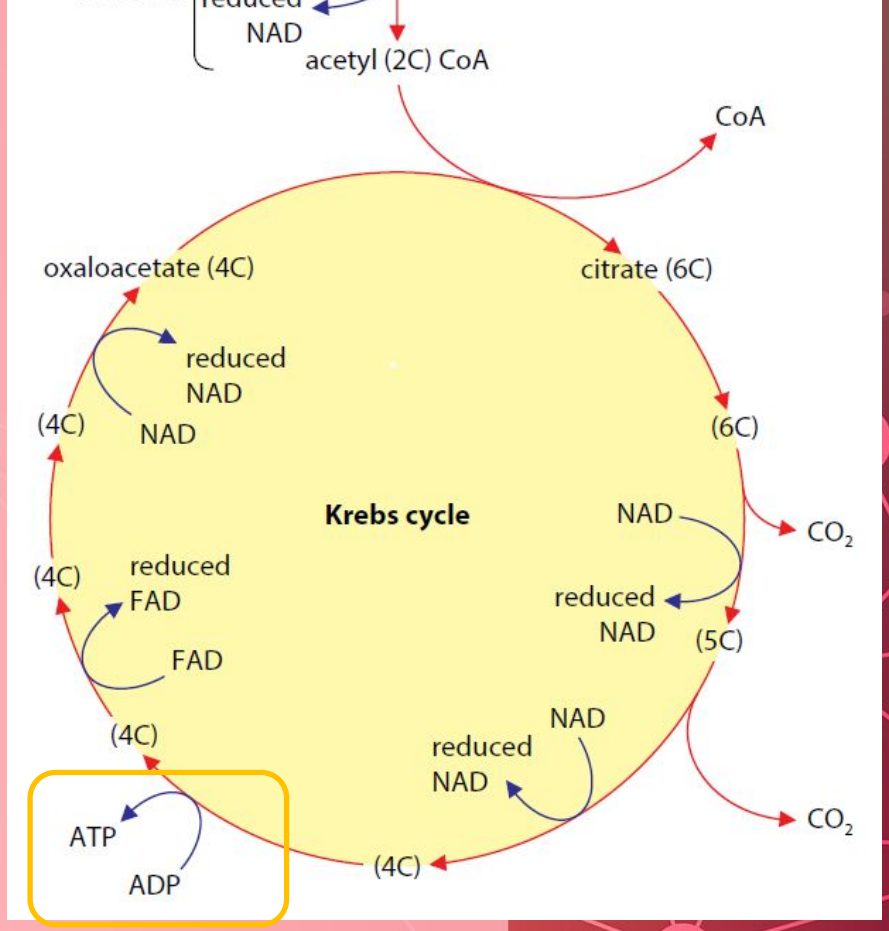


oxaloacetate (4C) + acetyl (2C) CoA → citrate (6C) + CoA

Krebs Cycle Events

3. ATP production

- *ATP is produced along the 4C intermediates series*
- *Net ATP produced by 1 krebs cycle:* *1*
- *Net ATP produced by 1 glucose:* *2*



oxaloacetate (4C) + acetyl (2C) CoA → citrate (6C) + CoA

ATP Production Tally of 1 glucose so far…

Stage	ATP used	ATP made	Net gain in ATP
Glycolysis	2	4	2
Link reaction	0	0	0
Krebs cycle	0	2	2

Looking at these processes so far, was oxygen directly involved in the production of ATP???

Last Steps…

Oxidative phosphorylation

- *Happens in the inner mitochondrial membrane (folds called **cristae**)*
- *carbon-compound intermediates from krebs cycle are not involved anymore.*
- *Only the reduced NAD and FAD from both glycolysis and krebs cycle are used here.*
- *Redox reactions via transfer of electrons is involved*