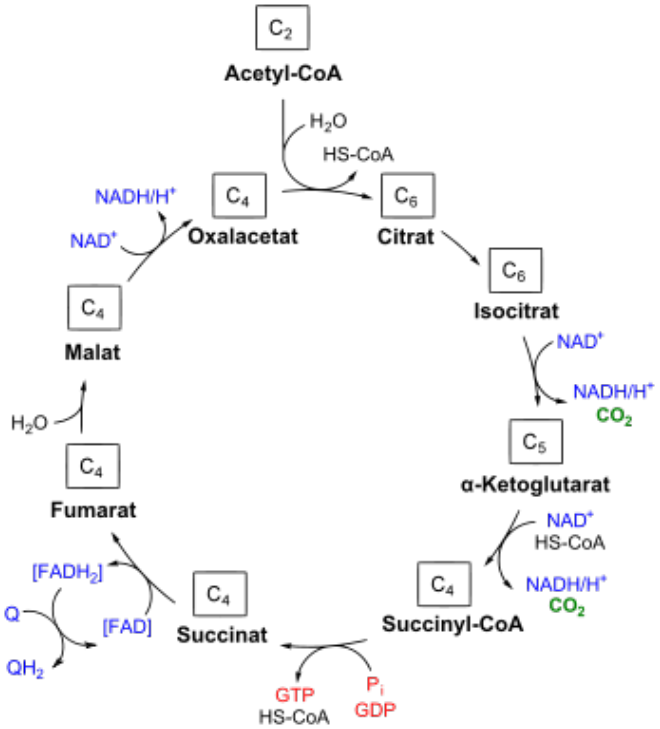
CONCEPT: CITRIC ACID CYCLE (KREBS CYCLE - TCA CYCLE)

Overview

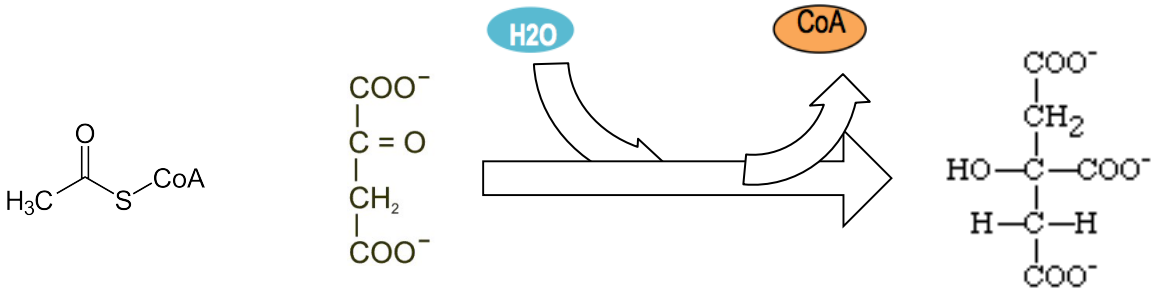
- The **citric acid cycle** is a set of metabolic reactions that occur after glycolysis to _____ CO_2 and NADH
  - □ Pyruvate (glycolysis product) is decarboxylated (removes carboxyl group and releases CO_2) to create *acetyl CoA*
    - **Acetyl CoA** is the starting molecule for the citric acid cycle
    - The **pyruvate dehydrogenase complex** is the group of proteins responsible for this reaction
  - □ The citric acid cycle oxidizes acetyl CoA to _____ 1 GTP, 3 NADH, and 1 $FAHD_2$
    - The NADH is passed to the next step in cellular respiration (electron transport chain)
  - □ The requirement for oxygen is indirect (the citric acid cycle doesn't use oxygen) but it is still classified as aerobic
    - The electron transport chain needs oxygen to replace the NAD^+ used by the citric acid cycle

EXAMPLE: Overview of the Citric Acid Cycle



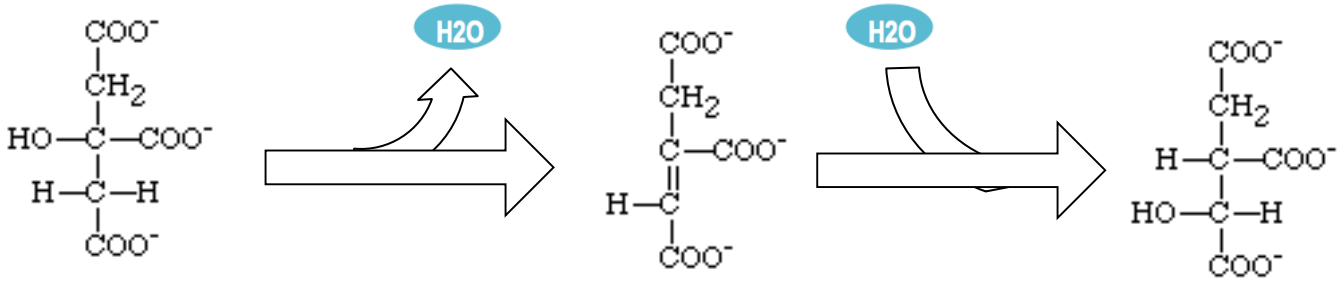
Cycle Steps

1. **Citrate Synthesis**
   - Water is consumed and CoA is released



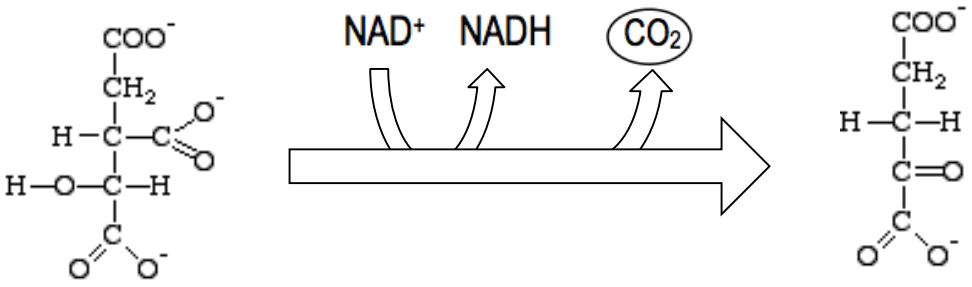
Acetyl-CoA Oxaloacetate Citrate

2. **Isomerization** (rearrangement of atoms)
   - Hydroxyl group is isomerized



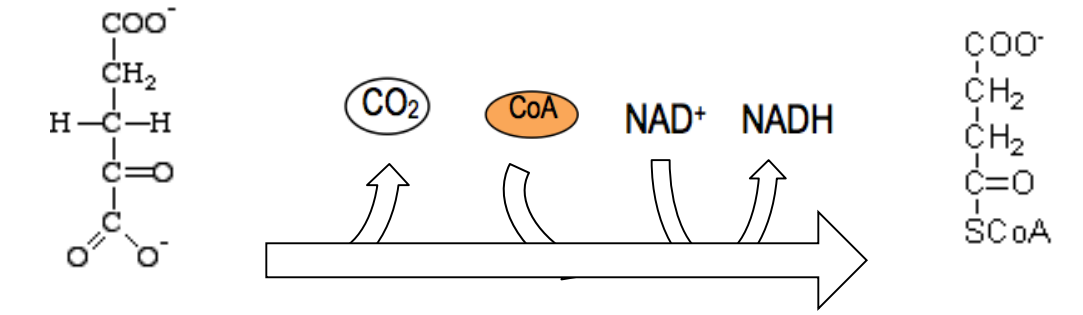
Citrate *Cis*-aconitate isocitrate

3. **CO_2 and NADH creation**
   - Carbon oxidation creates CO_2 and NADH



isocitrate α-ketoglutarate

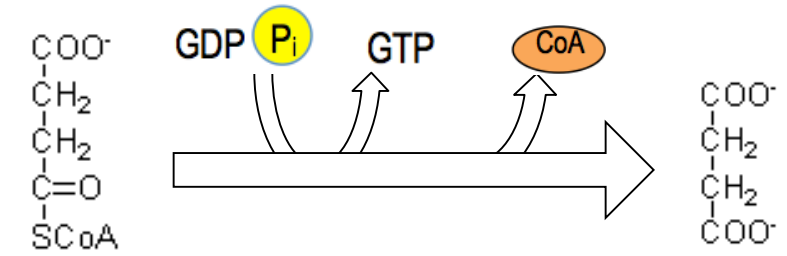
4. **CO_2 and NADH creation** (Second time)
   - Second oxidation creates more CO_2 and NADH



α-ketoglutarate

Succinyl-CoA

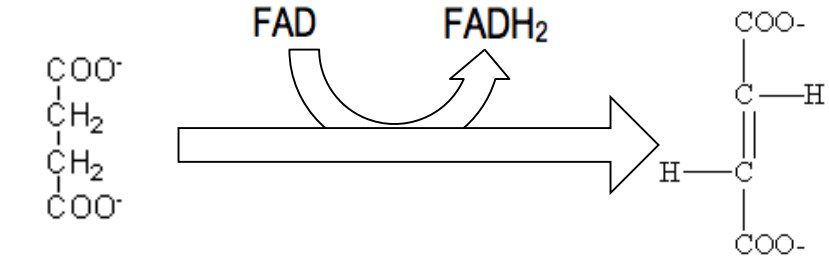
5. **GTP creation**



Succinyl-CoA

Succinate

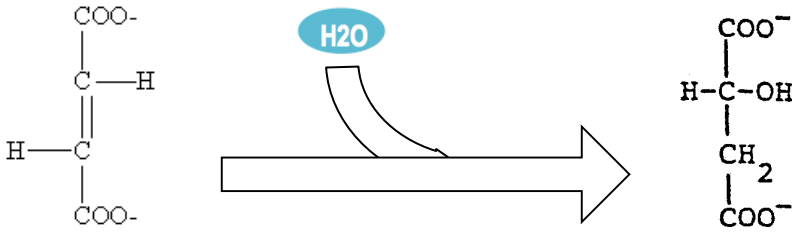
6. **$FADH_2$ creation**
   - Third oxidation results in creation of $FADH_2$



Succinate

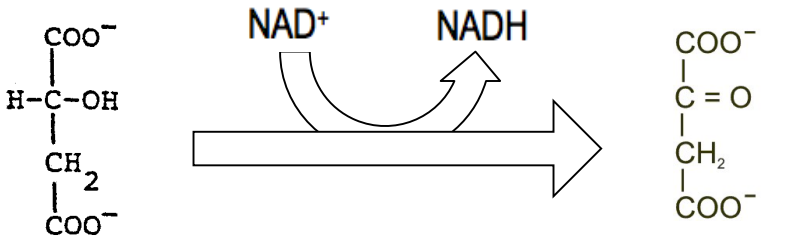
Fumarate

7. **Addition of Water**
   - Water is added which adds a hydroxyl group next to the carbonyl atom



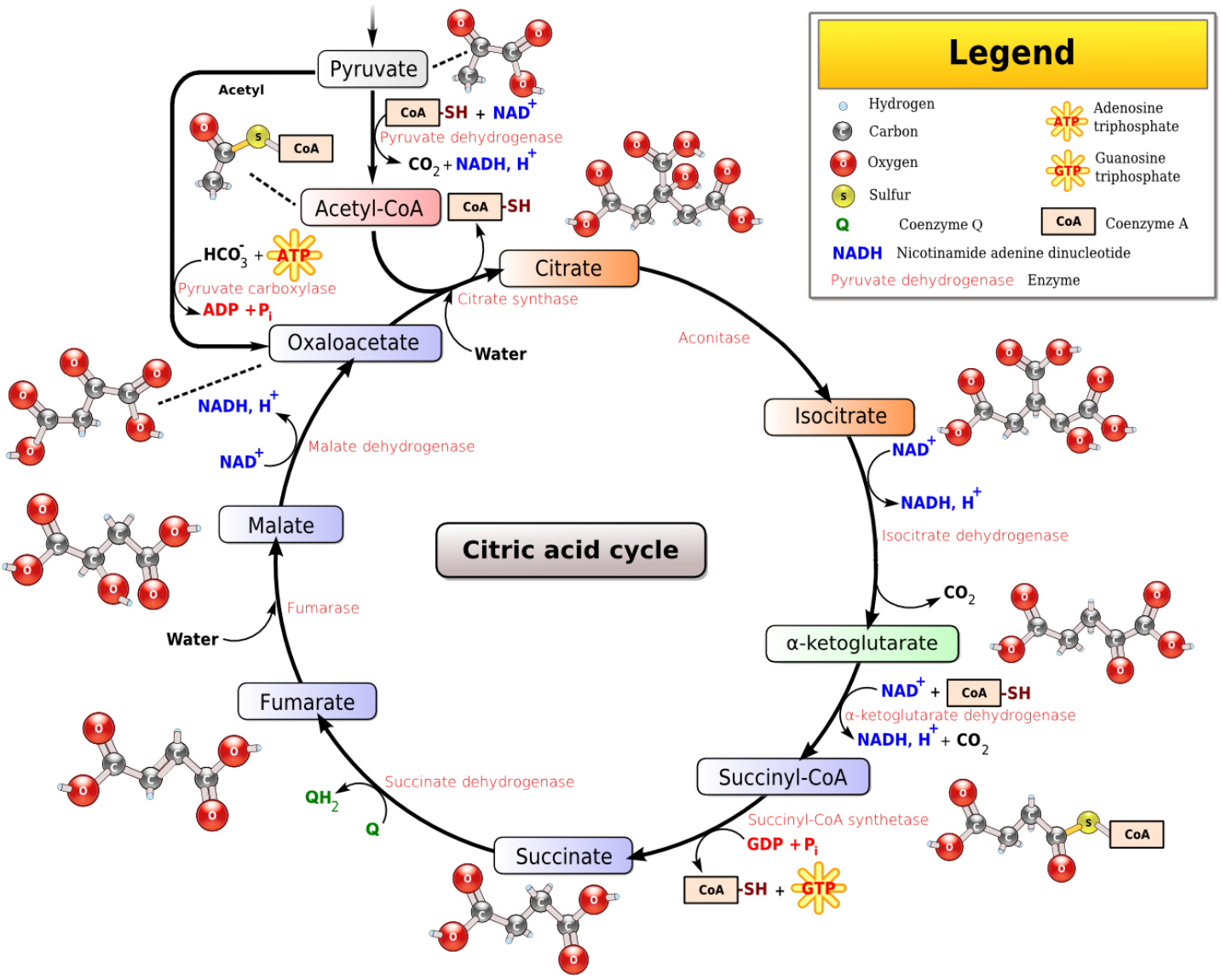
Fumarate L-malate

8. **NADH creation**
   - Four oxidation leads to NADH creation and oxaloacetate (used in step 1)



L-malate Oxaloacetate

EXAMPLE: Review of the Citric Acid Cycle



PRACTICE

1. Which of the following is not a product of the citric acid cycle?
    a. NADH
    b. CO_2
    c. $FADH_2$
    d. Acetyle CoA

2. For each acetyl CoA that is oxidized in the citric acid cycle, what is created?
    a. 1 GTP, 3 NADH, and 1 $FAHD_2$
    b. 2 GTP, 1 NADH, and 3 $FAHD_2$
    c. 6 GTP, 2 NADH, and 1 $FAHD_2$
    d. 1 GTP, 1 NADH, and 1 $FAHD_2$

3. The citric acid cycle requires oxygen indirectly, because oxygen is necessary for what to occur?
    a. Replace FADH
    b. Replace GDP
    c. Replace ADP
    d. Replace NAD^+

4. What is the starting molecule for the citric acid cycle?
    a. Glucose
    b. Pyruvate
    c. Acetyl CoA
    d. Citrate