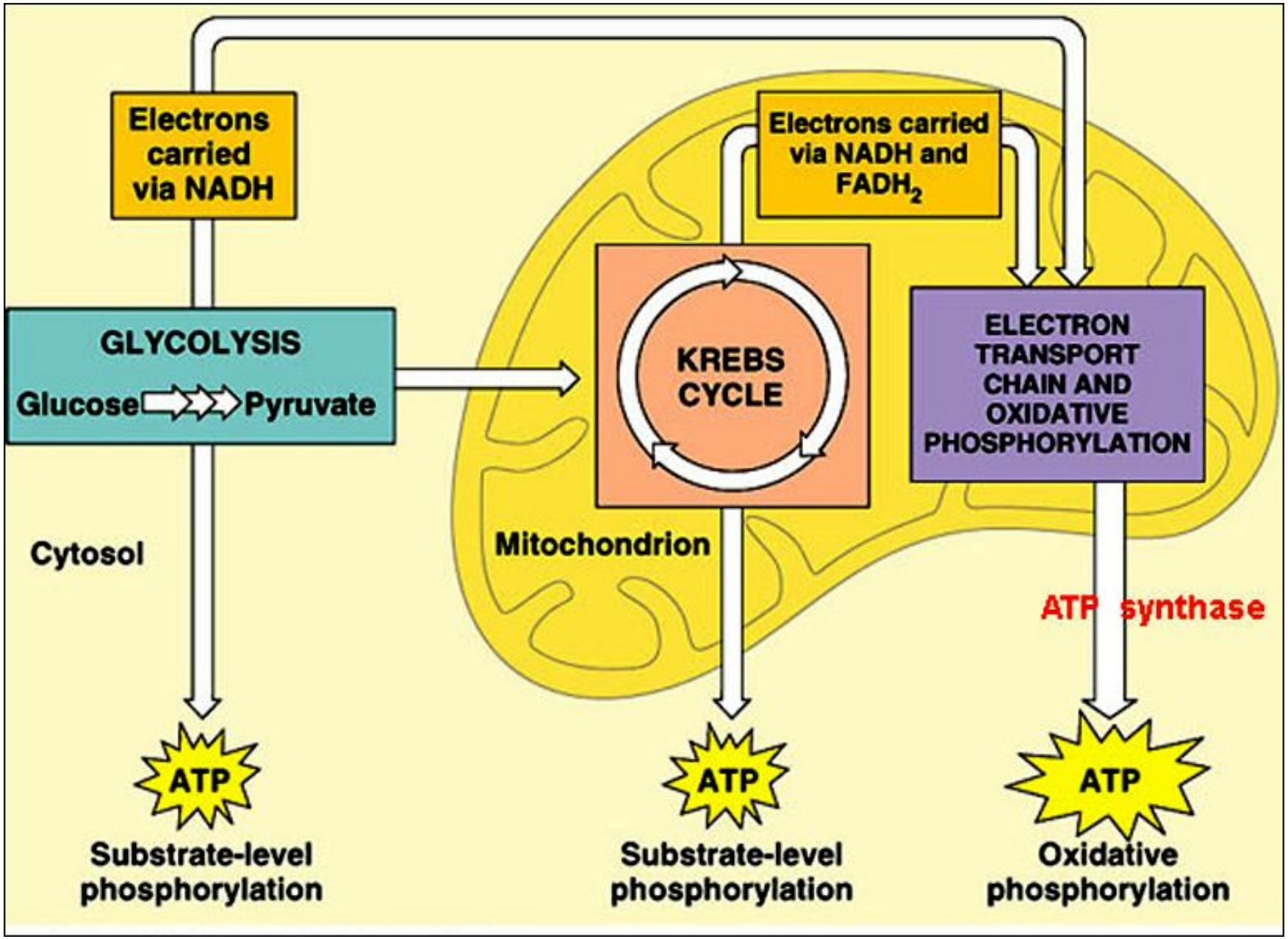

Electrons carried via NADH
Electrons carried via NADH and $FADH_2$
GLYCOLYSIS
Glucose
Pyruvate
KREBS CYCLE
ELECTRON TRANSPORT CHAIN AND OXIDATIVE PHOSPHORYLATION
Cytosol
Mitochondrion
ATP synthase
ATP
ATP
ATP
Substrate-level phosphorylation
Substrate-level phosphorylation
Oxidative phosphorylation

The Krebs cycle

Learning objective

- describe the Krebs cycle

Success criteria

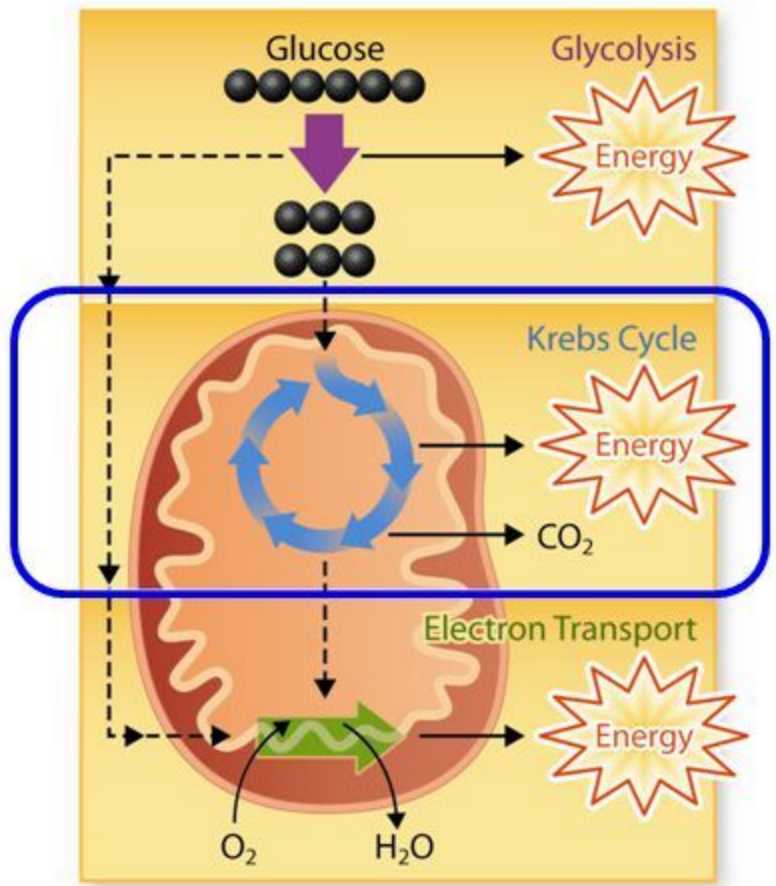
1. Knows the Krebs cycle
2. Describes the Krebs cycle
3. Correctly identifies incoming and outgoing products of the Krebs cycle
4. Explains the role of the Krebs cycle in energy metabolism

Terminology

Acetyl-CoA, Citric acid cycle, Citrate – 6C, Isocitrat – 6C, Alfa – Ketoglutarat 5C, Succinyl – CoA – 4C, Succinat – 4C, Fumarate – 4C, Malat – 4C, Oxalacetat - 4C, ATP, NADH, FADH, CO_2, Alfa – Ketoclutarat synthase, Fumarate reductase,

Stage 2: Krebs Cycle

In the second stage of cellular respiration a little more energy is converted.

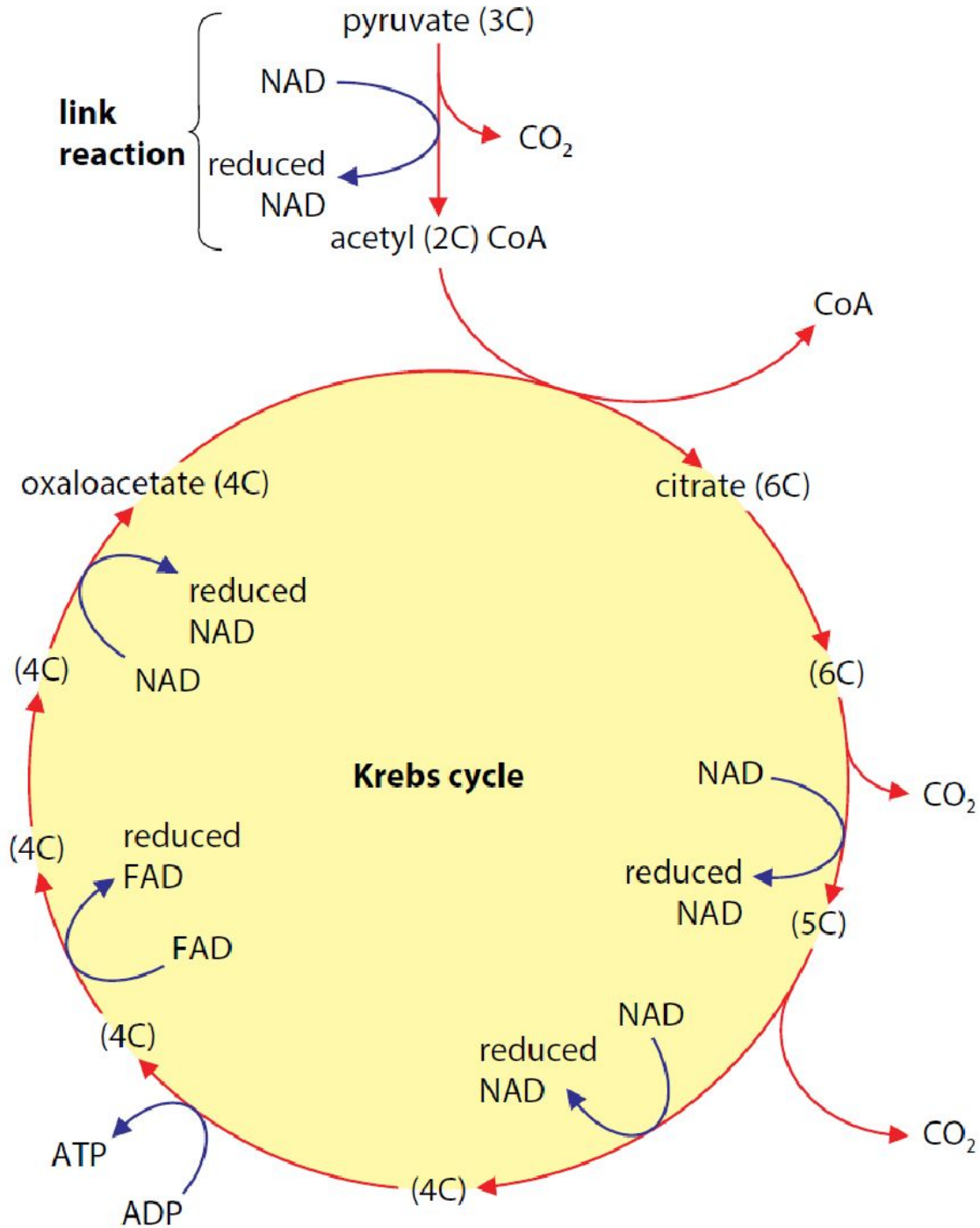


The Krebs cycle

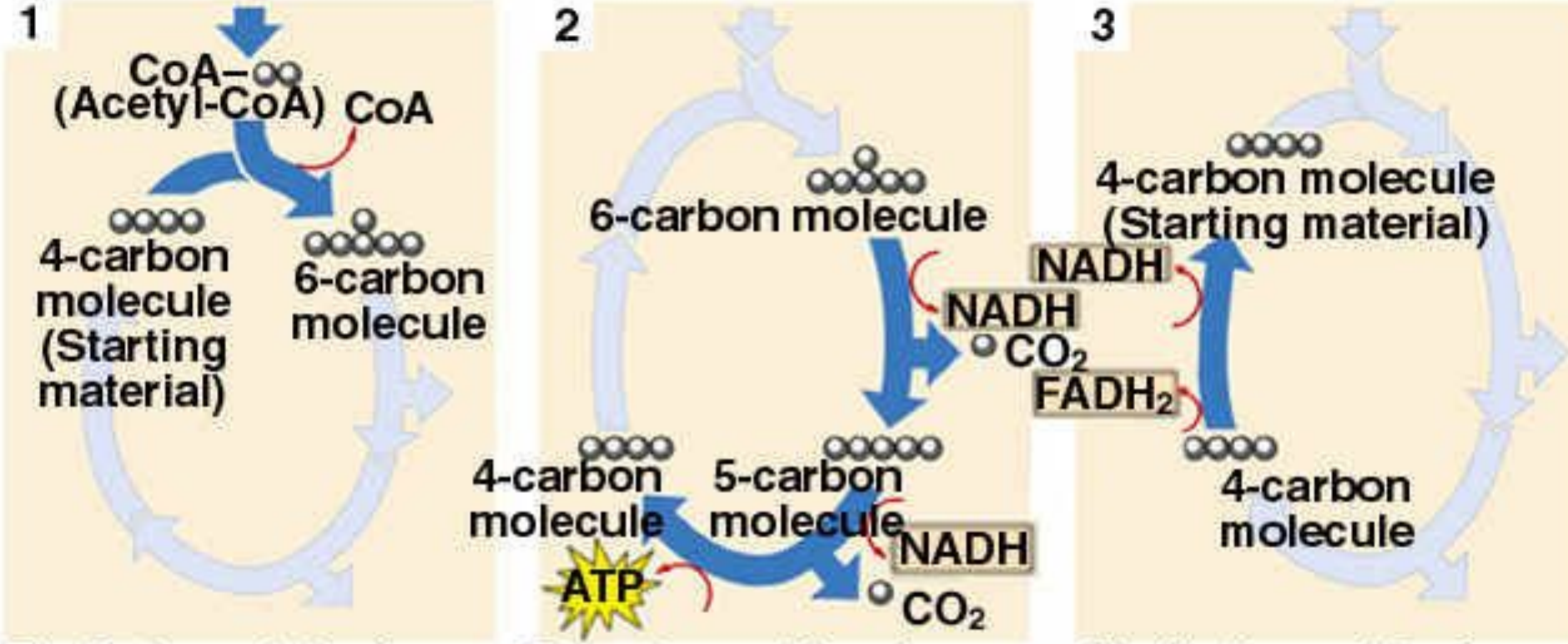
The Krebs cycle (also known as the citric acid cycle or tricarboxylic acid cycle) was discovered in **1937 by Hans Krebs**.

The Krebs cycle is a closed pathway of **enzyme controlled reactions**.

- **Acetyl coenzyme A combines with a four-carbon compound (oxaloacetate)** to form a **six-carbon compound (citrate).**
- The citrate is **decarboxylated** and **dehydrogenated** in a series of steps, to yield **carbon dioxide**, which is given off as a waste gas, **and hydrogens which are accepted by the carriers NAD and FAD**.
- **Oxaloacetate is regenerated to combine with another acetyl coenzyme A.**


pyruvate (3C)
link reaction
NAD
reduced NAD
CO_2
acetyl (2C) CoA
CoA
oxaloacetate (4C)
citrate (6C)
reduced NAD
NAD
(4C)
(6C)
Krebs cycle
NAD
CO_2
reduced NAD
(5C)
(4C)
reduced FAD
FAD
NAD
reduced NAD
(4C)
CO_2
ATP
ADP
(4C)

Krebs Cycle Overview



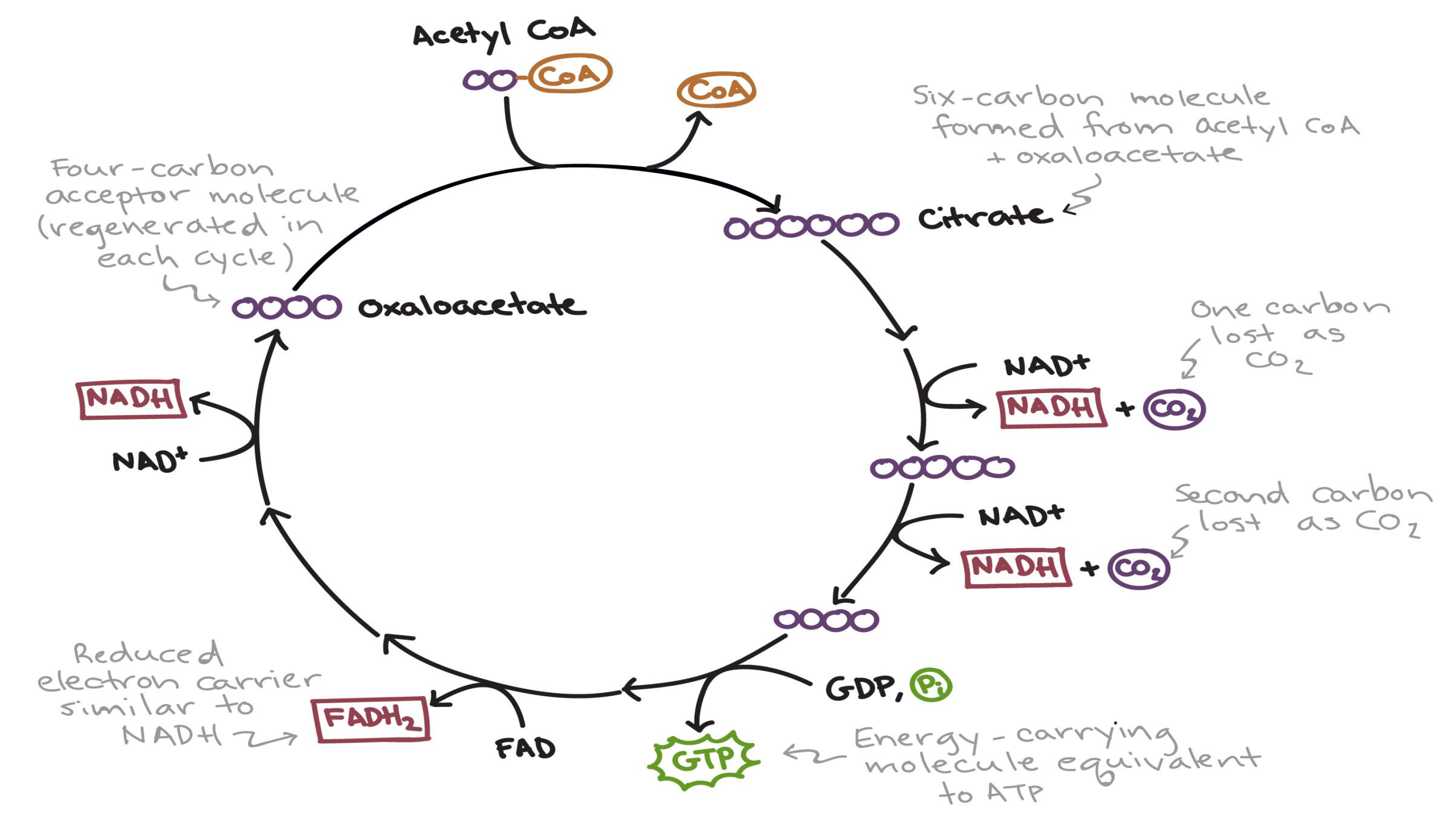
The Krebs cycle begins when a two-carbon fragment is transferred from acetyl-CoA to a four-carbon molecule (the starting material).

Then, the resulting six-carbon molecule is oxidized (a hydrogen removed to form NADH) and decarboxylated (a carbon removed to form CO_2). Next, the five-carbon molecule is oxidized and decarboxylated again, and a coupled reaction generates ATP.

Finally, the resulting four-carbon molecule is further oxidized (hydrogens remove to form $FADH_2$ and NADH). This regenerates the four-carbon starting material, completing the cycle.

the Krebs cycle

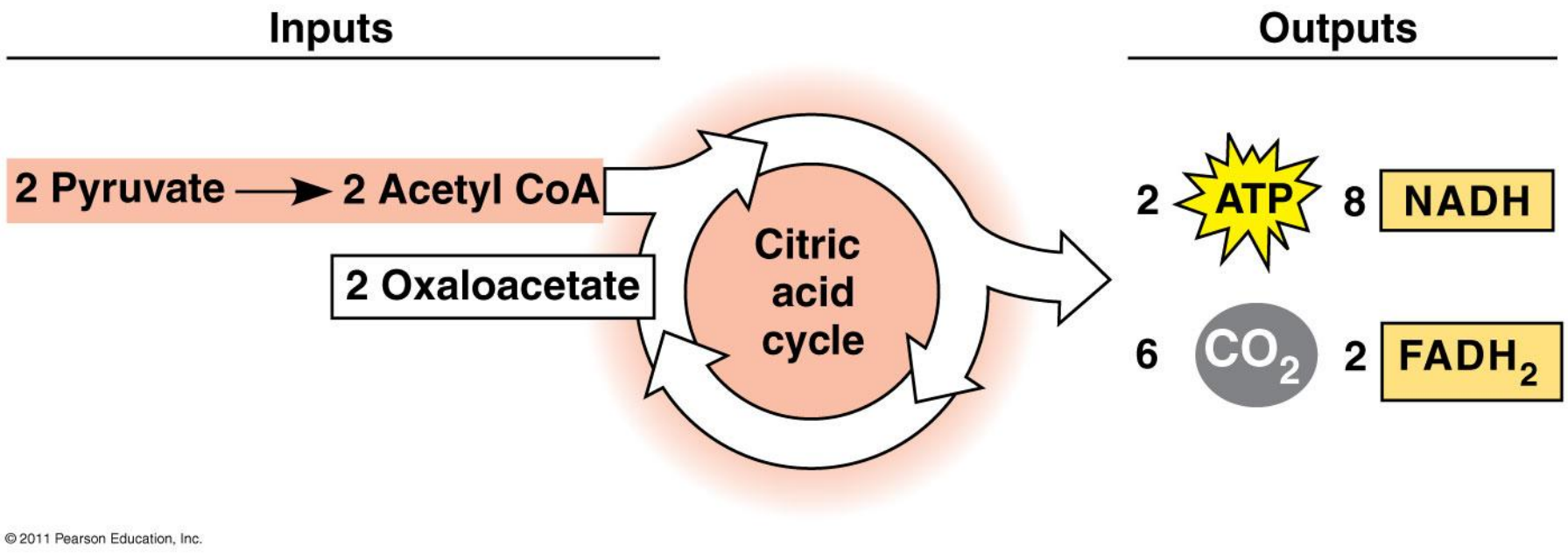
- **Two molecules of carbon dioxide** are given off in separate **decarboxylation reactions**.
- A molecule of **ATP is formed as part 1** of the reactions of the cycle - as with glycolysis, this **ATP synthesis** is 'at substrate level' too.
- **Three molecules of reduced NAD are formed**.
- One molecule of another hydrogen accepter - **FAD (flavin adenine dinucleotide) is reduced.** (NAD is the chief hydrogen- carrying coenzyme of respiration but FAD is another coenzyme with this role in the Krebs cycle).


Acetyl CoA
CoA
CoA
Six-carbon molecule formed from acetyl CoA + oxaloacetate
Citrate
Four-carbon acceptor molecule (regenerated in each cycle)
Oxaloacetate
NAD+
NADH + CO2
One carbon lost as CO2
NADH
NAD+
NAD+
NADH + CO2
Second carbon lost as CO2
GDP, Pi
Reduced electron carrier similar to NADH
FADH2
FAD
GTP
Energy-carrying molecule equivalent to ATP

	Product			
Step	CO_2	ATP	Reduced NAD	Reduced FAD
Glycolysis	0	2	2	0
Link reaction (pyruvate → acetyl CoA)	2	0	2	0
Krebs cycle	4	2	6	2
Totals	6	4	10	2

http://www.dbriers.com/tutorials/wp-content/uploads/2009/09/CitricAcidMol2.jpg

Summary of Citric Acid Cycle



Overall

The Krebs cycle will produce the following products for every glucose molecule broken down

- 6 NADH
- 2 FADH2
- 2 ATP
- 4 CO_2