Nucleotides and Nucleosides

- Nucleotides are the basic building blocks of nucleic acids, like DNA and RNA, which are crucial for storing and transmitting genetic information.
- Nucleotides also play key roles in cellular energy transfer, signaling, and metabolism.

1. Structure of Nucleotides:

A nucleotide is composed of three components:

✓**Nitrogenous Base:**

There are two types of nitrogenous bases:

- Purines: Adenine (A) and Guanine (G)
- Pyrimidines: Cytosine (C), Thymine (T) in DNA, and Uracil (U) in RNA.

✓**Pentose Sugar:**

A five-carbon sugar, which can be:

- Deoxyribose in DNA
- Ribose in RNA

✓**Phosphate Group:**

- One or more phosphate groups attached to the 5' carbon of the pentose sugar.

Together, these three components form a nucleotide, which can be represented as a structure with a nitrogenous base attached to the 1' carbon of the sugar, and the phosphate group(s) attached to the 5' carbon.

2. Nucleosides:

✓A nucleoside consists of only two components:

- Nitrogenous Base
- Pentose Sugar

✓It lacks the phosphate group that is present in nucleotides.

✓Example: Adenosine (adenine + ribose) is a nucleoside.

3. Functions of Nucleotides:

✓**Building Blocks of DNA and RNA:**

- Nucleotides link together to form the long chains of DNA and RNA.
- In DNA, nucleotides are connected by phosphodiester bonds between the 3' hydroxyl group of one sugar and the 5' phosphate group of the next.

✓**Energy Carriers:**

- Adenosine triphosphate (ATP) is a nucleotide that serves as the primary energy currency of the cell.
- It stores energy in its high-energy phosphate bonds.

✓**Signaling Molecules:**

- Cyclic AMP (cAMP) and cyclic GMP (cGMP) are nucleotides that act as second messengers in various signal transduction pathways.

✓**Coenzymes:**

- Many coenzymes, such as NAD+ (nicotinamide adenine dinucleotide) and FAD (flavin adenine dinucleotide), are derived from nucleotides and are crucial for metabolic processes.

4. Nucleic Acids:

- Nucleotides are the monomers that make up nucleic acids like DNA and RNA. DNA stores genetic information, while RNA plays various roles in gene expression, including acting as a messenger (mRNA), a structural component (rRNA) and an adaptor molecule (tRNA).