

Semester-III

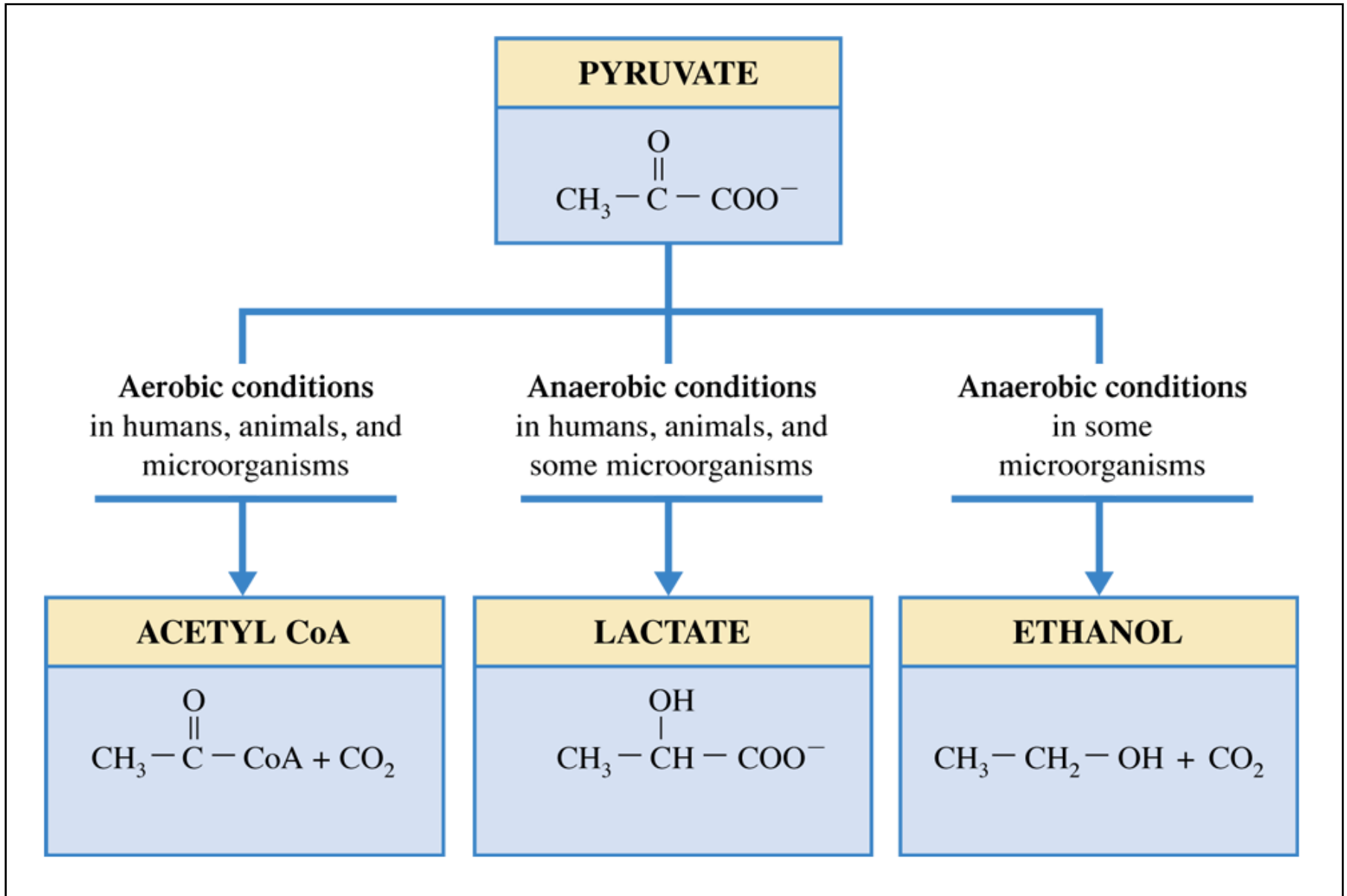
Biochemistry Notes

CARBOHYDRATE

by

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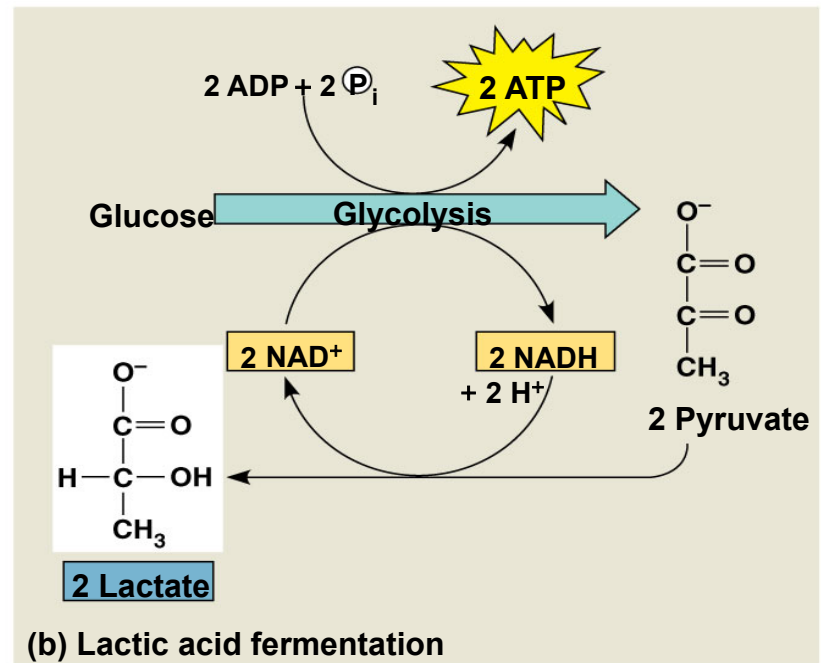
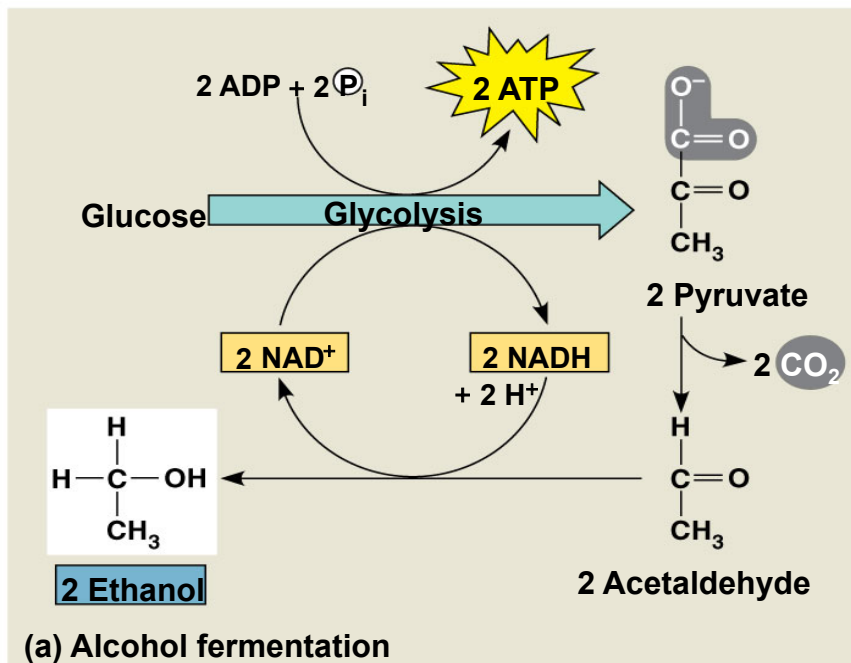
Three common fates of pyruvate



Types of Fermentation

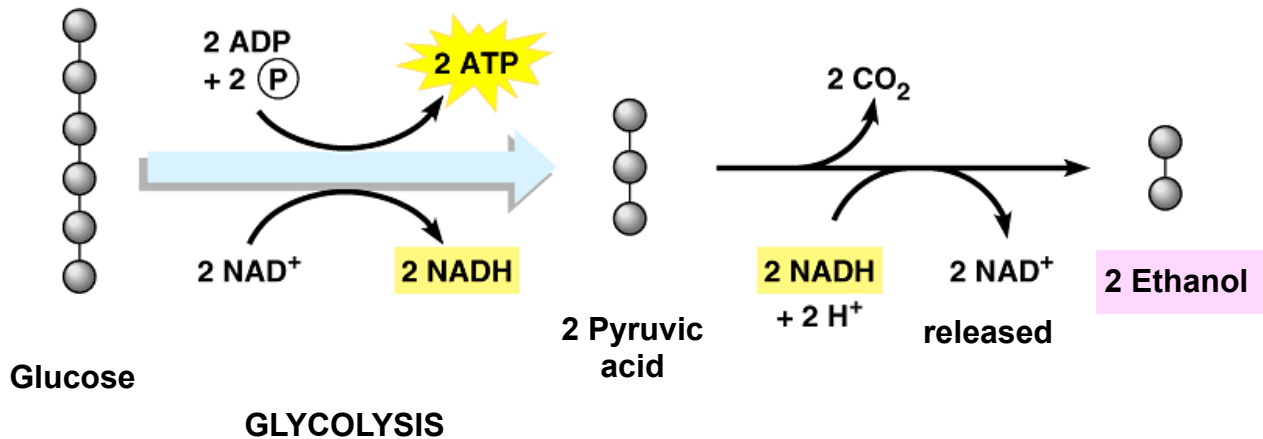
- Fermentation consists of glycolysis plus reactions that regenerate NAD^+ , which can be reused by glycolysis
- Two common types are **alcohol fermentation** and **lactic acid fermentation**

In the absence of O_2 Glycolysis alone will still produce some **ATP**. Different organisms follow 1 of 2 different metabolic pathways: each will regenerate **NAD^+**



- In **alcoholic fermentation**, 3 C pyruvic acid is converted to CO_2 and ethanol ($\text{C}_2\text{H}_5\text{OH}$)

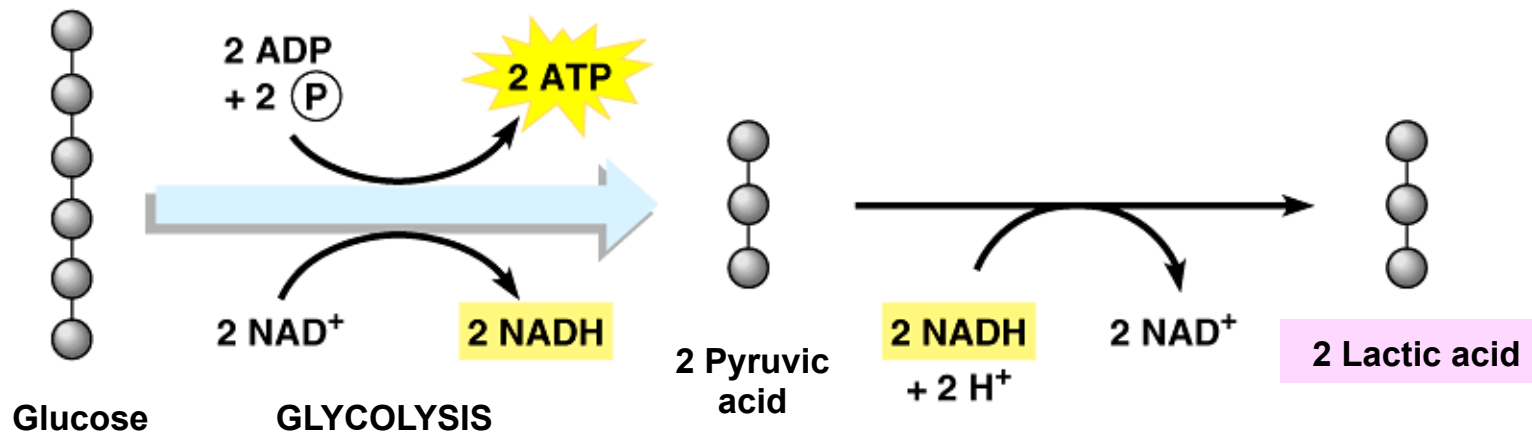
– This **recycles NAD^+** to keep glycolysis working



Ethanol is the oxidizing agent helping NADH get **oxidized** back to NAD^+ .

Pyruvic acid
decarboxylated
 forming CO_2 and ethanol
 NADH molecules oxidized
 back into NAD^+ .

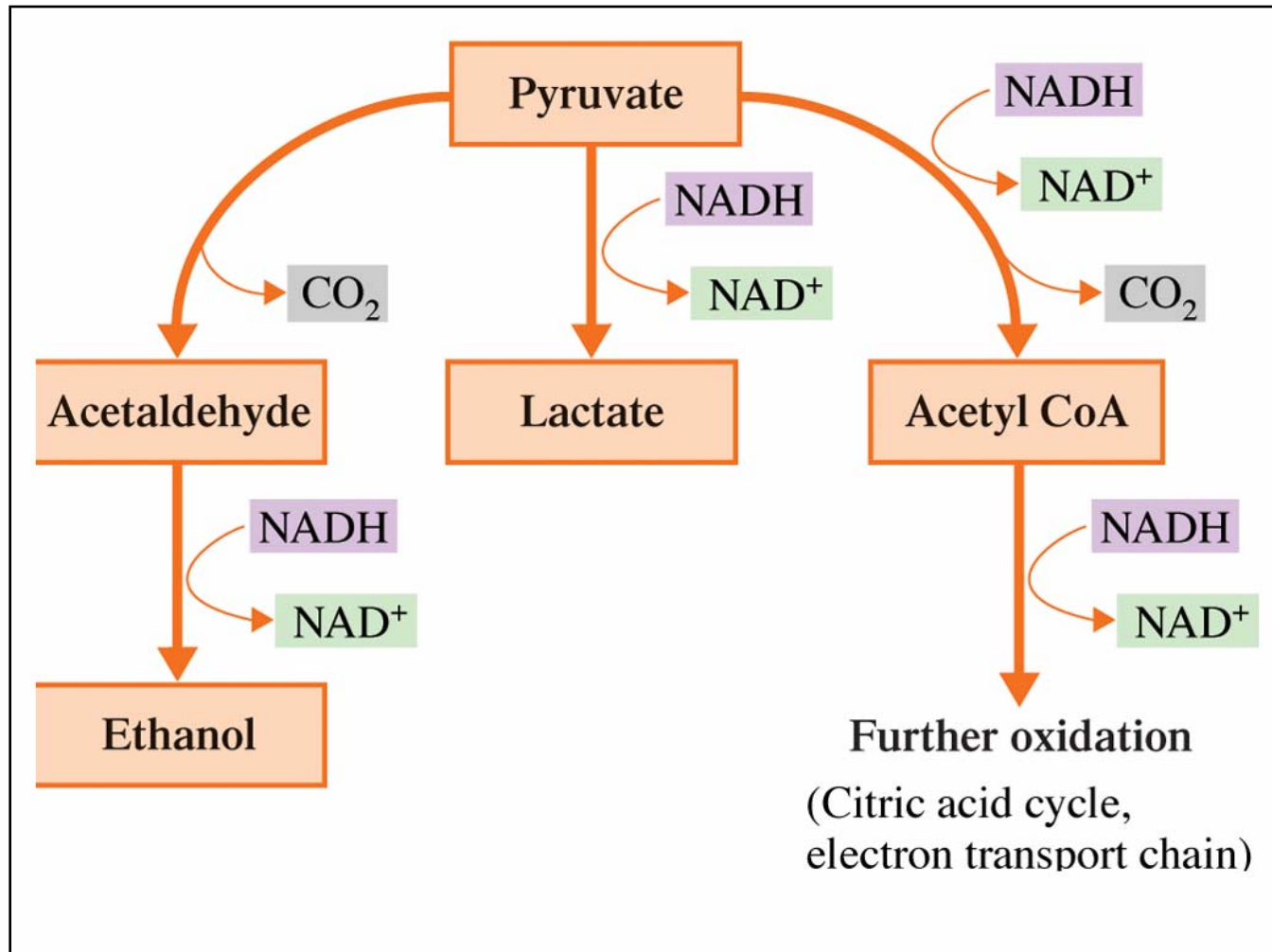
- In **lactic acid fermentation**, pyruvic acid is converted to **lactic acid**
 - As in alcoholic fermentation, **NADH** is recycled by **oxidation** back to **NAD⁺**
- Lactic acid fermentation is used to make cheese, yogurt, kefir, sauerkraut, pickles, poi, & wine



Our muscle cells do this if needed.

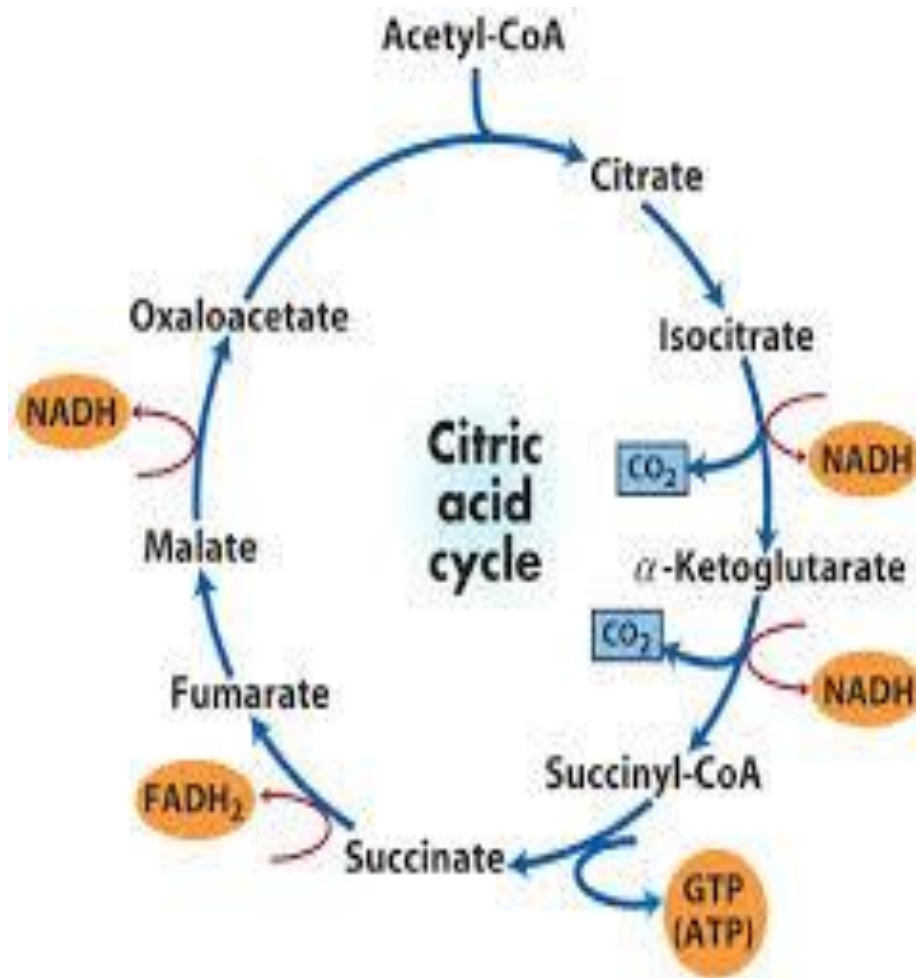
- In alcohol fermentation, pyruvate is converted to ethanol in two steps, with the first releasing CO_2
- Alcohol fermentation by yeast is used in brewing, winemaking, and baking
- In lactic acid fermentation, pyruvate is reduced to NADH, forming lactate as an end product, with no release of CO_2
- Lactic acid fermentation by some fungi and bacteria is used to make cheese and yogurt
- Human muscle cells use lactic acid fermentation to generate ATP when O_2 is scarce

All 3 fates of pyruvate from glycolysis provide for the **regeneration** of NAD^+ from NADH .



TCA Cycle

- ◆ Discovered by **Hans Krebs** in 1937
- ◆ He received the **Nobel Prize** in physiology or medicine in 1953



Acetyl CoA + Oxaloacetate \longrightarrow Citrate

- Enzyme: citrate synthase
- Inhibited by ATP

Isocitrate \longrightarrow α -Ketoglutarate

- Enzyme: isocitrate dehydrogenase
- Inhibited by ATP & NADH
- Stimulated by ADP & NAD⁺

α -Ketoglutarate \longrightarrow Succinyl CoA

- Enzyme: α -Ketoglutarate dehydrogenase
- Similar to PDH complex
- Inhibited by Succinyl CoA & NADH also high-energy charge.

- Glycolysis produces pyruvate by oxidation of glucose
- The pyruvate is then oxidized to A.CoA in the mitochondria
- The acetyl units are oxidized to CO₂ by TCA cycle in the mitochondrial matrix
- Energy released during both the oxidation rxns are collected by NAD⁺ and FAD
- So NADH and FADH₂ carry energy in the form of electrons