ATP Production

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ILOs:

1 Introduction

2 Explain how ATP is produced

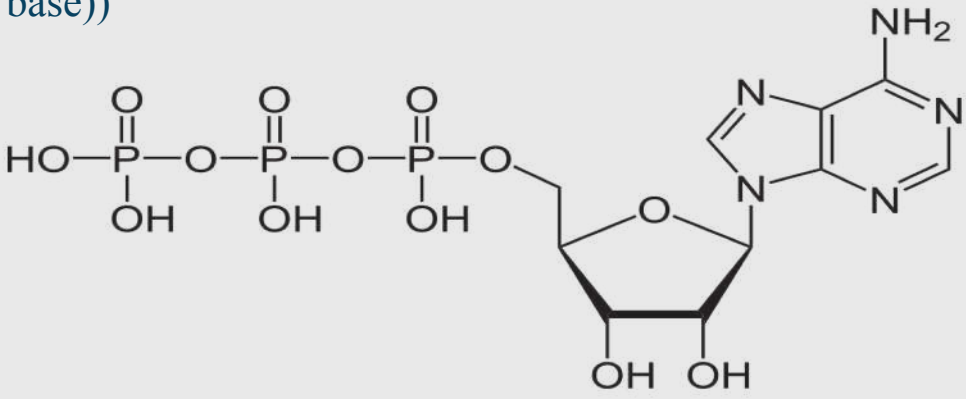
3 Discuss the function of ATP

4 Identify clinical significance of ATP

5 Summary

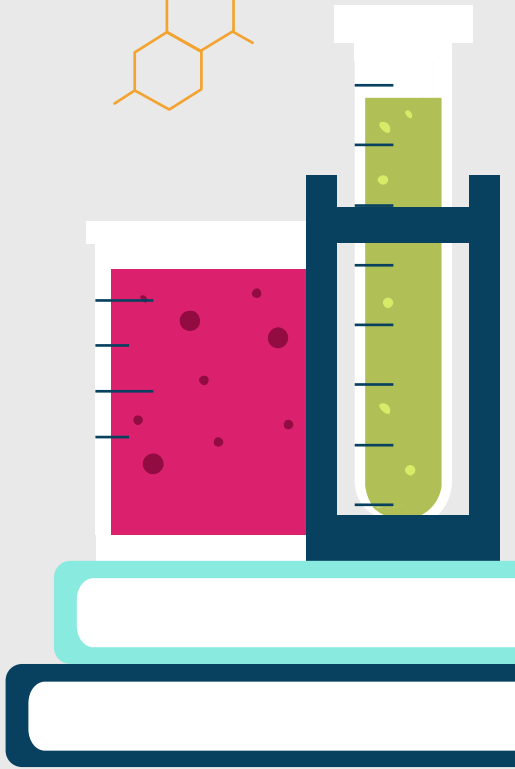
Introduction

Adenosine triphosphate (ATP), energy-carrying molecule found in the cells of all living organisms. ATP captures chemical energy obtained from the breakdown of food molecules and releases it to fuel other cellular processes. (ribose, a five-carbon sugar, three phosphate groups, and adenine , a nitrogen-containing compound (also known as a nitrogenous base))



Production of ATP (Cellular Respiration):

1. Glycolysis
2. Prepartory reaction
3. Cirtric acid cycle
4. Electron transport chain



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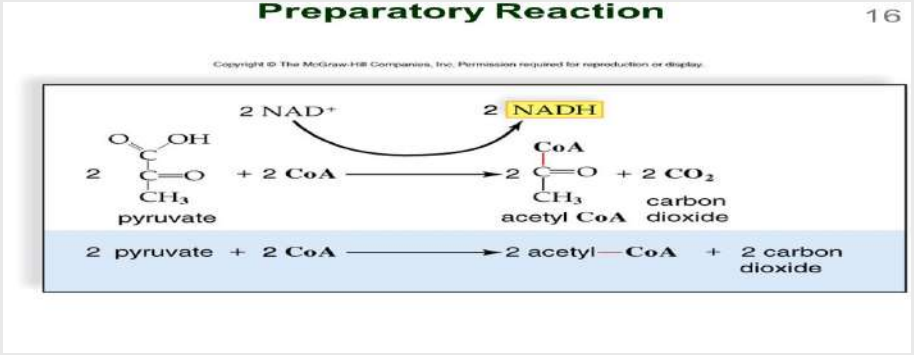
Glycolysis

- Glycolysis is the process in which glucose is broken down to produce energy.
- It produces two molecules of pyruvate.
- Cytosol of Cytoplasm
- Glucose ⟶ 2 pyruvate = 2ATP+2NADH
- Aerobic = 8ATP (produce pyruvate)
- Anaerobic = 2ATP (produces lactate)

2

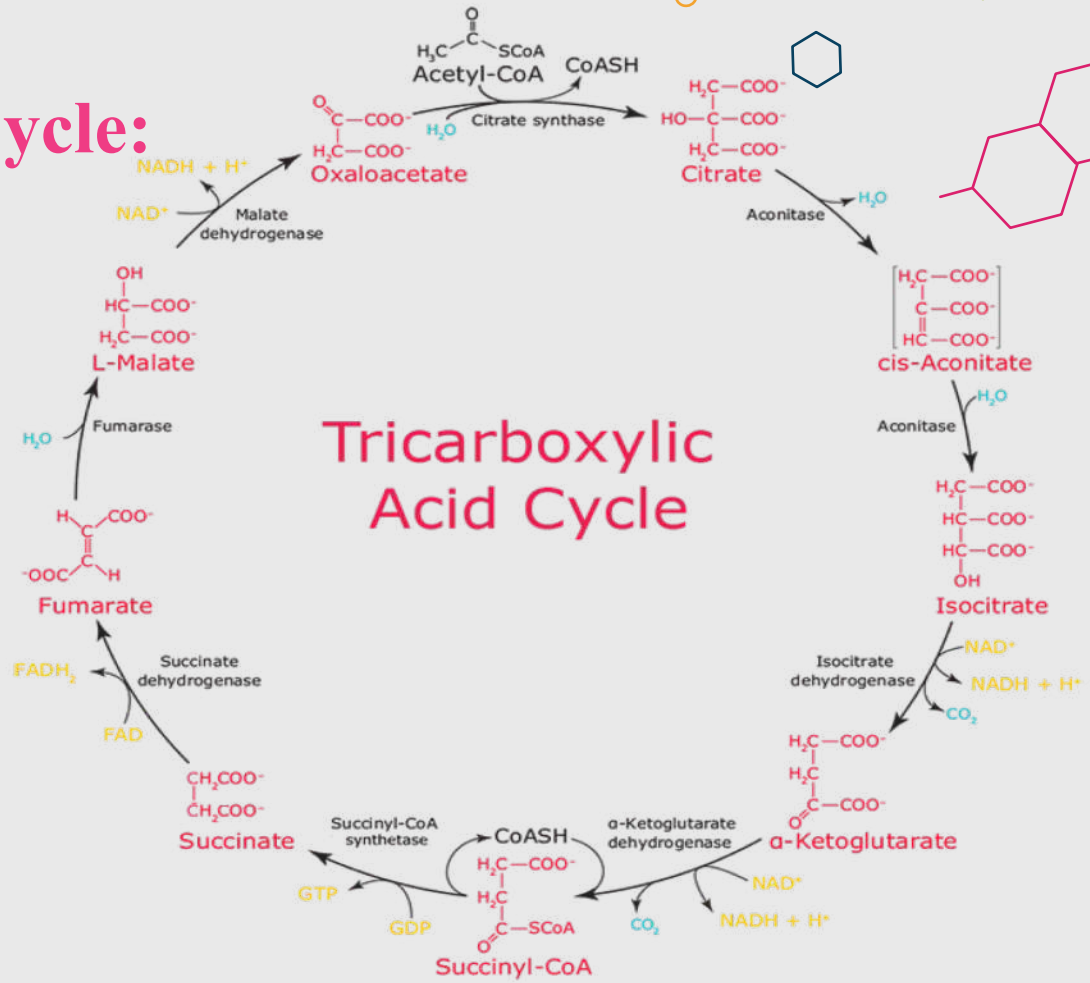
Preparatory Reaction

- Pyruvate moves in mitochondria = acetyl CoA
- 2 NADH is produced
- Release of CO2



3 Cirtric Acid Cycle:

- The remaining carbons from the intial glucose are oxidised releasing CO2.
- 1GTP = 1ATP are produced.
- 3NADH is produced.
- FADH2 is produced.



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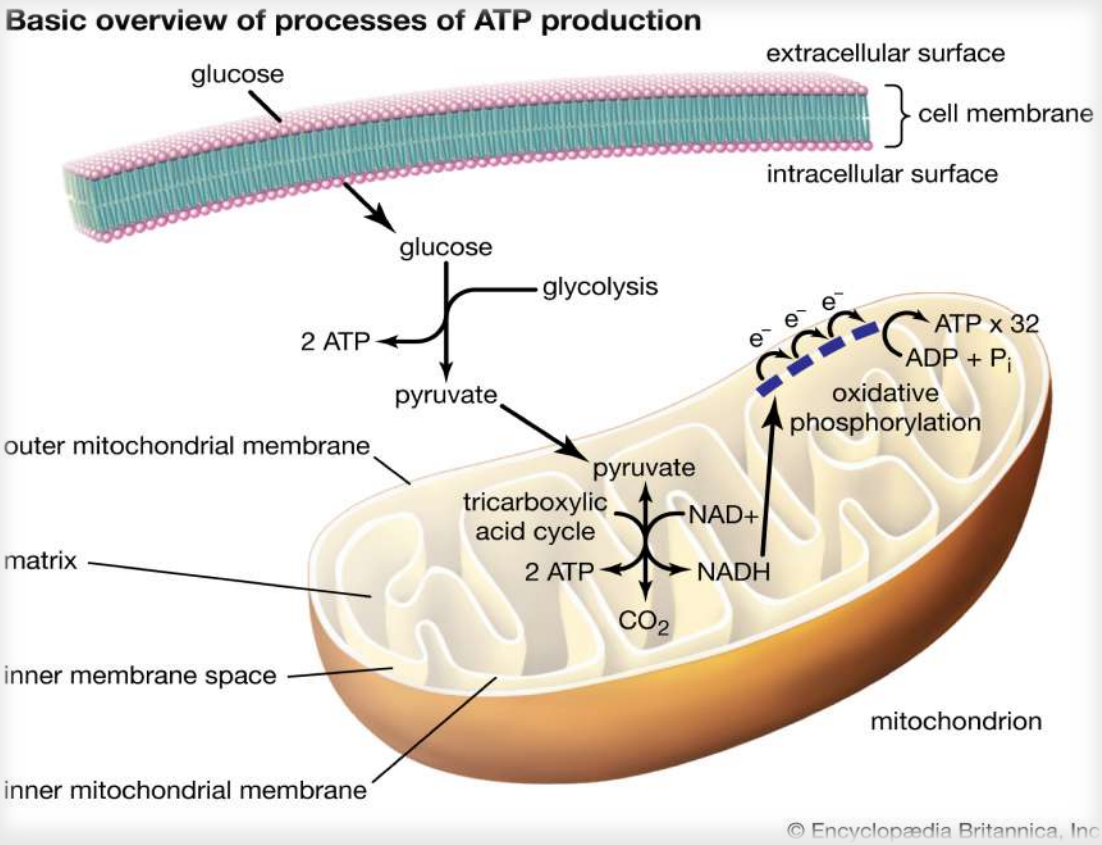
Electron Transport Chain ETC:

- NADH, FADH from the previous stages give up electrons to the chain, energy is released and captured as electrons move from higher energy to lower energy state using a series of protein imbedded in the membrane of the mitochondria



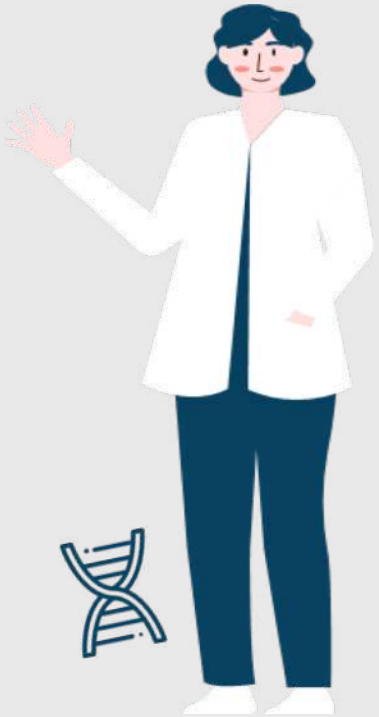
1 glucose molecule produces 36-38 ATP

Functions of ATP:

1. Intracellular Signaling
2. Muscle Contraction
3. DNA/RNA Synthesis
4. Energy stored

1 Intracellular Signaling:

- ATP can function as intracellular messenger release, These messengers include hormones, various-enzymes, lipid mediators, neurotransmitters, nitric oxide, growth factors.
- ATP utilization in intracellular signaling can be observed in ATP acting as a substrate for adenylate cyclase. This process mostly occurs in G-protein coupled receptor signaling pathways.
- Upon binding to adenylate cyclase, ATP converts to cyclic AMP, which assists in signaling the release of calcium from intracellular stores, The cAMP has other roles, including secondary messengers in hormone signaling cascades, activation of protein kinases, and regulating the function of ion channels.



2 Muscle Contraction:

- There are three primary roles that ATP performs in the action of muscle contraction. The first is through the generation of force against adjoining actin filaments through the cycling of myosin cross-bridges.
- The second is the pumping of calcium ions from the myoplasm across the sarcoplasmic reticulum against their concentration gradients using active transport.
- The third function performed by ATP is the active transport of sodium and potassium ions across the sarcolemma

3 DNA/RNA Synthesis:

DNA and RNA synthesis requires ATP. ATP is one of four nucleotide-triphosphate monomers that is necessary during RNA synthesis. DNA synthesis uses a similar mechanism, the ATP first becomes transformed by removing an oxygen atom from the sugar to yield deoxyribonucleotide DATP.

4 Energy stored in ATP:

- the energy from cellular respiration is stored in the bond between the 2nd and 3rd phosphate groups of ATP.
- When the cell needs energy to do work, ATP loses its 3rd phosphate group, releasing energy stored in the bond that the cell can use to do work.

Clinical Significance:

1

ATPs Role in Pain Control

2

Anesthesia

3

Cardio and Surgery

1 ATPs Role in Pain Control:

- The intravenous (IV) adenosine infusion acts on the A1 adenosine receptor, initiating a signaling cascade that ultimately aids the pain-relieving effects observed in inflammation.

2 Anesthesia:

- ATP supplementation produced positive outcomes during anesthesia. Evidence shows that low doses of adenosine reduce neuropathic pain, ischemic pain, and hyperalgesia to a level comparable to morphine.

3 ATP and Cardio surgery:

ATP has been demonstrated to be a safe and practical pulmonary vasodilator in patients affected by pulmonary hypertension. Similarly, adenosine and ATP can be employed during surgery to induce hypotension in patients.

Summary:

1. ATP donates much of chemical energy requiring for biochemical processes.

2. ATP is produced by cellular respiration and it can function as a ubiquitous trigger of intracellular messenger release.

3. ATP helps cells to do work by releasing its 3rd phosphate group.

References

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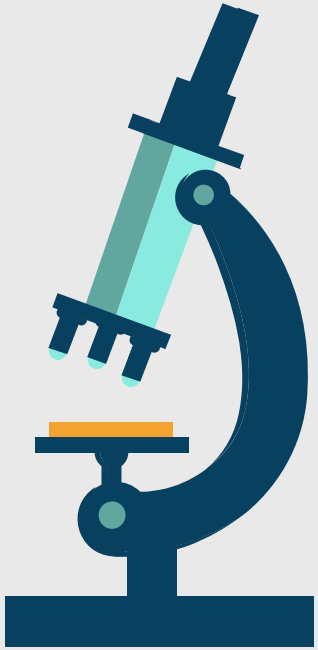

Thanks!

Do you have any questions?