CONCEPT OF OXIDATIVE PHOSPHORYLATION

Dr. R. Prasad,
Assistant Professor,
Department of Zoology,
Eastern Karbi Anglong College

RESPIRATION

- Respiration: A process where cells derive energy with a controlled reaction between H+ and O_2; & the end product being water.

- Aerobic organisms are able to capture a far greater proportion of the available free energy of respiratory substrates than anaerobic organisms.

- Objective of respiration: To produce ATP

TWO WAYS TO SYNTHESIZE ATP

- **Oxidative Phosphorylation:**

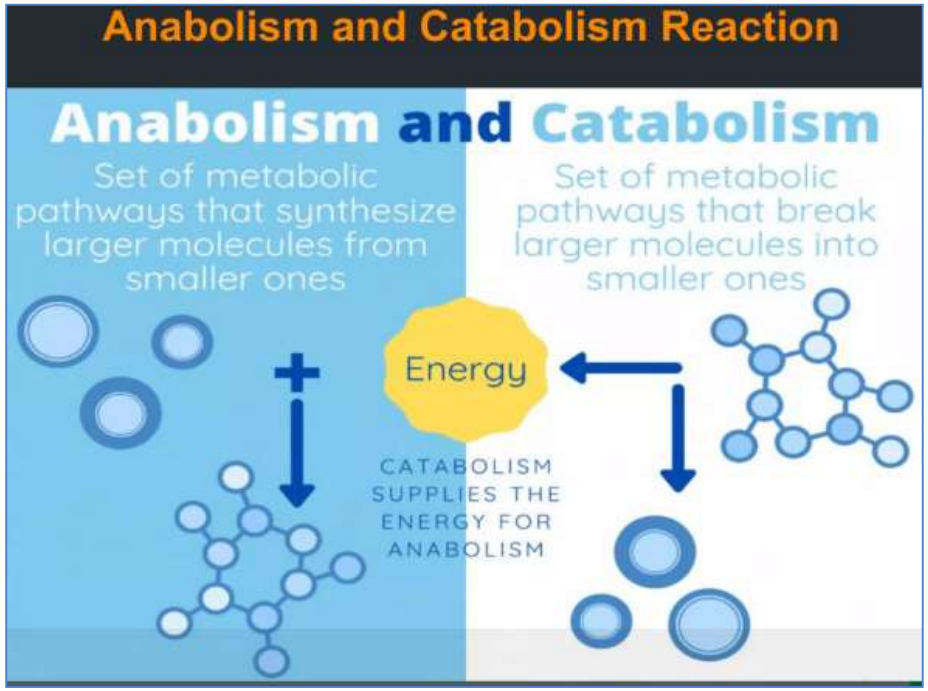
  The phosphorylation of ADP to ATP coupled to electron transfer.

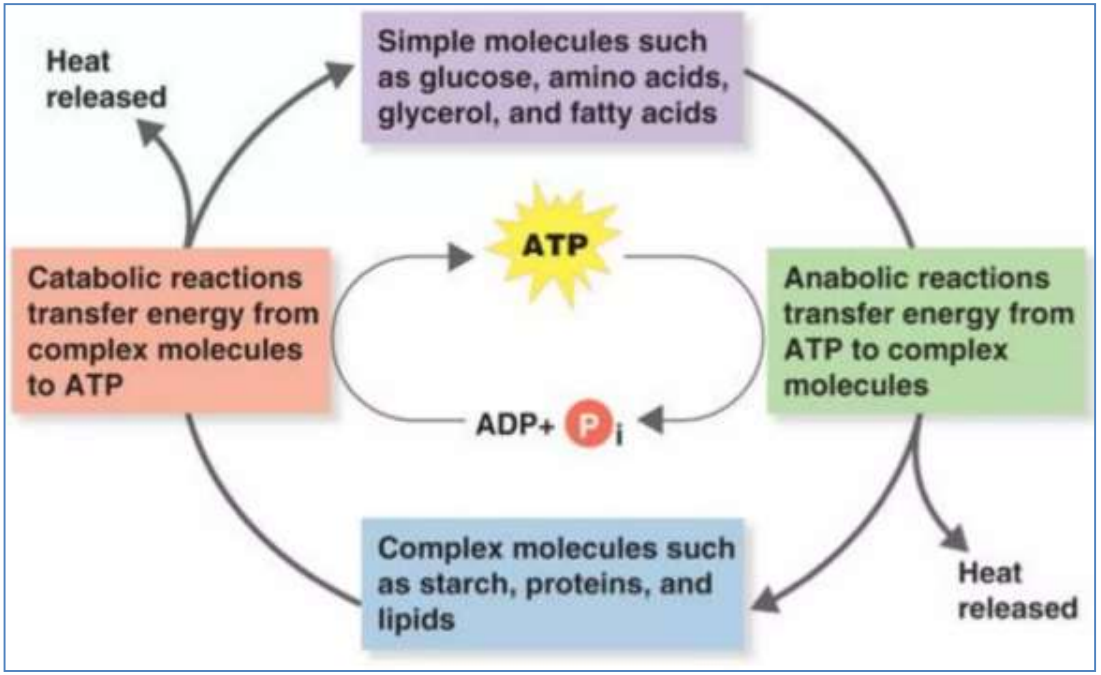
- **Substrate Level Phosphorylation:**

  Direct transfer the phosphate from chemical intermediate (also called substrate) to ADP or GDP forming ATP or GTP, independent of electron transfer chain.

METABOLISM

- Metabolism: Sum of the chemical reactions in an organism.
- Catabolism: Energy releasing processes
- Anabolism: Energy using processes
- Catabolism provides the building blocks and energy for anabolism.


Anabolism and Catabolism Reaction
Anabolism and Catabolism
Set of metabolic pathways that synthesize larger molecules from smaller ones
Set of metabolic pathways that break larger molecules into smaller ones
Energy
CATABOLISM SUPPLIES THE ENERGY FOR ANABOLISM


Heat released
Simple molecules such as glucose, amino acids, glycerol, and fatty acids
ATP
Catabolic reactions transfer energy from complex molecules to ATP
Anabolic reactions transfer energy from ATP to complex molecules
ADP+ Pi
Complex molecules such as starch, proteins, and lipids
Heat released

OXIDATIVE PHOSPHORYLATION

- Oxidative phosphorylation is the process of ATP formation, when electrons are transferred by electron carriers from NADH or $FADH_2$ to oxygen.
- Oxidation coupled with phosphorylation is called **Oxidative phosphorylation**.
- Mitochondria are the site of oxidative phosphorylation in eukaryotes.
- During transfer of electrons through the ETC energy is produced.

- This energy is coupled to the formation of ATP from ADP.
- By an enzyme F_0F_1 ATPase.

A. Oxidation step: Electron transport chain

$$NADH + H^+ + O_2 \dashrightarrow NAD^+ + H_2O$$

$$FADH_2 + O_2 \dashrightarrow FAD + H_2O$$

B. Phosphorylation step

$$ADP + Pi \dashrightarrow ATP$$

MITOCHONDRIA

- Mitochondria: "Powerhouse of the cell" since the final energy release takes place in the mitochondria only.

- Mitochondria is the site of oxidative phosphorylation in eukaryotes.

- The NADH and $FADH_2$, formed during glycolysis, β-oxidation of fatty acids and the TCA cycle, give up their electrons to reduce molecular O_2 to H_2O.

- Electron transfer occurs through a series of protein electrons carriers, the final acceptor being O_2; the pathway called as the Electron Transport Chain (ETC).

- Function of ETC: To facilitate the controlled release of free energy that was stored in reduced cofactors during catabolism.

- Energy is released when electrons are transported from higher energy $NADH/FADH_2$ to lower energy O_2.
- This energy is used to phosphorylate ADP.

- Because energy generated by the transfer of electrons through the electron transport chain to O_2 is used in the production of ATP.
- The overall process is known as **Oxidative Phosphorylation**.
- Oxidative phosphorylation is responsible for 90% of total ATP synthesis in the cell.