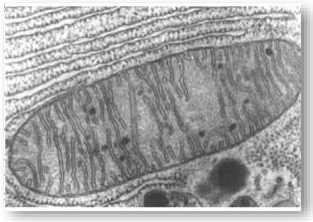
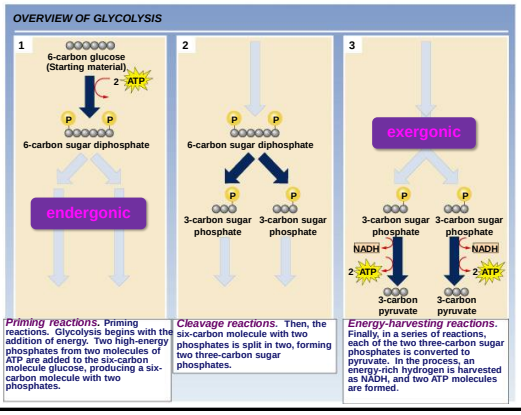
Chapter 9.2

Cellular Respiration: Pyruvate Oxidation & Citric Acid Cycle





Glycolysis is only the start

- Glycolysis

  glucose → → → → → pyruvate
  6C 2x 3C

- but pyruvate has more energy to yield!
  - 3 more C to strip off (to oxidize)
  - if O_2 is not available, pyruvate is reduced to oxidize NAD+ (meaning that NADH is regenerated to NAD+)

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  glucose → → → → → pyruvate
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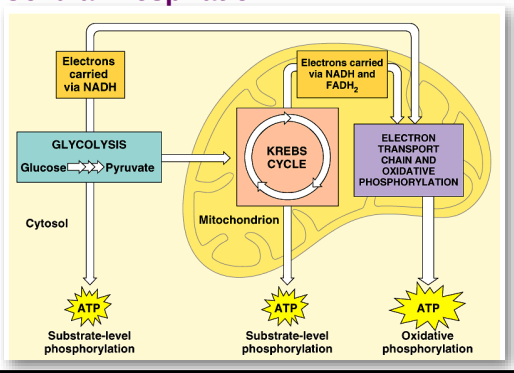
- but pyruvate has more energy to yield!
  - 3 more C to strip off (to oxidize)
  - if O_2 is available, pyruvate enters mitochondria
  - enzymes of Krebs cycle complete oxidation of "sugar" to CO_2

    pyruvate → → → → → CO_2
    3C 1C

Cellular Respiration



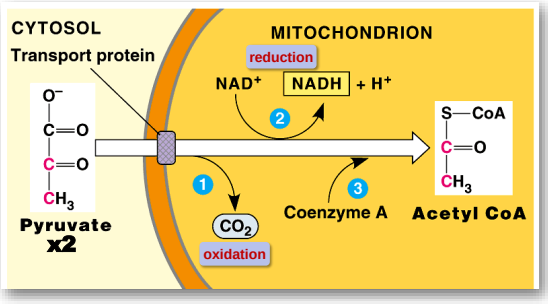
Oxidation of Pyruvate

- Pyruvate enters mitochondria

  2x [pyruvate → → → acetyl CoA + CO_2]
  3C 2C 1C
  NAD+ NADH

  - 3 step oxidation process (on next slide)
    - releases 1 CO_2 (count the carbons!)
    - reduces NAD → NADH (stores energy – endergonic)
    - 2C combines with CoA, producing acetyl CoA
- Acetyl CoA enters Krebs cycle
- where does CO_2 go?

Pyruvate oxidized to Acetyl CoA



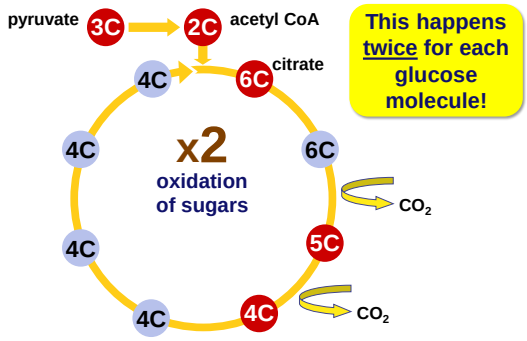
Yield = 2C compound + CO_2 + NADH x2

Krebs cycle

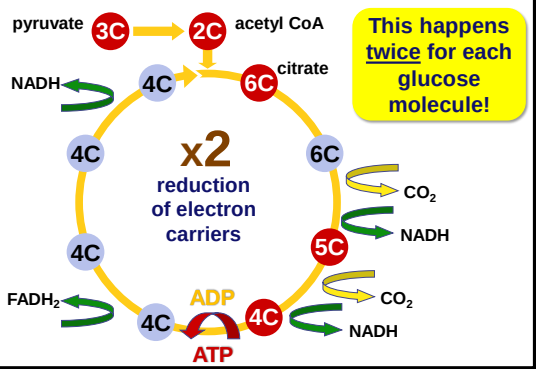
Hans Krebs
1900-1981

- a.k.a. Citric Acid Cycle
  - in mitochondrial matrix
  - 8 step pathway
    - each catalyzed by specific enzyme
    - step-wise catabolism of 6C citrate molecule
- Evolved AFTER glycolysis
  - makes evolutionary sense!
    - bacteria → 3.5 billion years ago (glycolysis)
    - free O_2 → 2.7 billion years ago (photosynthesis)
    - eukaryotes → 1.5 billion years ago (aerobic respiration)

Count the carbons!



Count the electron carriers!



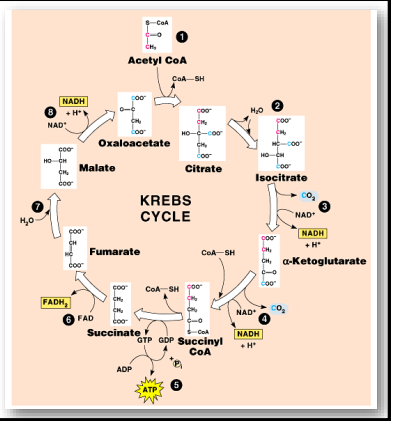
So we fully oxidized glucose

$C_6H_{12}O_6$

↓

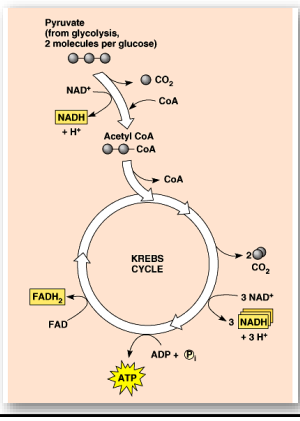
CO_2

& ended up with a net gain of 4 ATP!

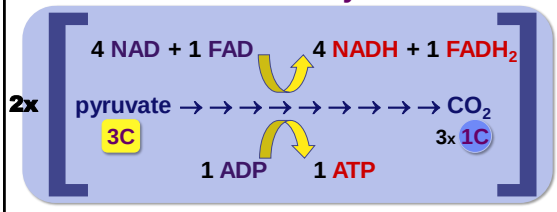


NADH & $FADH_2$

- Krebs cycle produces large quantities of electron carriers
  - NADH
  - $FADH_2$
    - stored energy!
    - they go to ETC



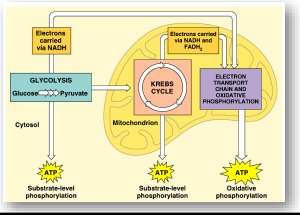
Energy stored from Pyruvate Oxidation and Krebs Cycle



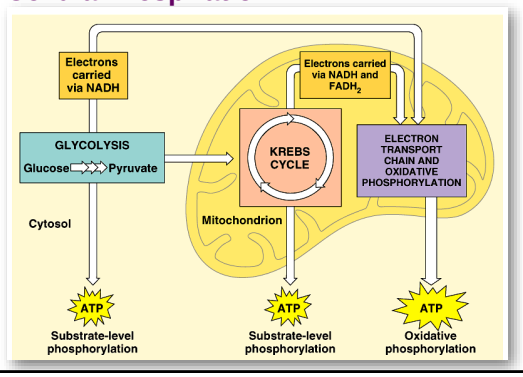
Net gain = 2 ATP
= 8 NADH
= 2 $FADH_2$

So why the Krebs cycle?

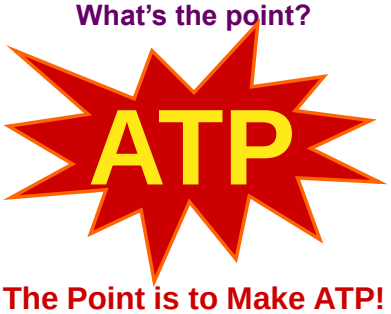
- If the yield is only 2 ATP, then why?
  - value of NADH & $FADH_2$
    - electron carriers
    - reduced molecules store energy!
    - to be used in the Electron Transport Chain



Cellular Respiration



What's the point?



The Point is to Make ATP!

Any Questions??