

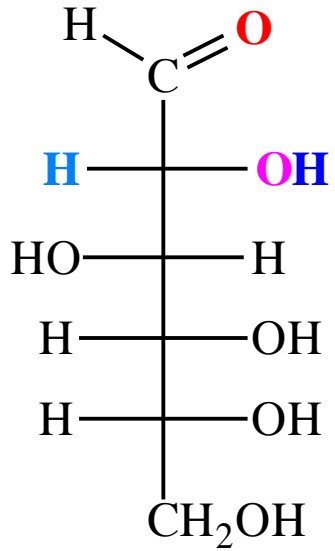
# Chemistry 2100

## Chapter 28

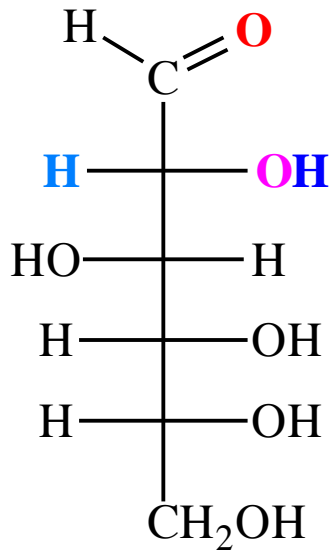
# Carbohydrate Catabolism

- *glycolysis*: glucose  $\longrightarrow$  pyruvate  $\cdots\longrightarrow$  acetyl CoA
- *TCA Cycle*: acetyl CoA  $\longrightarrow$  CO<sub>2</sub> + NADH / FADH<sub>2</sub>
- *oxidative phosphorylation*: NADH / FADH<sub>2</sub>  $\longrightarrow$  ATP

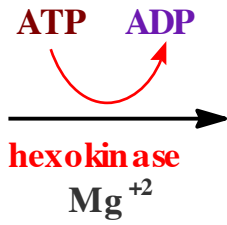
# Glycolysis

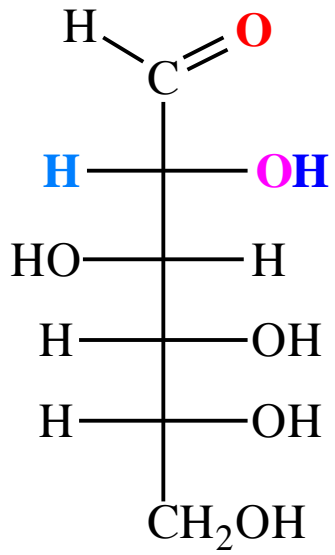


glucose

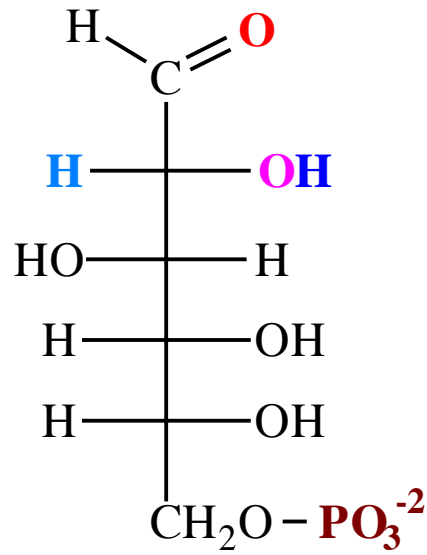
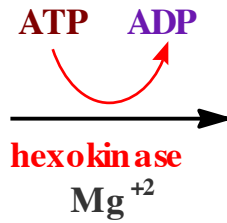


glucose

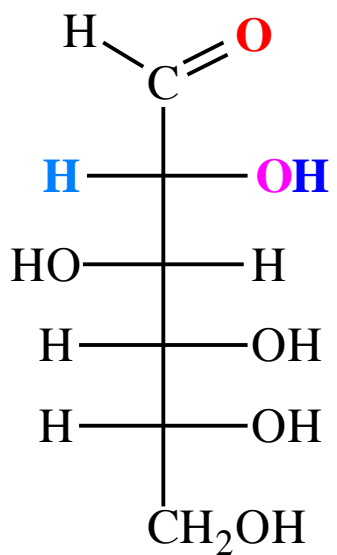




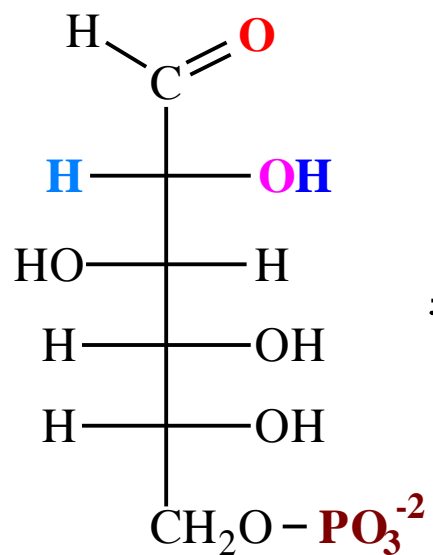
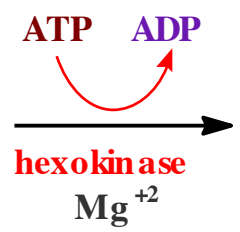
glucose



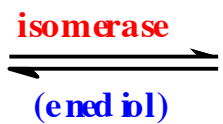
glucose-6-phosphate

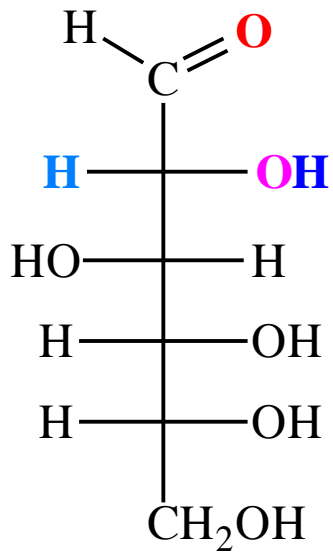


glucose

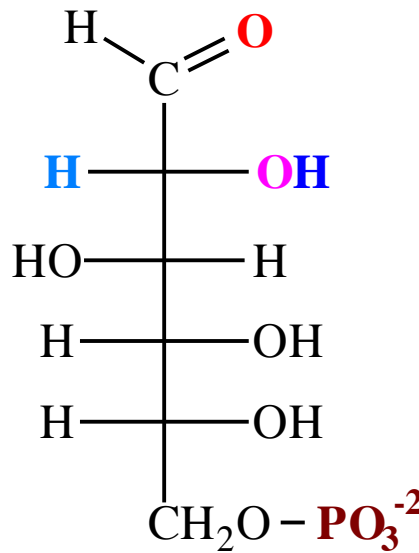
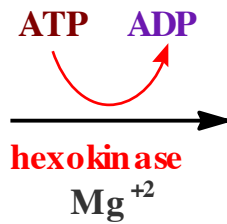


glucose-6-phosphate

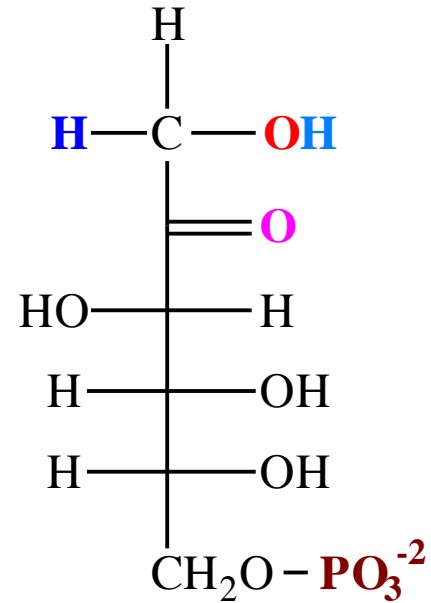
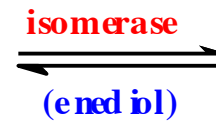




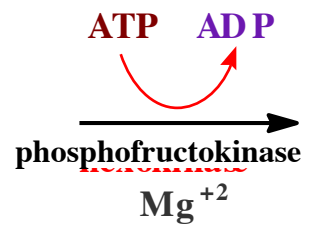
glucose



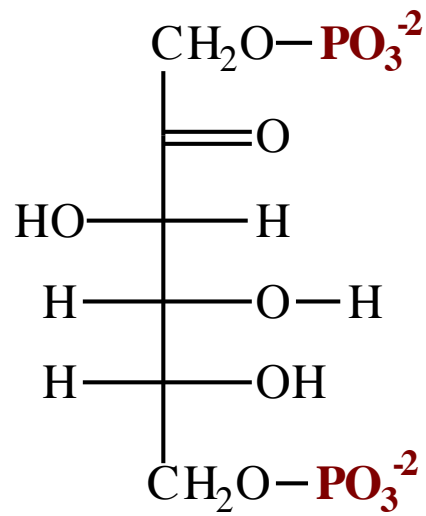
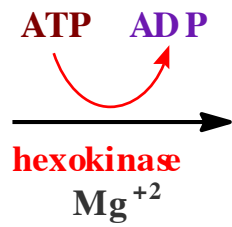
glucose-6-phosphate



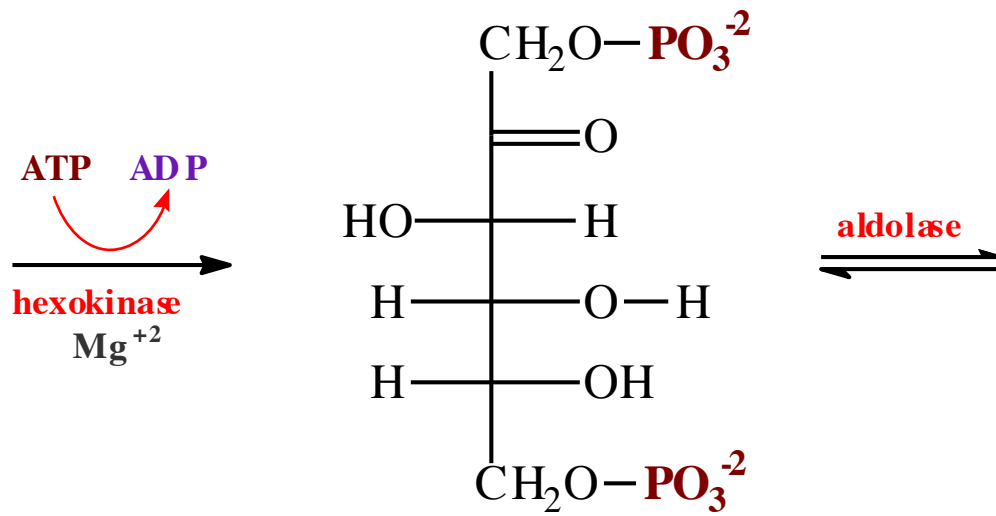
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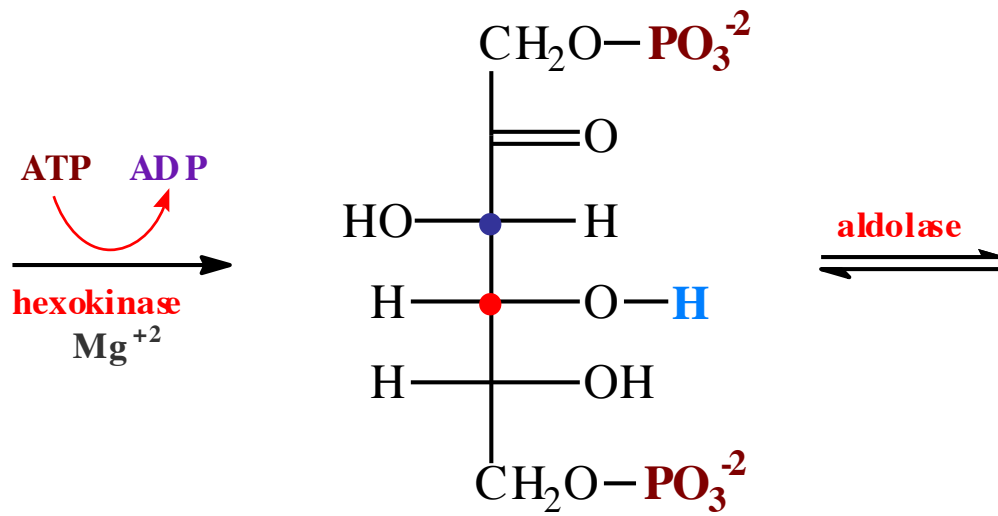




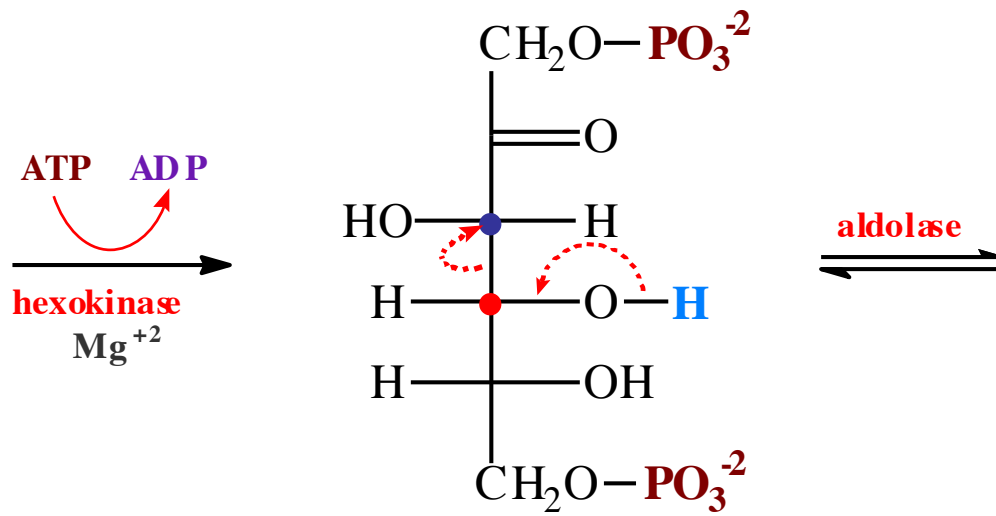
fructose-1,6-diphosphate



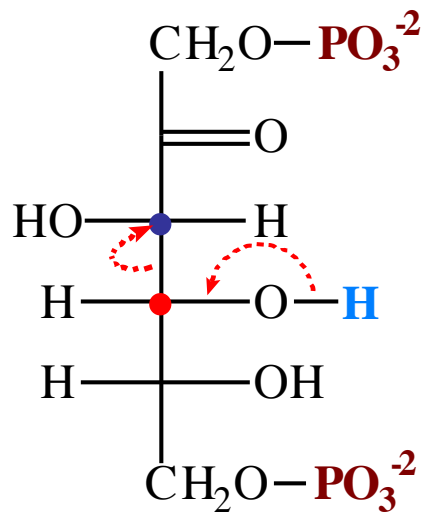
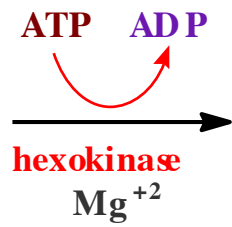
fructose-1,6-diphosphate



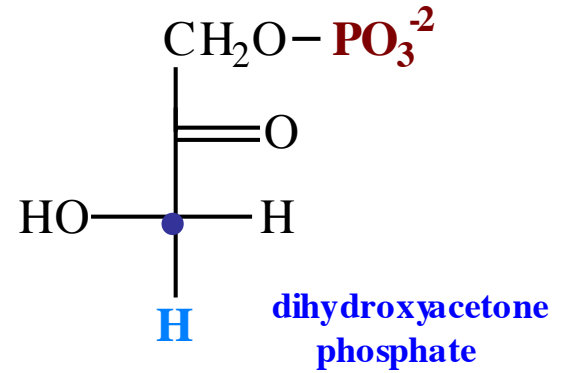
fructose-1,6-diphosphate

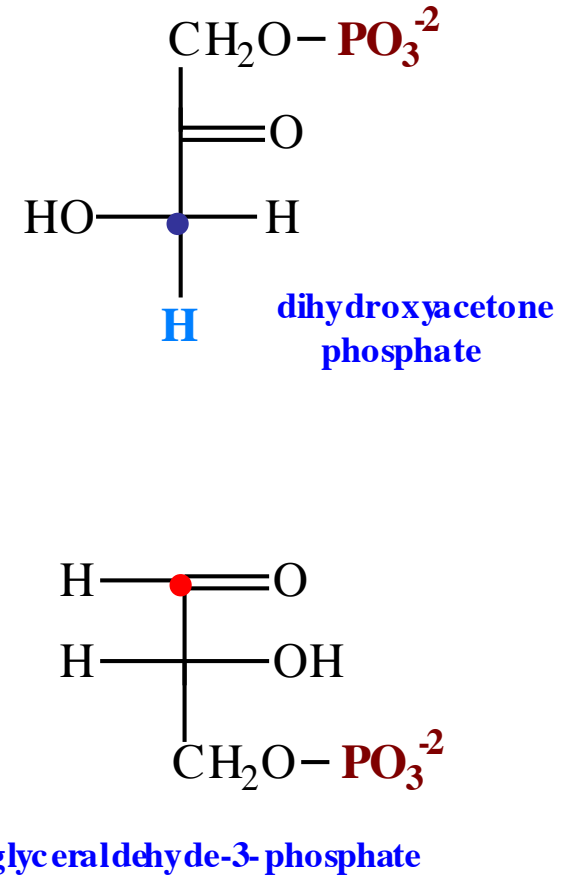
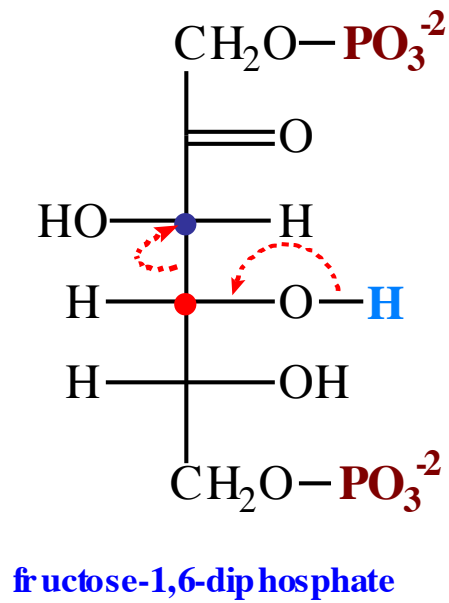
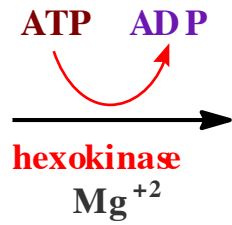


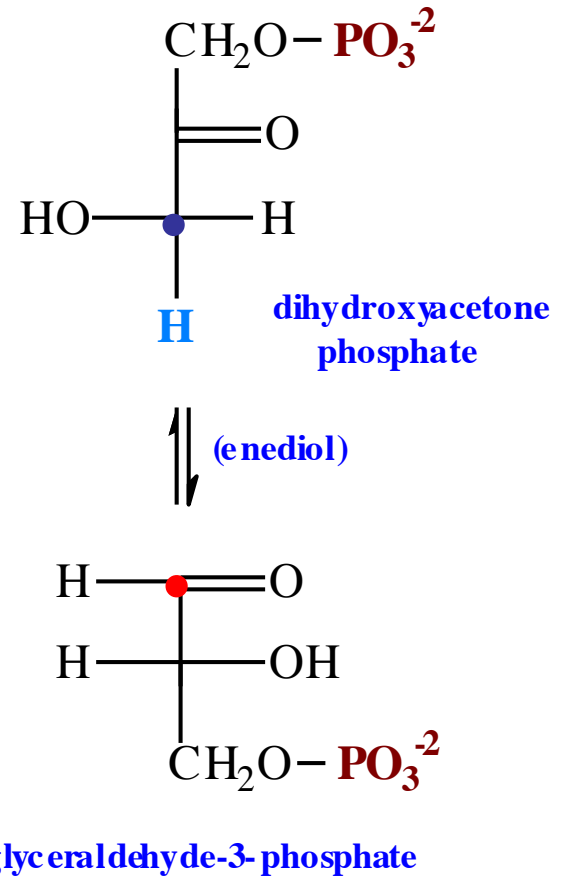
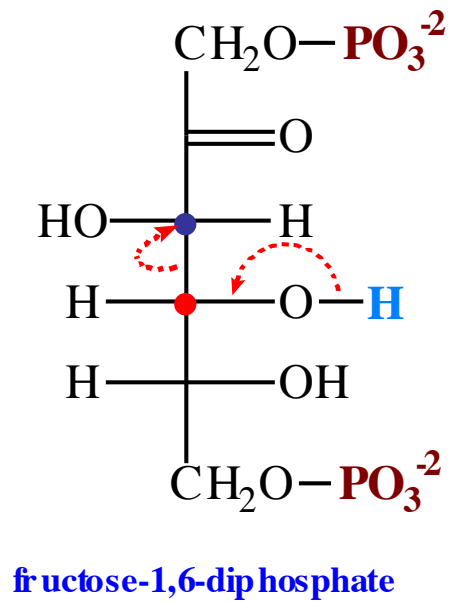
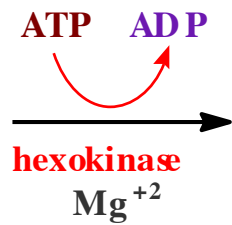
fructose-1,6-diphosphate

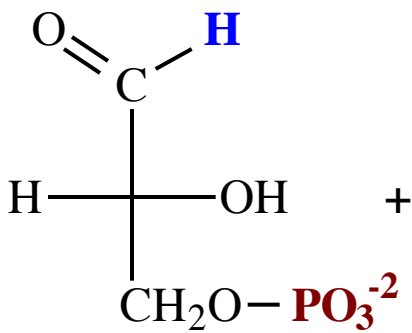


fructose-1,6-diphosphate

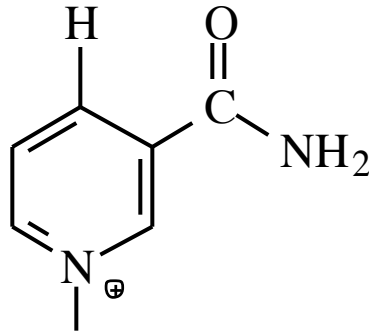




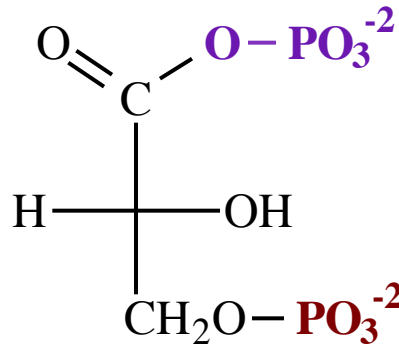




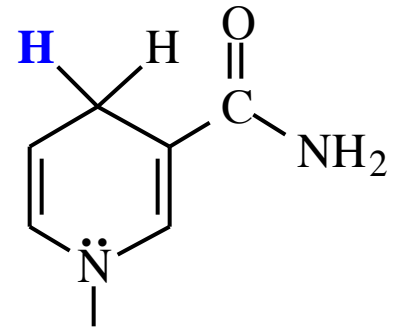
glyceraldehyde  
3-phosphate



NAD<sup>+</sup>

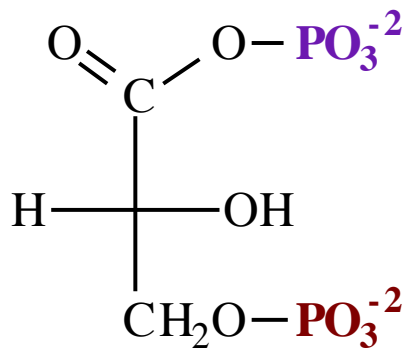


1,3-bisphospho  
glycerate

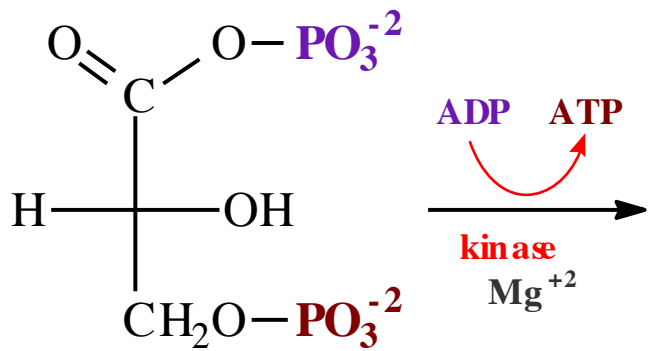


NADH

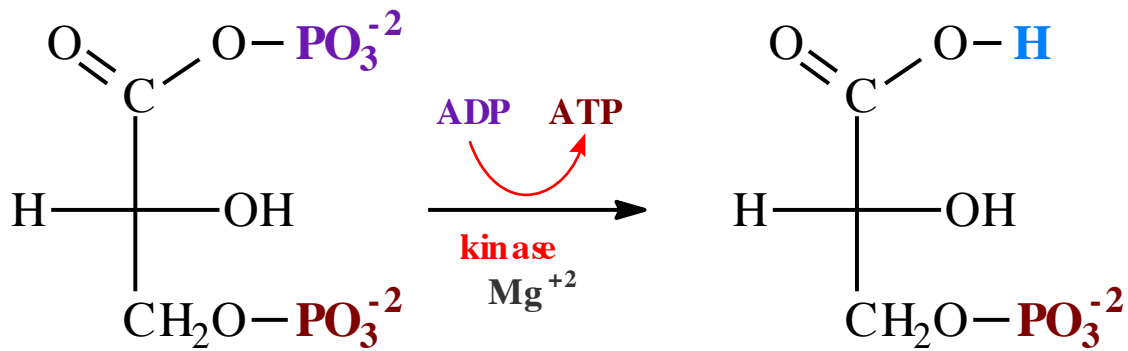




1,3 bisphospho  
1, glycerate

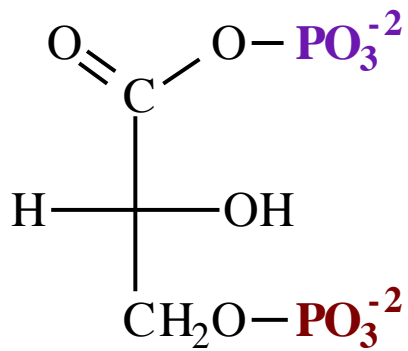


**1,3 bisphospho  
glycerate**

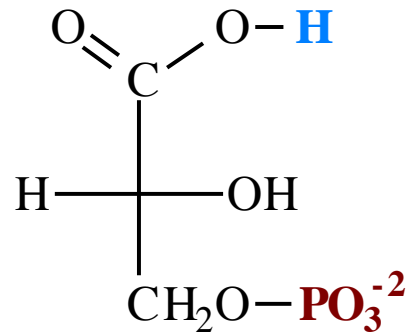
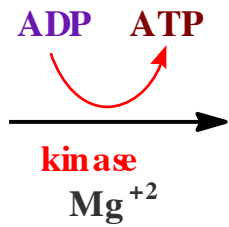


**1,3 bisphospho  
glycerate**

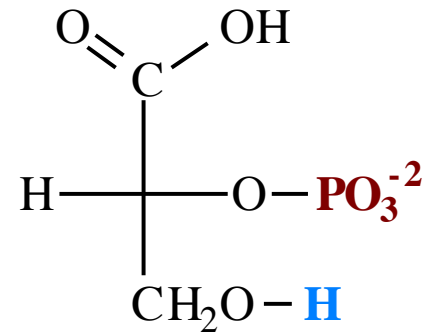
**3-phospho  
glycerate**



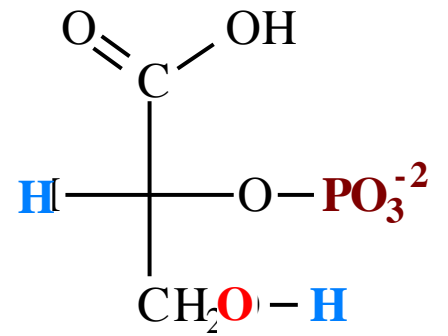
1,3 bisphospho  
glycerate



3-phospho  
glycerate

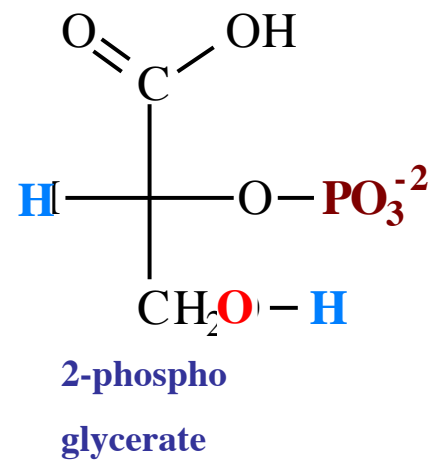
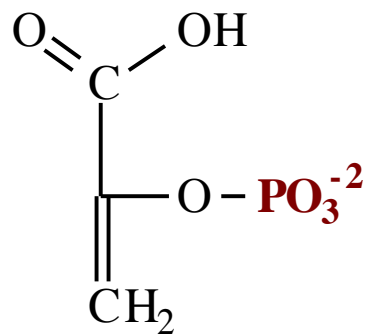


2-phospho  
glycerate

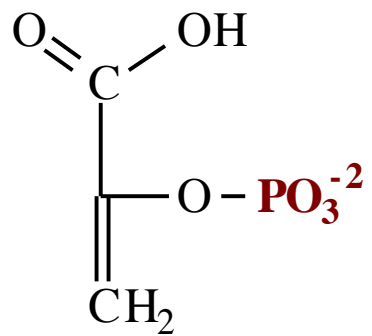


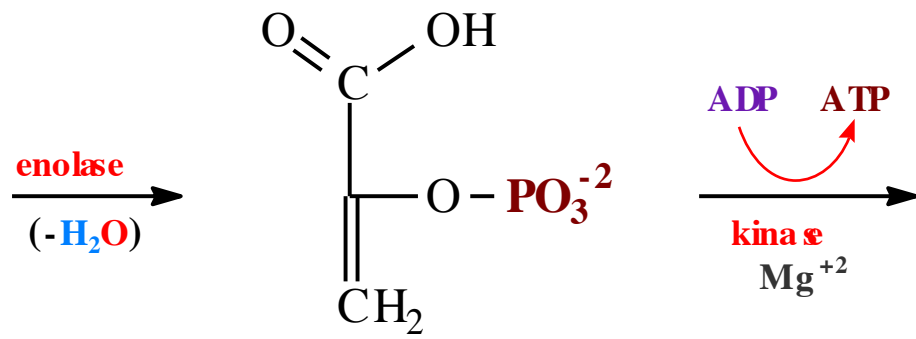
**2-phospho  
glycerate**

**enolase**  
→  
(-H<sub>2</sub>O)

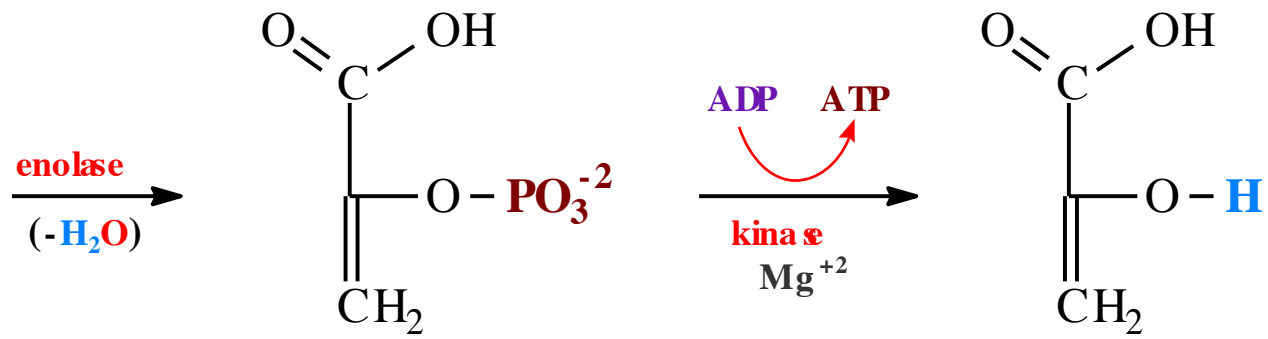


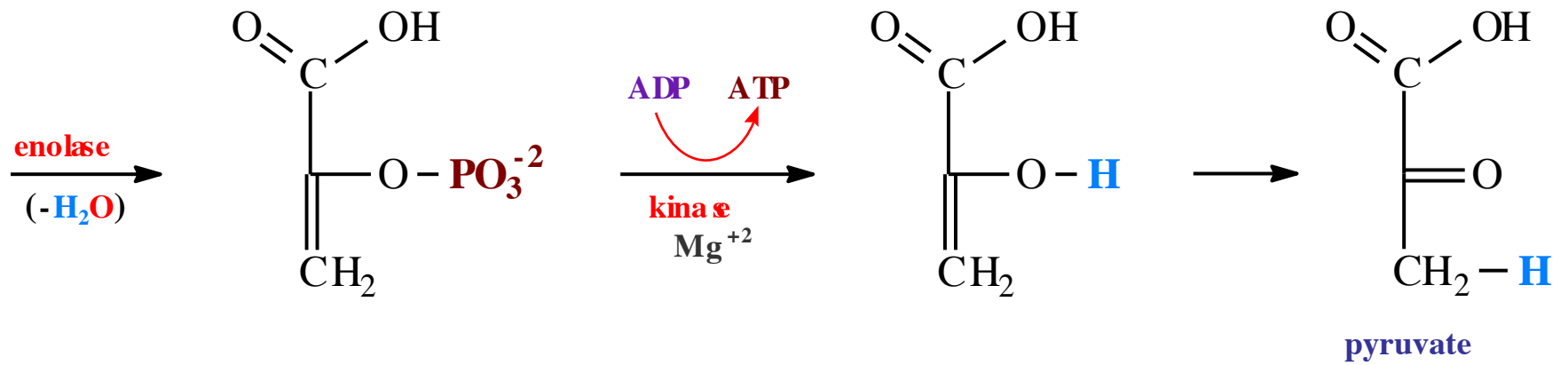
**enolase**  
→  
(-H<sub>2</sub>O)



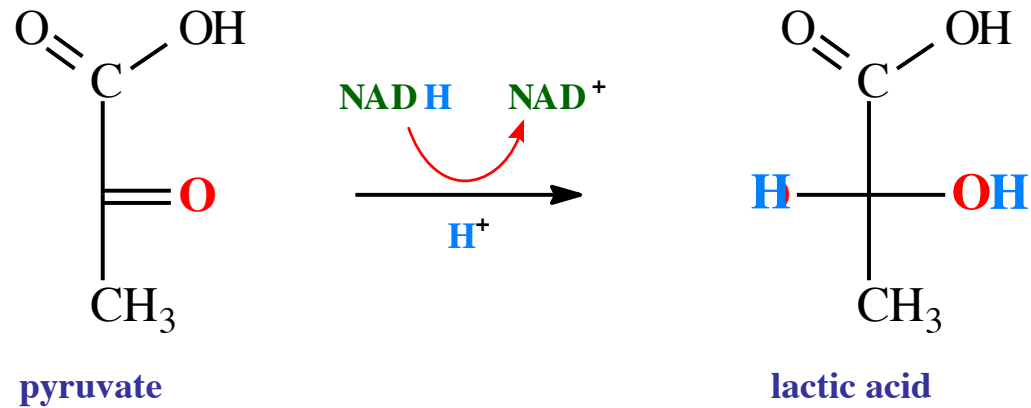




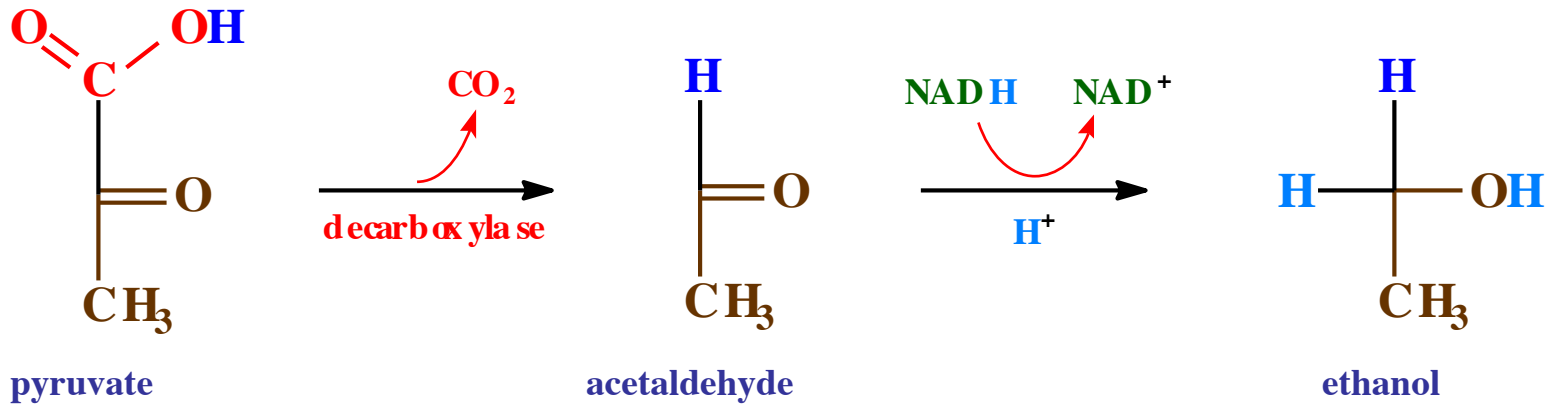




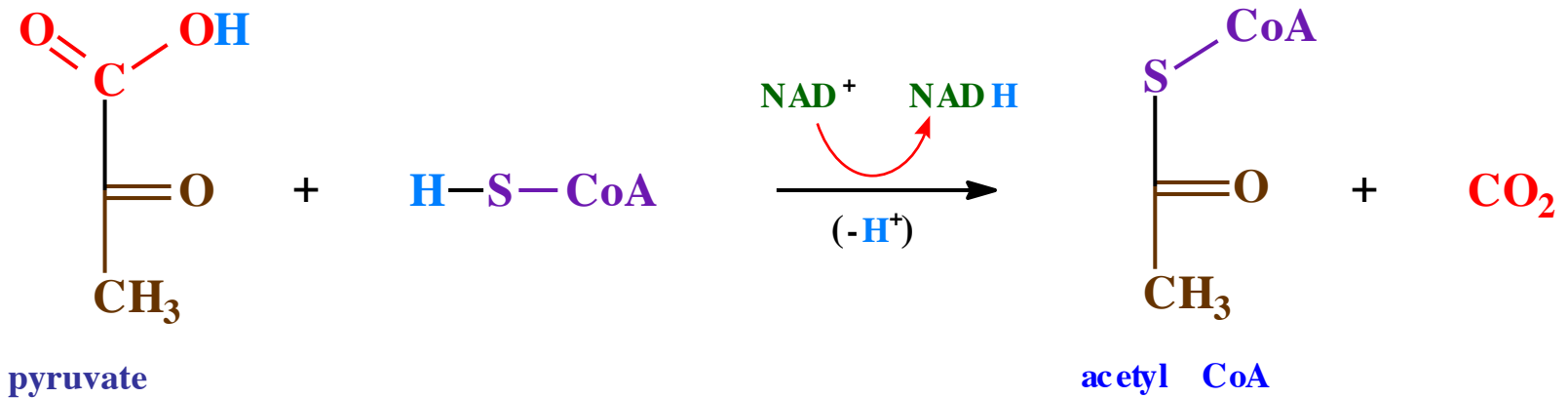
# Anaerobic Glycolysis



# Fermentation



# TriCarboxylic Acid Cycle Prep



- [http://highered.mcgraw-hill.com/sites/0072507470/student\\_view0/chapter25/animation\\_how\\_glycolysis\\_works.html](http://highered.mcgraw-hill.com/sites/0072507470/student_view0/chapter25/animation_how_glycolysis_works.html)

# Fatty Acids and Energy

**Fatty acids in triglycerides are the principal storage form of energy for most organisms.**

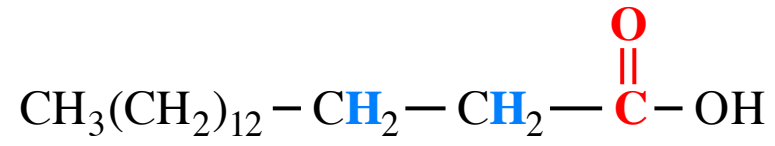
- Hydrocarbon chains are a highly reduced form of carbon.
- The energy yield per gram of fatty acid oxidized is greater than that per gram of carbohydrate oxidized.

---

|  | Energy<br>(kcal • mol <sup>-1</sup> ) | Energy<br>(kcal • g <sup>-1</sup> ) |
|--|---------------------------------------|-------------------------------------|
| $C_6H_{12}O_6 + 6O_2 \longrightarrow 6CO_2 + 6H_2O$<br>Glucose                 | 686                                   | 3.8                                 |
| $CH_3(CH_2)_{14}COOH + 23O_2 \longrightarrow 16CO_2 + 16H_2O$<br>Palmitic acid | 2,340                                 | 9.3                                 |

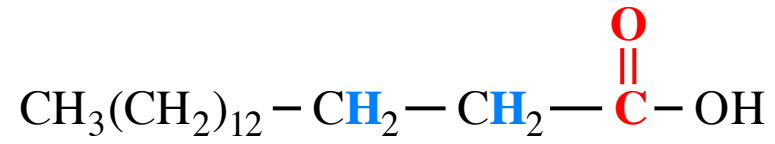
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## $\beta$ -oxidation





## β-oxidation



HS - CoA  
thiokinase

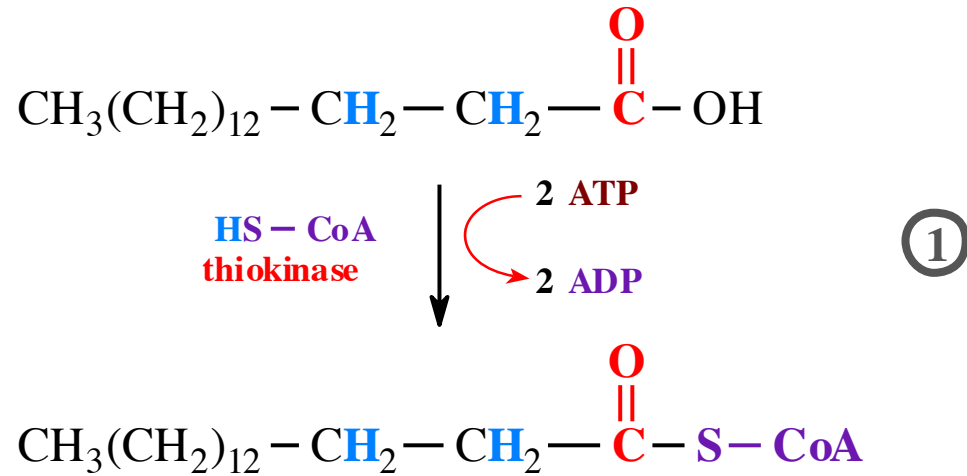


2 ATP

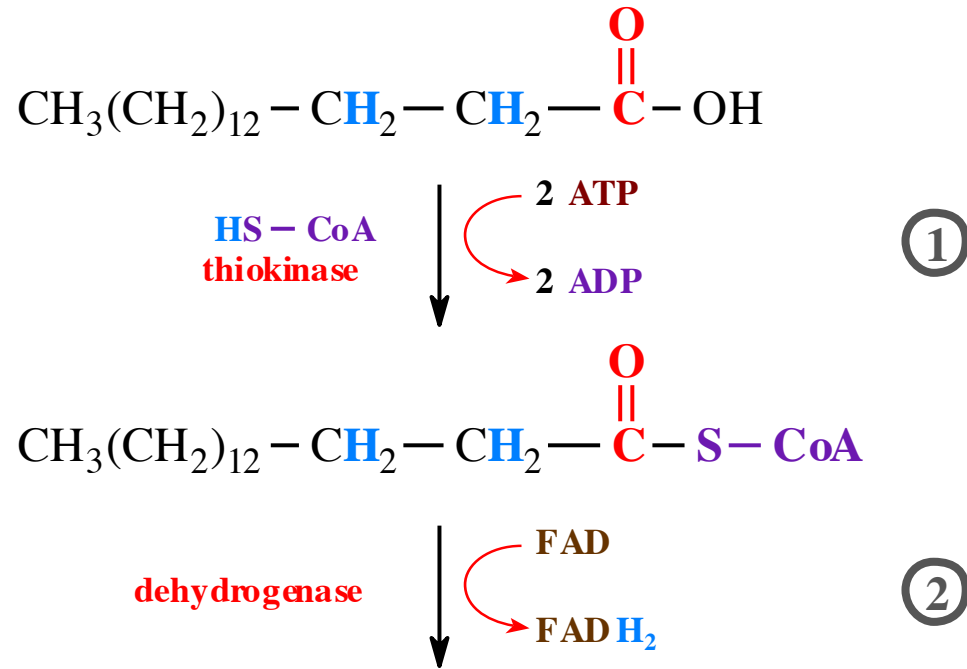
2 ADP

①

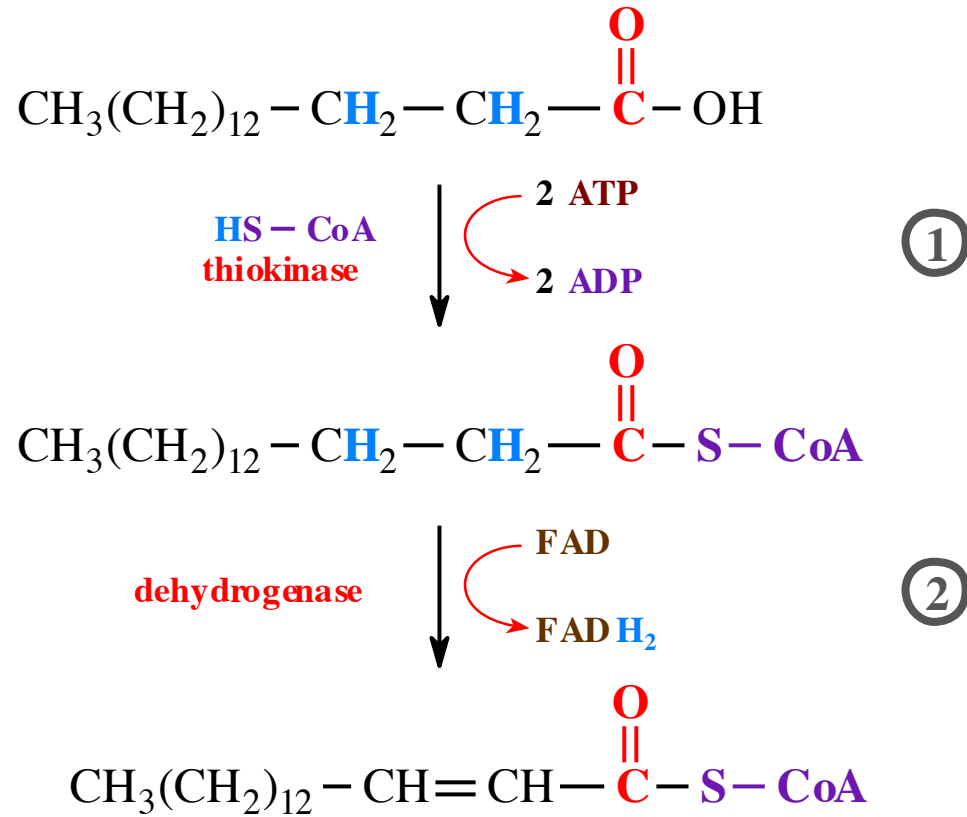
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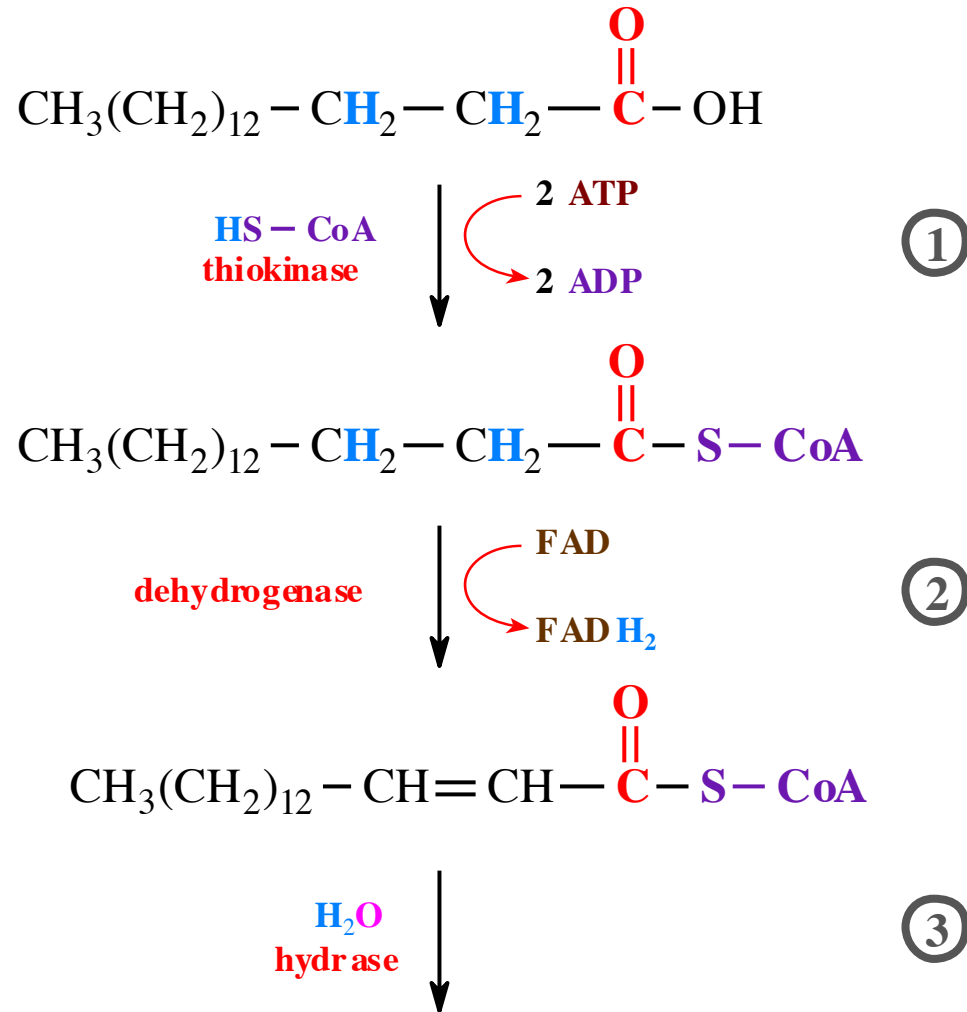
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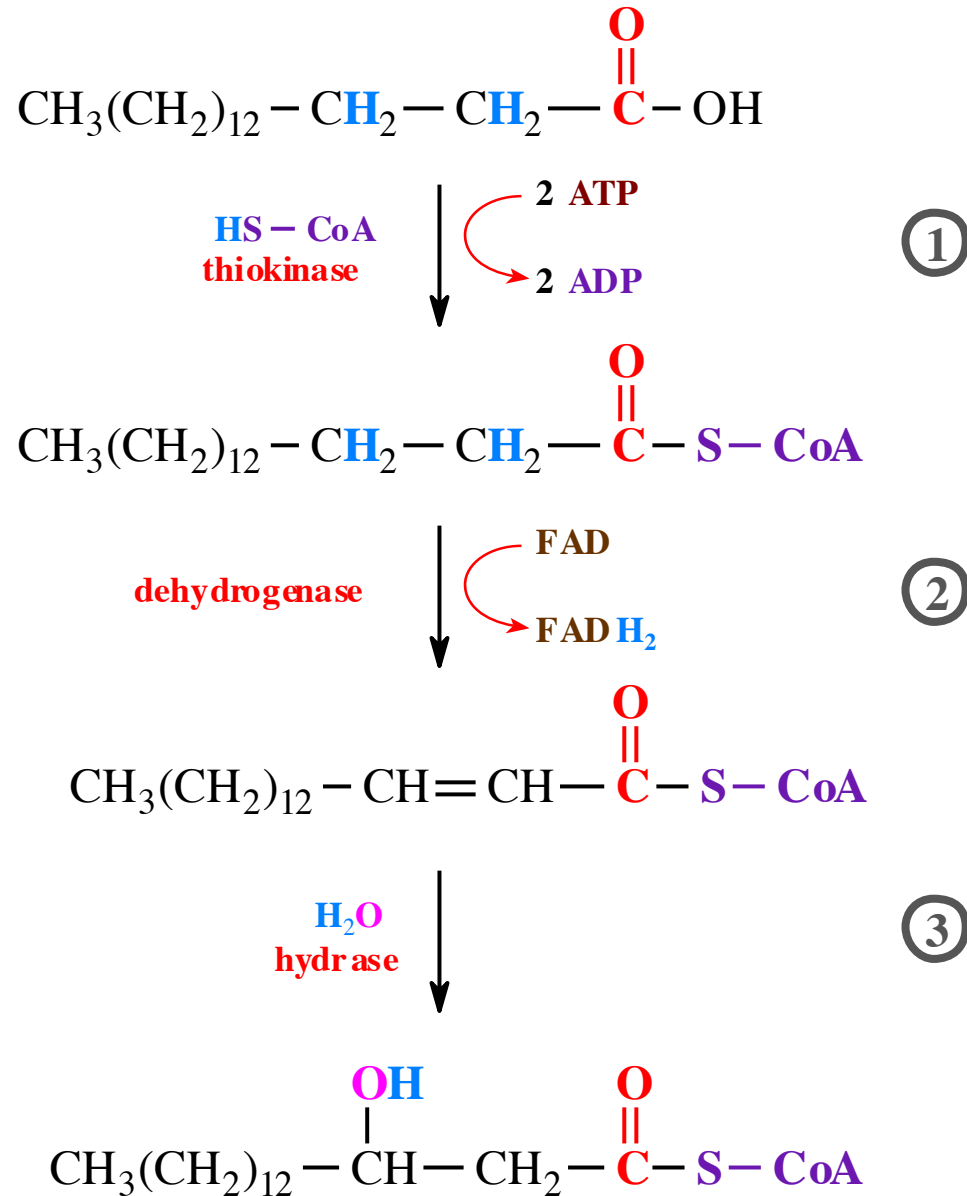
# β-oxidation



# β-oxidation



# β-oxidation



## β-oxidation



# β-oxidation



dehydrogenase



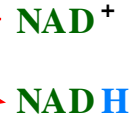
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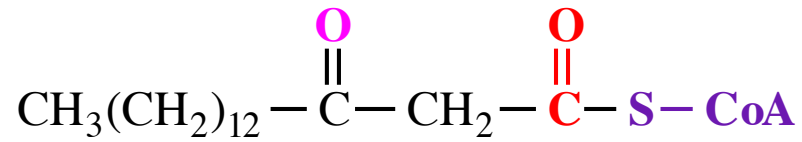
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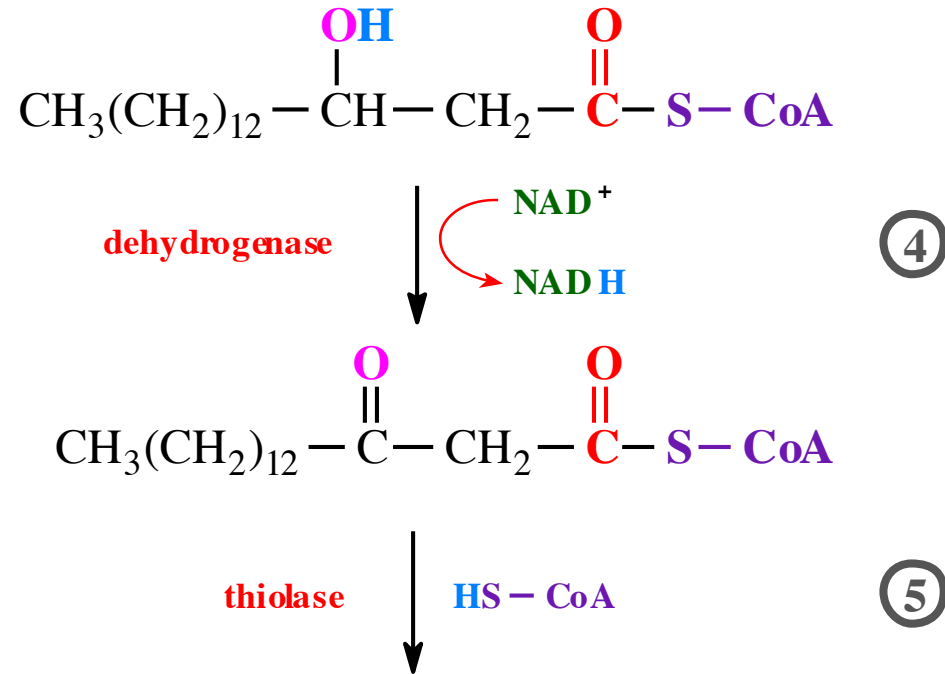
dehydrogenase



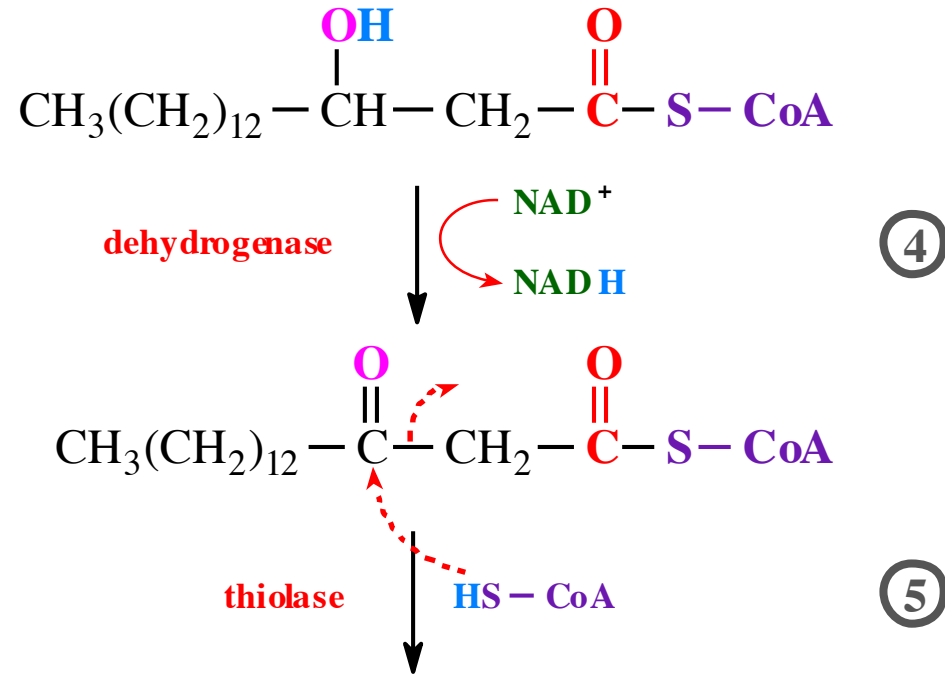
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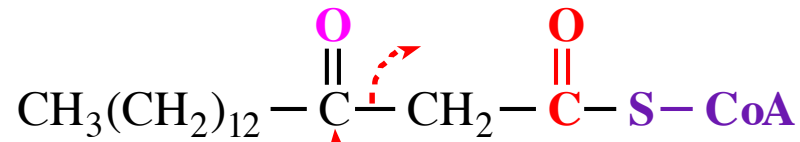
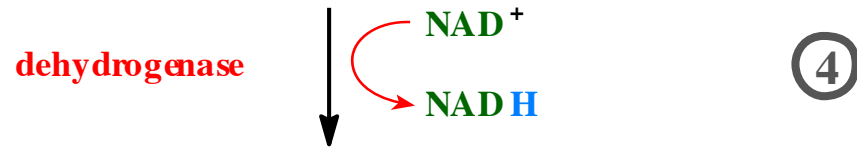
# β-oxidation



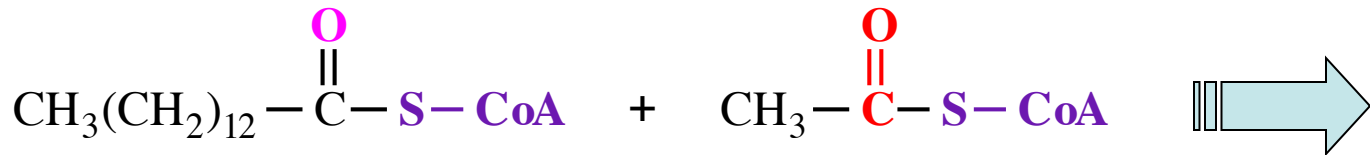
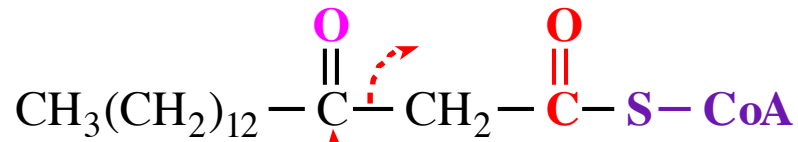
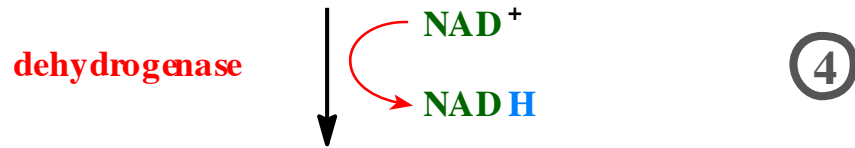
# β-oxidation



# β-oxidation



# β-oxidation

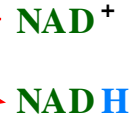


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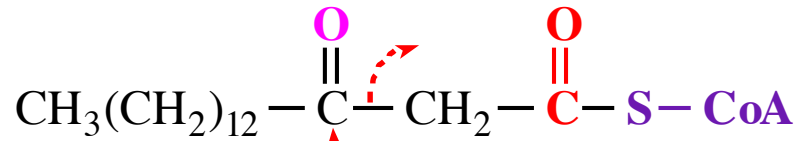


back to ②

dehydrogenase



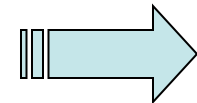
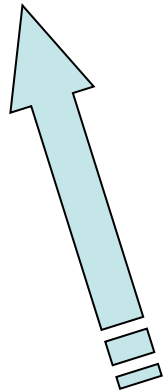
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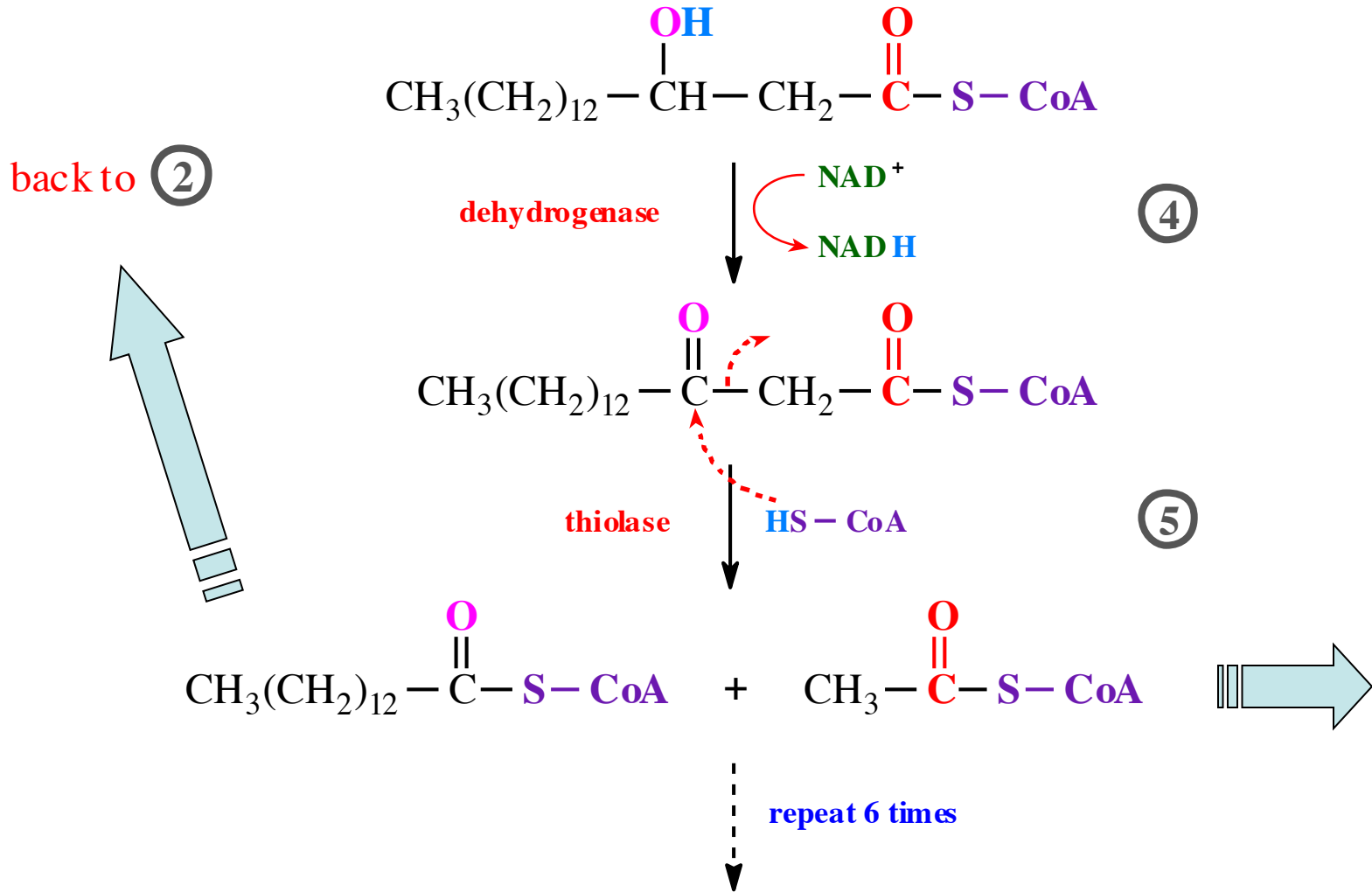
thiolase

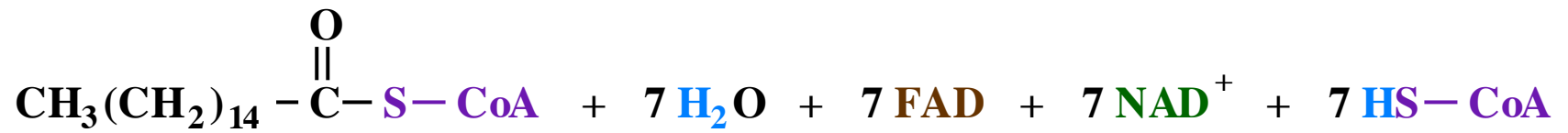


⑤



# β-oxidation







# Energy Yield on $\beta$ -Oxidation

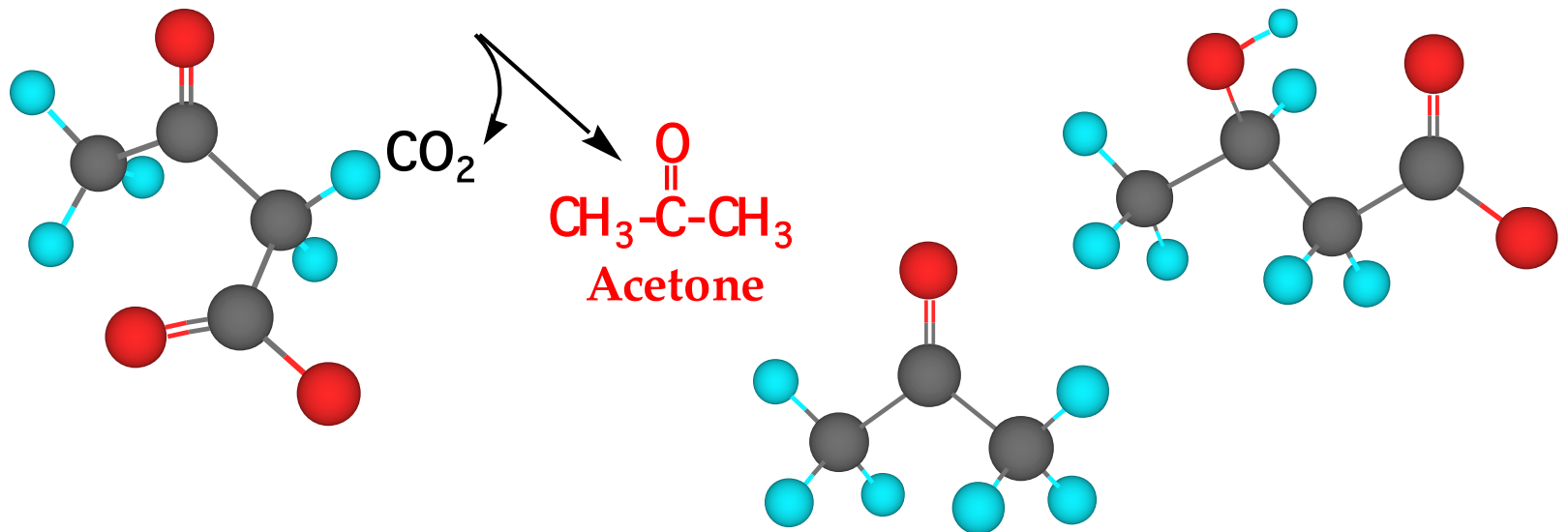
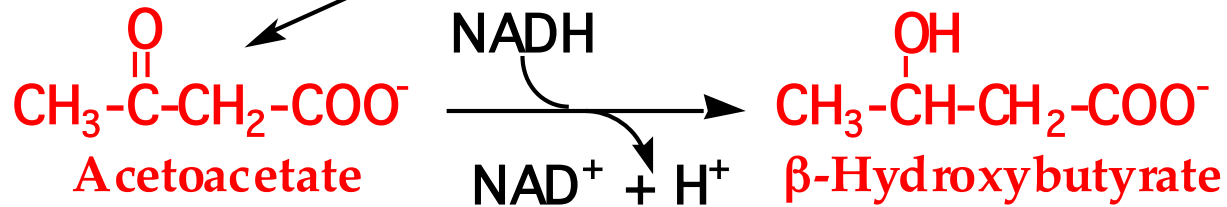
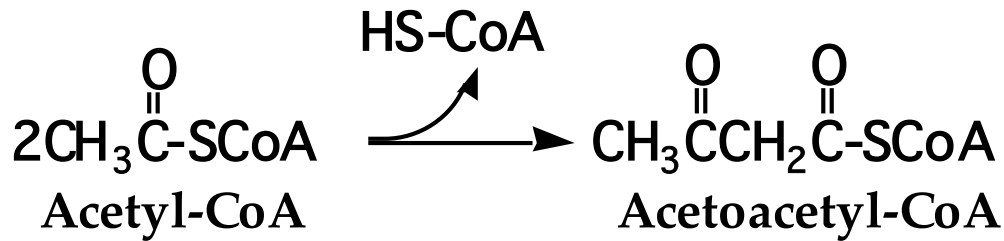
- Yield of ATP per mole of stearic acid (C<sub>18</sub>).

| Step | Chemical Step  | Happens      | ATP        |
|------|--|--------------|------------|
| 1    | <b>Activation</b> (stearic acid $\rightarrow$ stearyl CoA)                           | Once         | <b>-2</b>  |
| 2    | <b>Oxidation</b> (acyl CoA $\rightarrow$ trans-enoyl CoA) produces FADH <sub>2</sub> | 8 times      | <b>16</b>  |
| 4    | <b>Oxidation</b> (hydroxy-acyl CoA to ketoacyl CoA) produces NADH + H <sup>+</sup>   | 8 times      | <b>24</b>  |
|      | <b>Oxidation</b> of acetyl CoA by the common metabolic pathway, etc.                 | 9 times      | <b>108</b> |
|      |  | <b>TOTAL</b> | <b>146</b> |

# Ketone Bodies

- **Ketone bodies:** Acetone,  $\beta$ -hydroxybutyrate, and acetoacetate;
  - Are formed principally in liver mitochondria.
  - Can be used as a fuel in most tissues and organs.
- Formation occurs when the amount of acetyl CoA produced is excessive compared to the amount of oxaloacetate available to react with it and take it into the TCA; for example:
  - Dietary intake is high in lipids and low in carbohydrates.
  - Diabetes is not suitably controlled.
  - Starvation.

# Ketone Bodies



# Protein Catabolism

