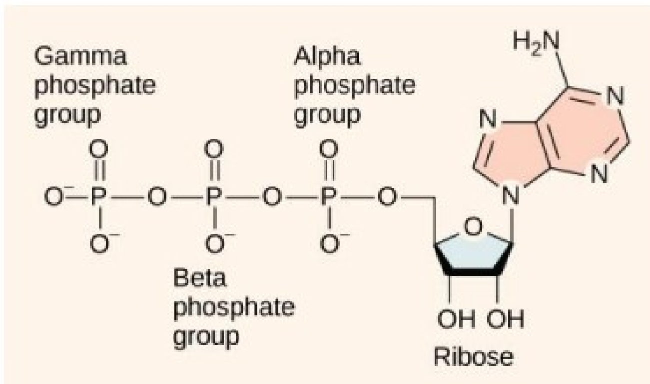
FORMATION AND ROLE OF ATP, CREATININE PHOSPHATE AND BMR

ATP – Adenosine triphosphate is called the energy currency of the cell.

These molecules provide energy for various biochemical processes in the body. Therefore, it is called "**Energy Currency of the Cell**".

These ATP molecules are **synthesized by Mitochondria**, therefore it is called powerhouse of the cell.

ATP Structure



(adenosine triphosphate) has three phosphate groups that can be removed by hydrolysis to lenosine diphosphate) or AMP (adenosine monophosphate).The negative charges on the up naturally repel each other, requiring energy to bond them together and releasing energy nds are broken.

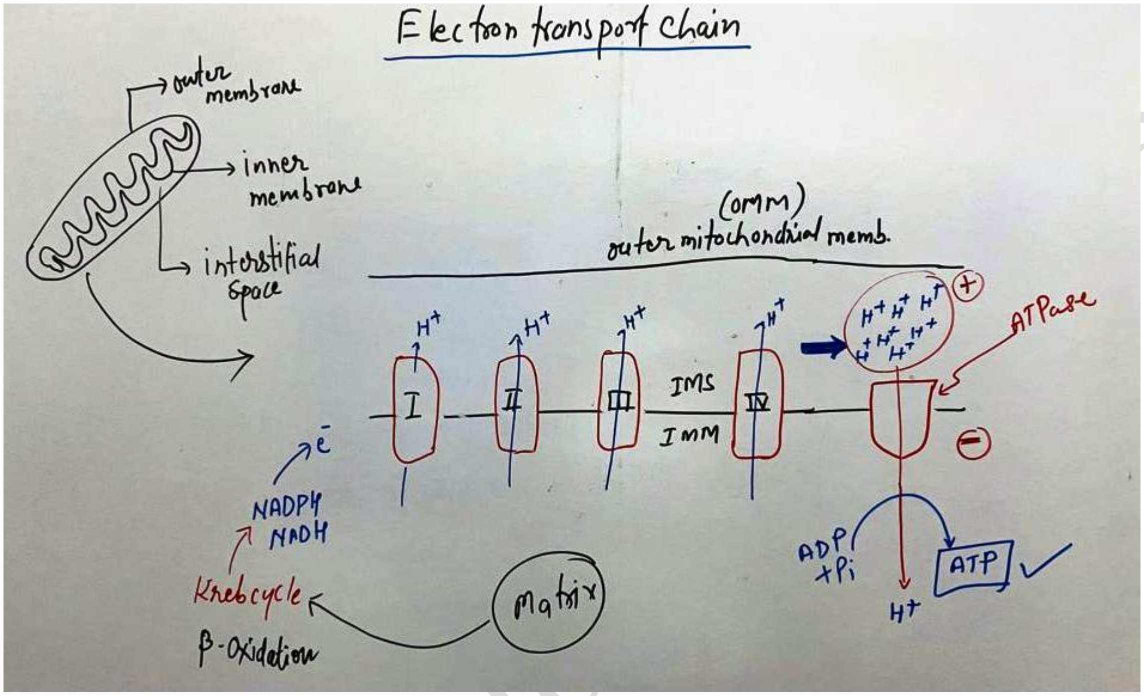
ATP molecules are largely composed of three essential components.

1. **The pentose sugar** molecule i.e. ribose sugar.
2. **Nitrogen base**- Adenine, attached to the first carbon of this sugar molecule.
3. The **three phosphate groups** which are attached in a chain to the 5th carbon of the pentose sugar. The phosphoryl groups, starting with the group closest to the ribose sugar, are referred to as the alpha, beta, and gamma phosphates. These phosphates play an important role in the activity of ATP.

FORMATION OF ATP

1. At the inner mitochondrial membrane, a high energy electron is passed along an electron transport chain.

2. The energy released pumps hydrogen out of the matrix space.
3. The gradient created by this drives hydrogen back through the membrane, through **ATP synthase.**
4. As this happens, the enzymatic activity of ATP synthase synthesiszes ATP from ADP



ADP+Pi →ATP+H2O.

FUNCTION OF ATP

1. **ATP in Intracellular Signaling**

   Signal transduction heavily relies on ATP. ATP can serve as a substrate for kinases, the most numerous ATP- binding protein.

2. **DNA/RNA Synthesis**

   DNA and RNA synthesis requires ATP. ATP is one of four nucleotide-triphosphate monomers that is necessary during RNA synthesis.

3. **Purinergic Signaling**

   Purinergic signaling is a form of extracellular paracrine signaling that is mediated by purine nucleotides, including ATP

4. **ATP in Muscle Contraction**

Muscle contraction is a necessary function of everyday life and could not occur without ATP.

5. Transport of substances through multiple membranes in the cell,
6. Synthesis of chemical compounds throughout the cell
7. To supply energy for the transport of sodium through the cell membrane
8. To promote protein synthesis by the ribosomes,
9. In addition to membrane transport of sodium, energy from ATP is required for membrane
10. Transport of potassium ions, calcium ions, magnesium ions, phosphate ions, chloride ions, urate ions, hydrogen ions, and many other ions and various organic substances

ROLE OF ATP MOLECULE IN METABOLISM

1. These ATP molecules can be recycled after every reaction.

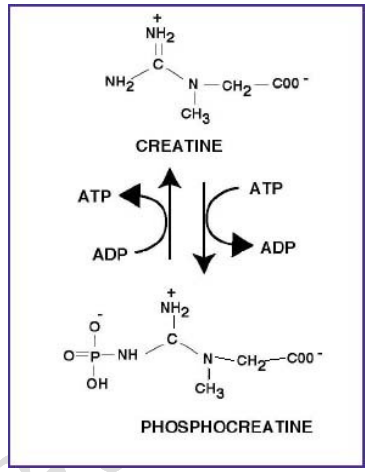
2. ATP molecule provides energy for both the exergonic and endergonic processes.

3. ATP serves as an extracellular signalling molecule and acts as a neurotransmitter in both central and peripheral nervous systems.

4. It is the only energy, which can be directly used for different metabolic process. Other forms of chemical energy need to be converted into ATP before they can be used.

5. It plays an important role in the Metabolism – A life-sustaining chemical reactions including cellular division, fermentation, photosynthesis, photophosphorylation, aerobic respiration, protein synthesis, exocytosis, endocytosis and motility

CREATININE PHOSPHATE



The muscles of the body function through the use of ATP, or adenosine triphosphate, to power contractions.

When one molecule of ATP is used in the contraction process, it is hydrolyzed to ADP, adenosine diphosphate, and an inorganic phosphate.

The muscles' limited ATP supply is used very quickly in muscle activity, so the need to regenerate ATP is essential.

One of the ways that this ATP supply is regenerated is through the molecule creatine phosphate (or phosphocreatine).

In the process of regeneration of ATP, creatine phosphate transfers a high-energy phosphate to ADP. The products of this reaction are ATP and creatine.

Creatine phosphate can be obtained from two sources: ingestion **of meat and internal production by the liver and kidneys.**

Creatine and creatinine (fromed from the metabolism of creatine) waste is removed from the body through the kidneys and urinary system.

ROLE

1. The supplementation of creatine phosphate has been shown in studies to be effective for many people. With supplementation, muscle mass, explosive power, and strength have been shown to increase in most cases.
2. Thus, for activities that require short bursts of energy such as football and sprinting, creatine phosphate has improved athletic performance.
3. Another advantage to taking creatine phosphate is that it is a legal substance in most athletic competitions, such as the Olympics and professional athletics.
4. In addition, creatine phosphate is not considered a drug by the FDA

BMR

- The Basal Metabolic Rate (BMR) is the energy required by an awake individual during physical, emotional and digestive rest.
- It is the minimum amount of energy required to maintain life or sustain vital functions like the working of the heart, circulation, brain function, respiration, etc.
- The metabolic rate during sleep is less than BMR.
- Basal metabolic energy required to support the basic processes of life, including circulation, respiration, temperature maintenance, etc.
- It excludes digestion and voluntary activities.
- BMR constitutes the largest proportion (2/3) of a person's daily expenditure.

FACTORS THAT AFFECT BMR

- Age – BMR higher in youth. Lean body mass declines with age; physical activity can¬ offset this effect.
- Height – tall people have larger surface area.¬
- Growth – children¬ & pregnant women have higher BMR's
- Body composition – more lean tissue, higher BMR
- Fever – raises BMR
- Stress
- Environmental temperature
- Fasting/starvation, lowers BMR
- Malnutrition, lowers BMR
- Thyroxine – regulates BMR

NORMAL VALUE FOR BMR

- Since BMR is affected by body surface area, it is usually expressed in kilocalories per hour/square meter of body surface.
- Body surface area is calculated using the formula

$$\mathbf{A = W^{0.425} \times H^{0.725} \times 71.84}$$

A = area in sq cm,

H = height in centimeters and W = weight in kilograms.

- The BMR is then calculated from the values of oxygen consumption, calorific value and surface area.
- NORMAL VALUE FOR BMR
- For adult men normal value for BMR is 34-37 kcal/square meter/hour, and For adult women, 30-35 kcal/Sq.m./hour.
- For easier calculations, BMR for an adult is fixed as 24 kcal/ kg body weight/day