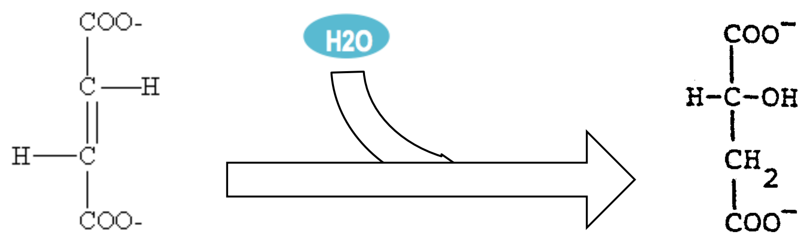
CONCEPT: CITRIC ACID CYCLE

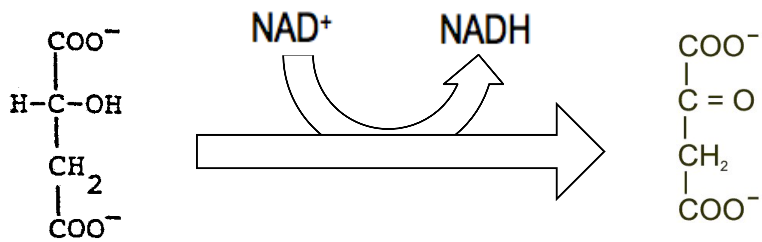
7. Fumarase ($\Delta G'^{\circ}$ = -4 kJ/mol) – fumarate → L-malate

  - □ Water added in two parts: first as OH^-, then H^+



8. Malate dehydrogenase ($\Delta G'^{\circ}$ = 30 kJ/mol) – malate → oxaloacetate

  - □ Generates NADH
  - □ ΔG close to 0 in biological conditions



- NADH will ultimately generate 2.5 ATP, and $FADH_2$ will ultimately generate 1.5 ATP
  - □ NADH generated by glyceraldehyde 3-phosphate dehydrogenase will generate 1.5 or 2.5 ATP
- 1 glucose → 30-32 ATP; 5-7 from glycolysis + 5 from pyruvate oxidation + 20 from citric acid cycle
  - □ Glycolysis generates 2 NADH + 2 ATP → 5-7 ATP
  - □ Pyruvate oxidation generates 2 NADH → 5 ATP
  - □ Citric acid cycle generates 6 NADH + 2 $FADH_2$ + 2 ATP/GTP → 20 ATP
- Generally, the citric acid cycle is regulated by the energy poor, and energy rich molecules involved in respiration
  - □ Energy rich molecules inhibit the cycle: ATP and NADH
  - □ Energy poor molecules stimulate the cycle: AMP, ADP, NAD^+
  - □ Pyruvate dehydrogenase is inhibited by ATP, acetyl-CoA, and NADH; stimulated by AMP, CoA, and NAD^+
  - □ Citrate synthase is inhibited by NADH, succinyl-CoA, citrate, and ATP; stimulated by ADP
  - □ Isocitrate dehydrogenase is inhibited by ATP; stimulated by ADP
  - □ α-Ketoglutarate dehydrogenase complex is inhibited by NADH and succinyl-CoA
- Anaplerotic reactions – generate oxaloacetate to replace the loss of acceptor molecules from the cycle
  - □ Many molecules from the citric acid cycle are important biosynthetic precursors for amino acids
  - □ Reactions 8, 7, 6, and 5 can be easily reversed to produce succinyl-CoA, also ß-oxidation of certain fatty acids