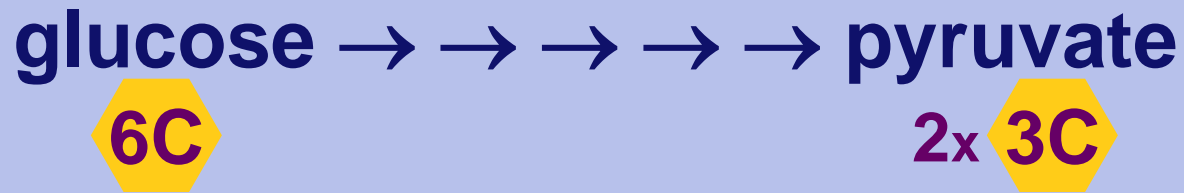


**Chapter 9.**  
**Cellular Respiration**  
**Oxidation of Pyruvate**  
**Krebs Cycle**



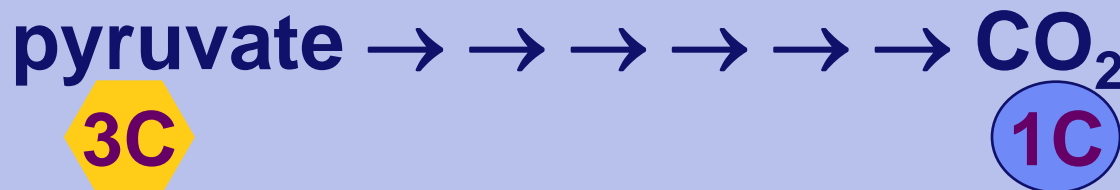
# Glycolysis is only the start

- Glycolysis

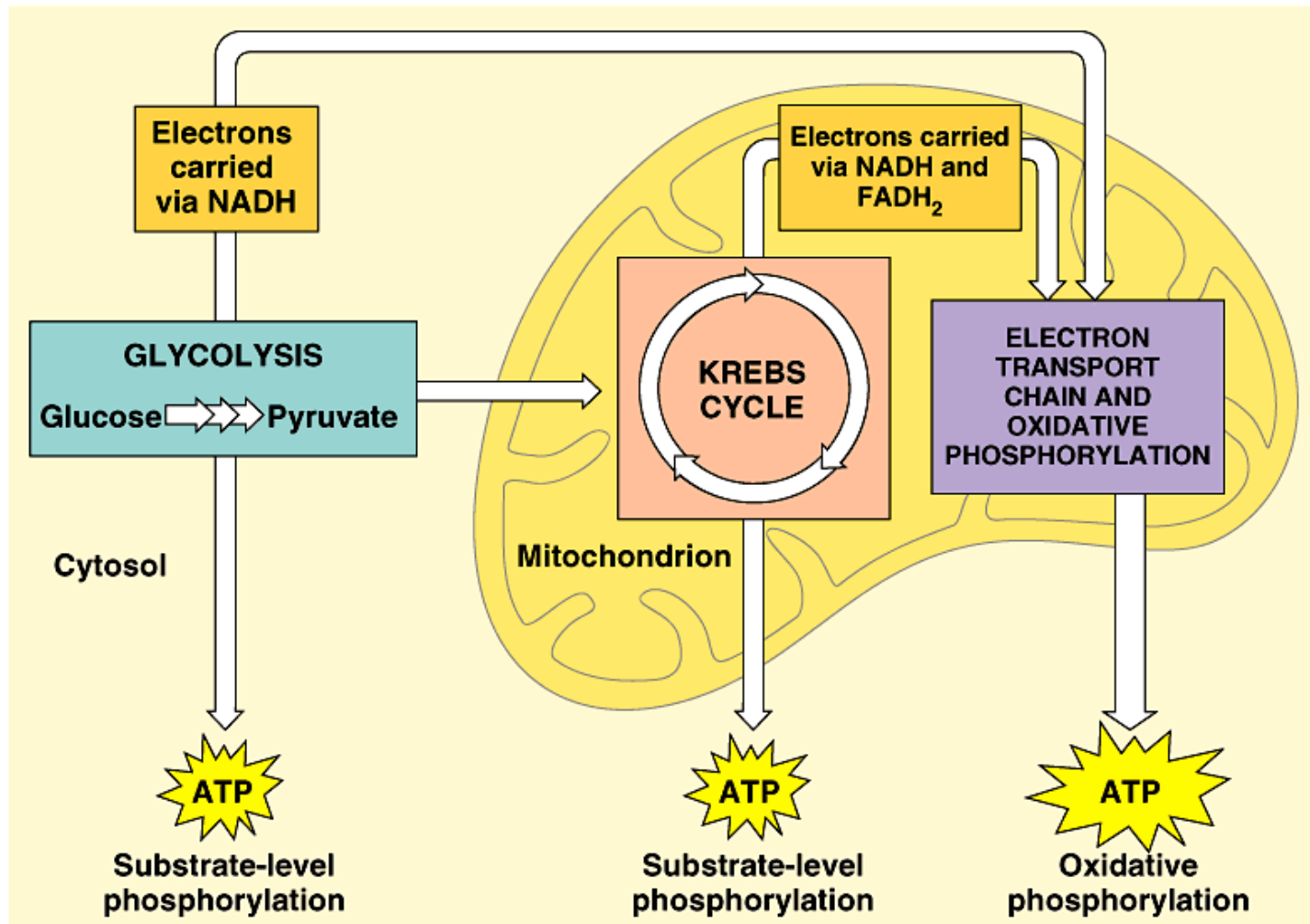


- Pyruvate has more energy to yield

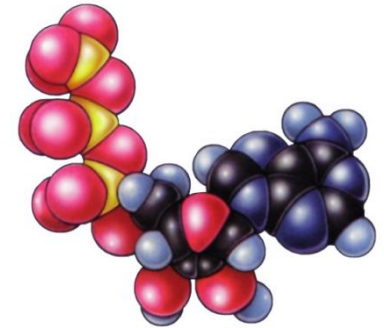
- ◆ 3 more C to strip off (to oxidize)
- ◆ if  $O_2$  is available, pyruvate enters mitochondria
- ◆ enzymes of Krebs cycle complete oxidation of sugar to  $CO_2$



# Cellular respiration



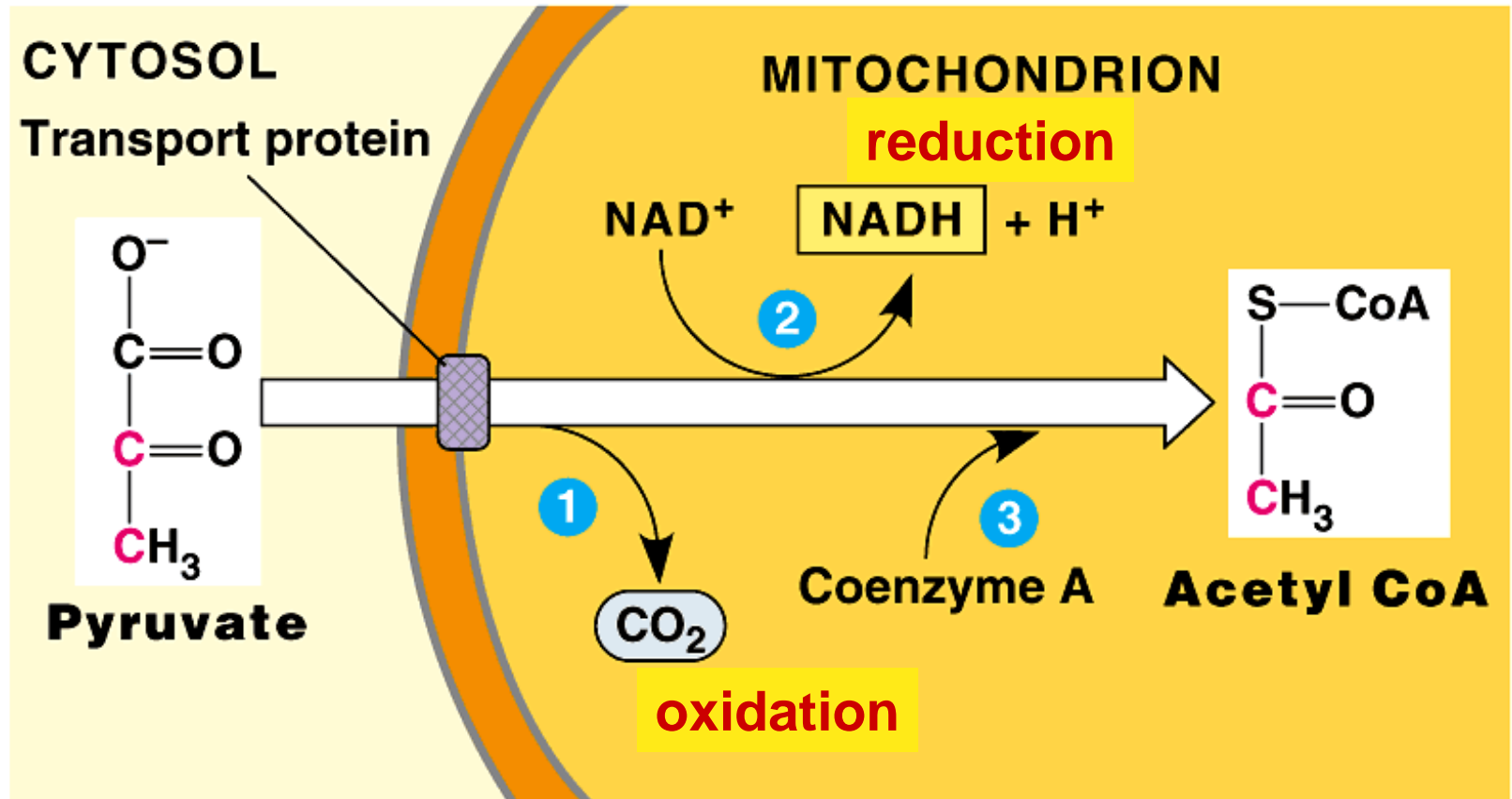
# What's the point?



## The Point is to Make ATP!



# Pyruvate oxidized to Acetyl CoA



**Yield = 2C sugar +  $\text{CO}_2$  + NADH**

1937 | 1953

# Krebs cycle



Hans Krebs  
1900-1981

- **aka Citric Acid Cycle**
  - ◆ in mitochondrial matrix
  - ◆ 8 step pathway
    - each catalyzed by specific enzyme
    - step-wise catabolism of 6C citrate molecule
- **Evolved later than glycolysis**
  - ◆ does that make evolutionary sense?
    - bacteria → 3.5 billion years ago (**glycolysis**)
    - free O<sub>2</sub> → 2.7 billion years ago (**photosynthesis**)
    - eukaryotes → 1.5 billion years ago (**aerobic respiration (organelles)**)

# Count the carbons!

pyruvate **3C** → **2C** acetyl CoA

**4C** → **6C** citrate

**4C** **6C**

**x2**  
oxidation  
of sugars

CO<sub>2</sub>

**5C**

CO<sub>2</sub>

**4C**

**4C**

This happens  
twice for each  
glucose  
molecule

# Count the electron carriers!

pyruvate **3C** → **2C** acetyl CoA

**4C** → **6C** citrate

NADH

**4C**

x2

**6C**

This happens twice for each glucose molecule

reduction of electron carriers

CO<sub>2</sub>

**4C**

**5C**

NADH

FADH<sub>2</sub>

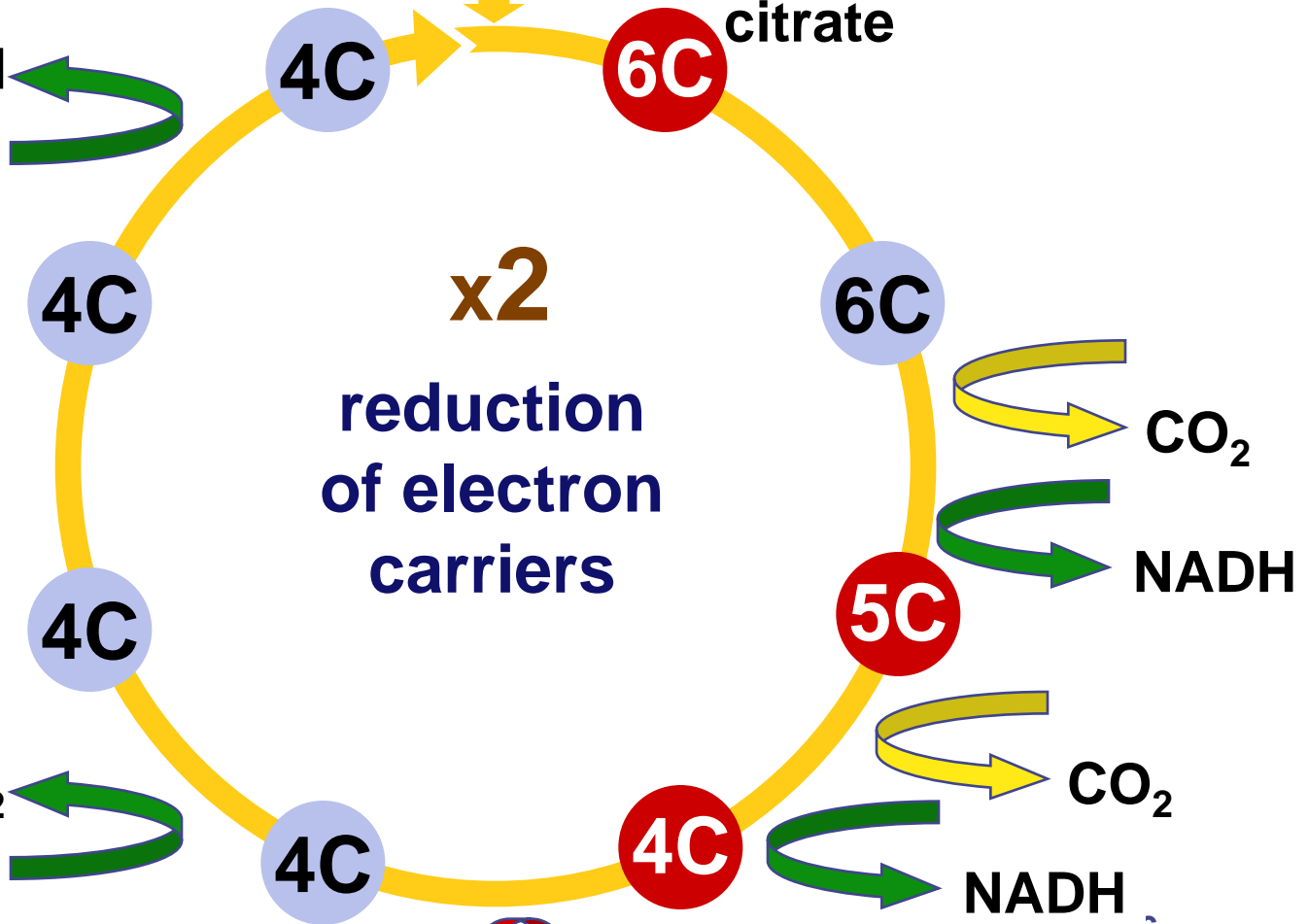
CO<sub>2</sub>

**4C**

**4C**

NADH

ATP

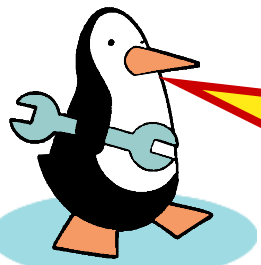


# Whassup?

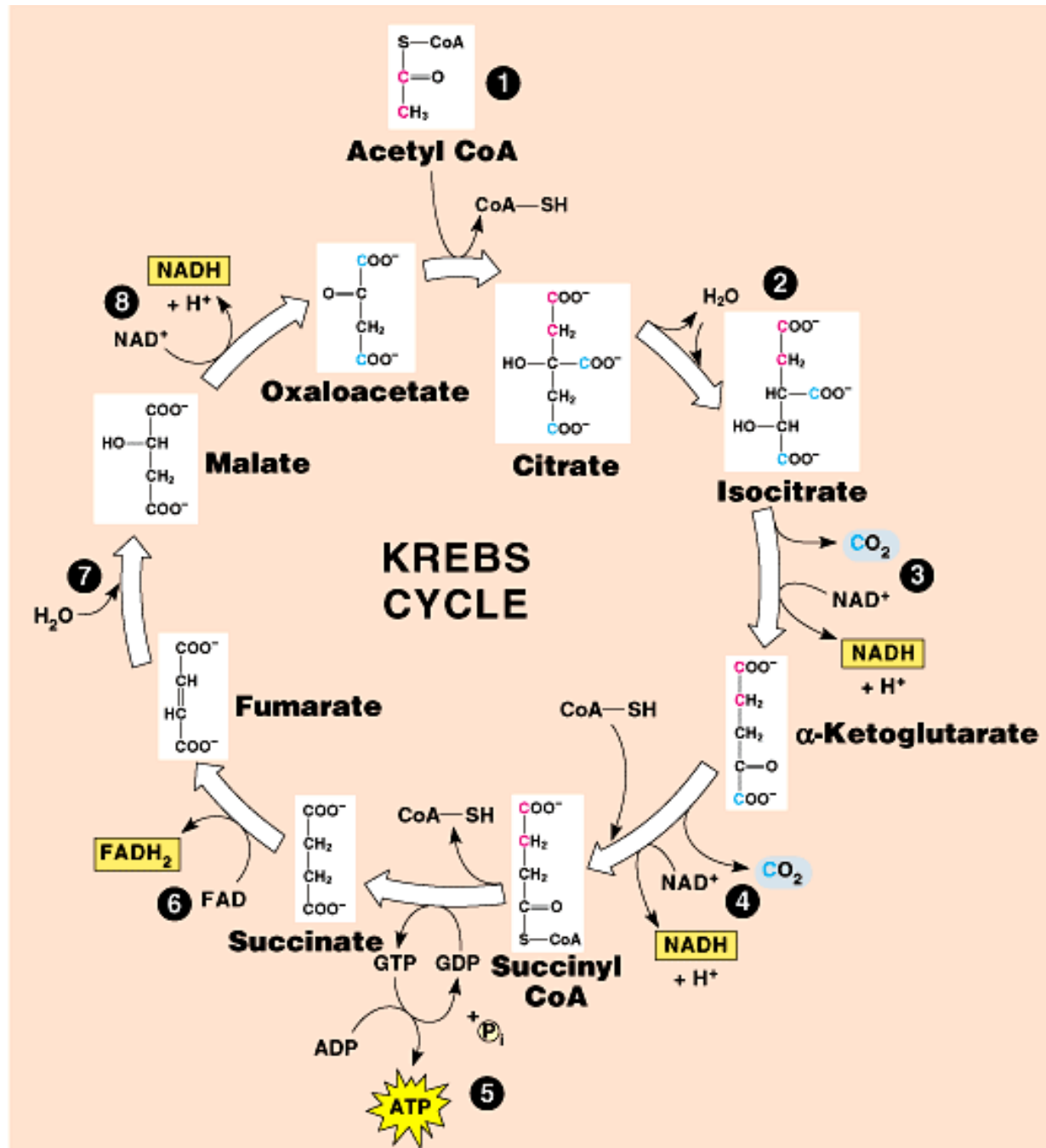
So we fully oxidized glucose



& ended up with 4 ATP!



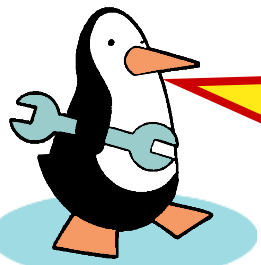
What's the Point?



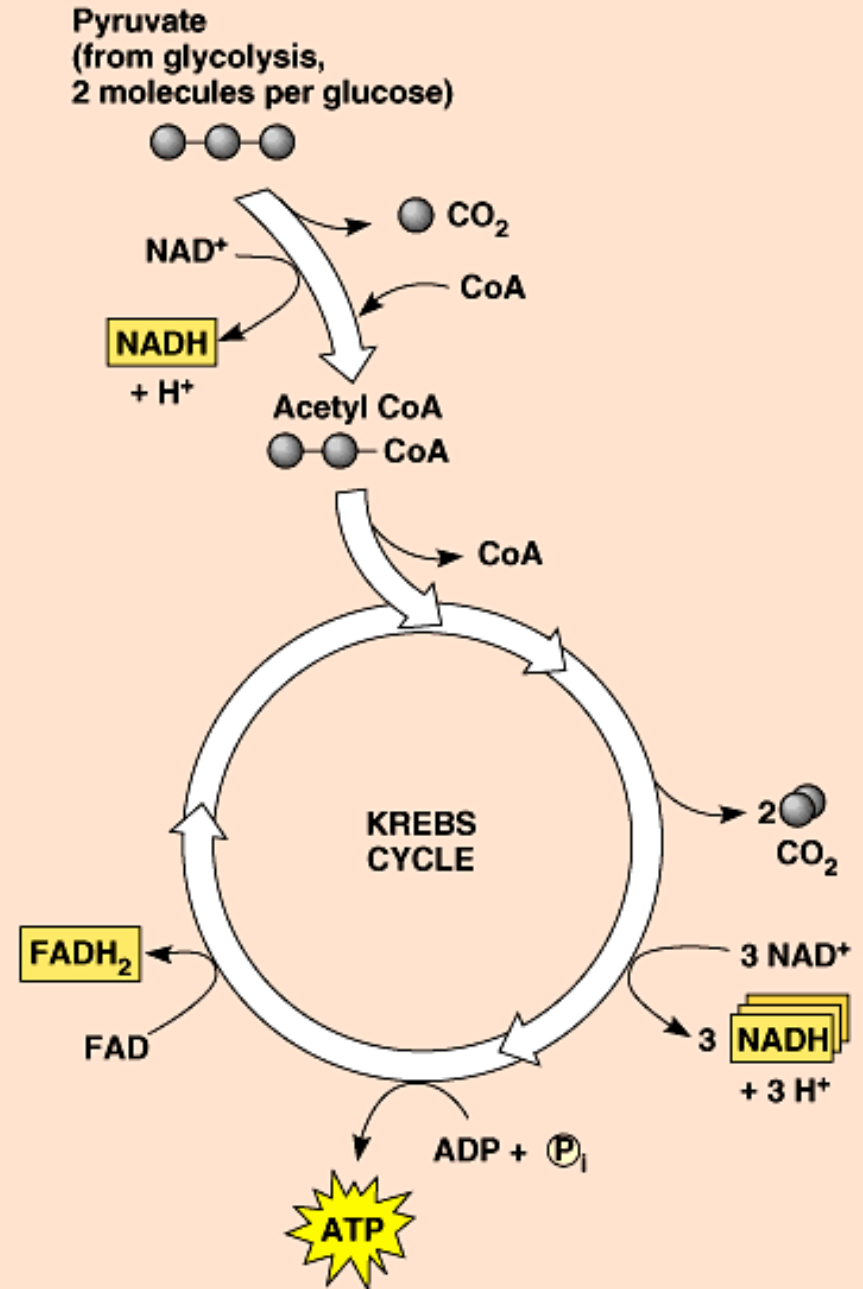
# NADH & FADH<sub>2</sub>

- Krebs cycle produces large quantities of electron carriers

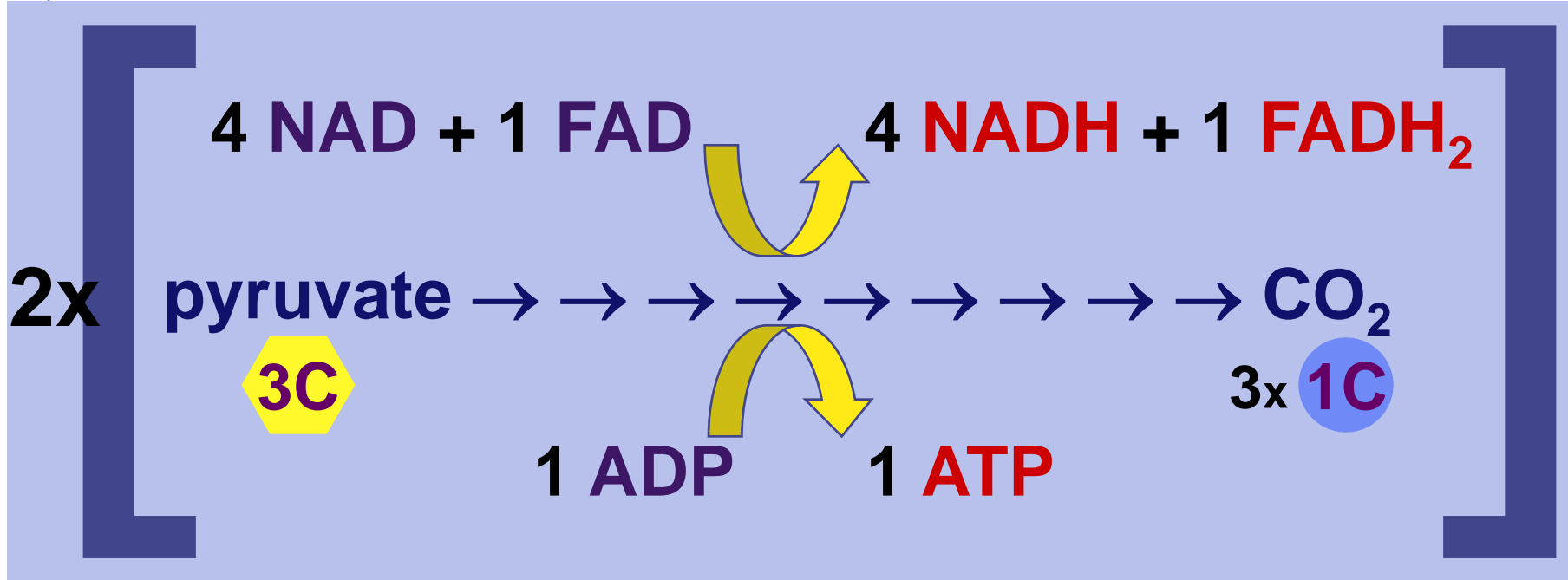
- ◆ NADH
- ◆ FADH<sub>2</sub>
- ◆ stored energy!
- ◆ go to ETC



What's so important about NADH?



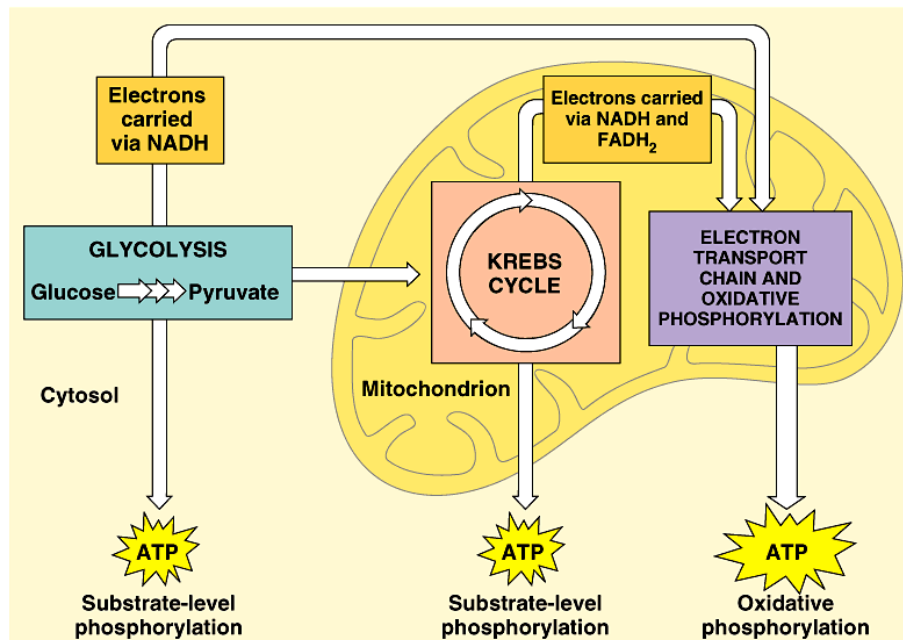
# Energy accounting of Krebs cycle



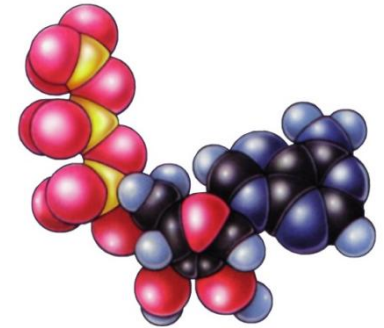
- Net gain = **2 ATP**  
= **8 NADH + 2 FADH<sub>2</sub>**

# So why the Krebs cycle?

- If the yield is only 2 ATP, then why?
  - ◆ value of NADH & FADH<sub>2</sub>
    - electron carriers
    - reduced molecules store energy!
    - to be used in the **Electron Transport Chain**



# What's the point?



**ATP**

## The Point is to Make ATP!

A decorative graphic consisting of a horizontal blue line extending from the left edge to the right, and a vertical blue line extending from the top edge to the bottom. At the top-left corner, there is a small white circle with a blue outline. At the bottom-right corner, there is a similar small white circle with a blue outline.

**Any Questions??**