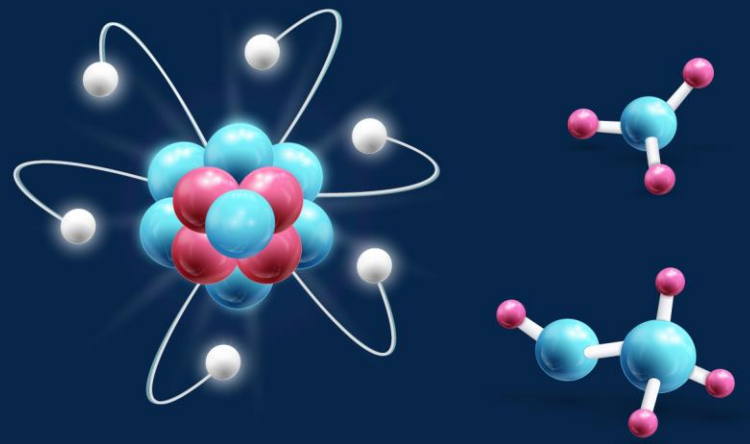
BIOMOLECULE - L2



CHEMISTRY

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AAKASH NATIONAL TALENT HUNT EXAM

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For Class VII to XII

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Proteins

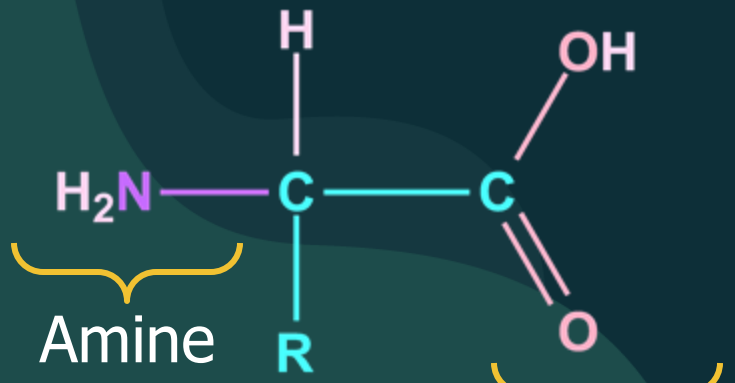
Proteins

Each **living cell** is made up of thousands of **different proteins**.

Proteins are **high molecular mass** complex, biopolymers of **amino acids**.

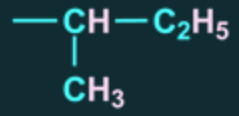
Amino Acids

The amino acids contain **amino** as well as **carboxylic acid** group.

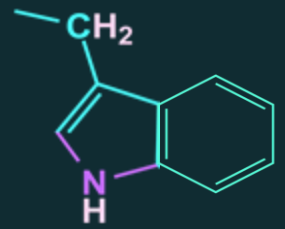
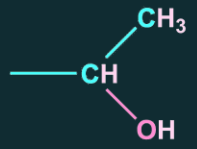


Amino Acids & Their Symbols

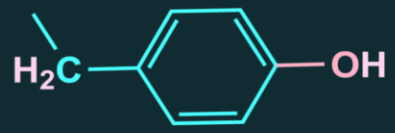
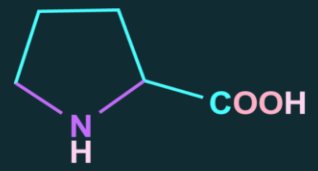
Neutral amino acid

Name of the amino acid	Three letter symbol	One letter code	Side chain (R)
Glycine	Gly	G	-H
Alanine	Ala	A	$-CH_3$
Valine	Val	V	$-CH(CH_3)_2$
Leucine	Leu	L	$-CH_2-CH-(CH_3)_2$
Isoleucine	Ile	I	
Phenyalanine	Phe	F	$-CH_2-C_6H_5$
Cysteine	Cys	C	$-CH_2-SH$

Neutral amino acid

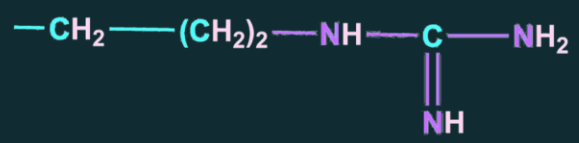
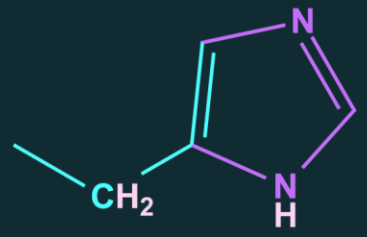
Name of the amino acid	Three letter symbol	One letter code	Side chain (R)
Methionine	Met	M	$-CH_2-CH_2-S-CH_3$
Tryptophan	Trp	W	
Serine	Ser	S	$-CH_2-OH$
Asparagine	Asn	N	$-CH_2-CO-NH_2$
Glutamine	Gln	Q	$-CH_2-CH_2-CO-NH_2$
Threonine	Thr	T	

Neutral and **Acidic** amino acid

Name of the amino acid	Three letter symbol	One letter code	Side chain (R)
Tyrosine	Tyr	Y	
Proline	Pro	P	 (Complete structure)

Name of the amino acid	Three letter symbol	One letter code	Side chain (R)
Aspartic acid	Asp	D	$-CH_2-COOH$
Glutamic acid	Glu	E	$-CH_2-CH_2-COOH$

Basic amino acid

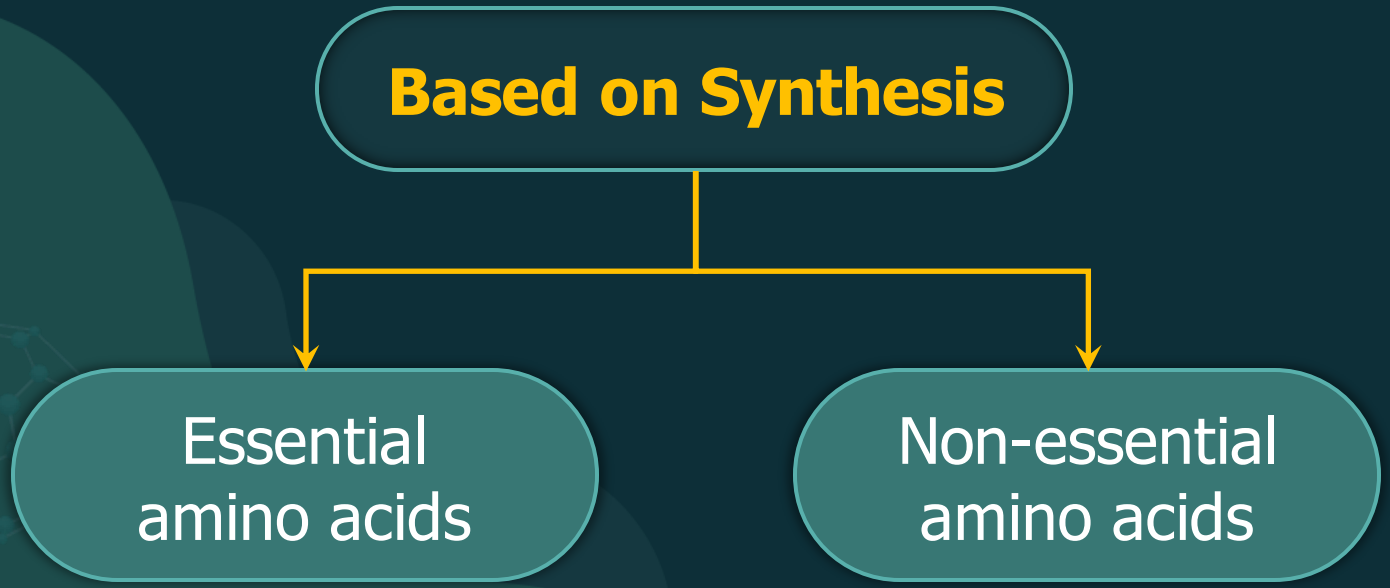
Name of the amino acid	Three letter symbol	One letter code	Side chain (R)
Arginine	Arg	R	
Histidine	His	H	
Lysine	Lys	K	$-CH_2-(CH_2)_3-NH_2$

Note

Almost all the naturally occurring amino acids have the **L configuration** at the **α carbon**, except for **glycine.**

Glycine is **achiral.**

Classification of Amino Acids



Essential Amino Acids

10 amino acids that should **necessarily** be present in our diet

PVT-TIM-HALL

Essential amino acids:
Phe, Val ,Thr, Trp, Ile,
Met, His, Arg, Leu, Lys,

Non-Essential Amino Acids

10 amino acids that are **synthesized** in our **body**

CAAATS-GGGP

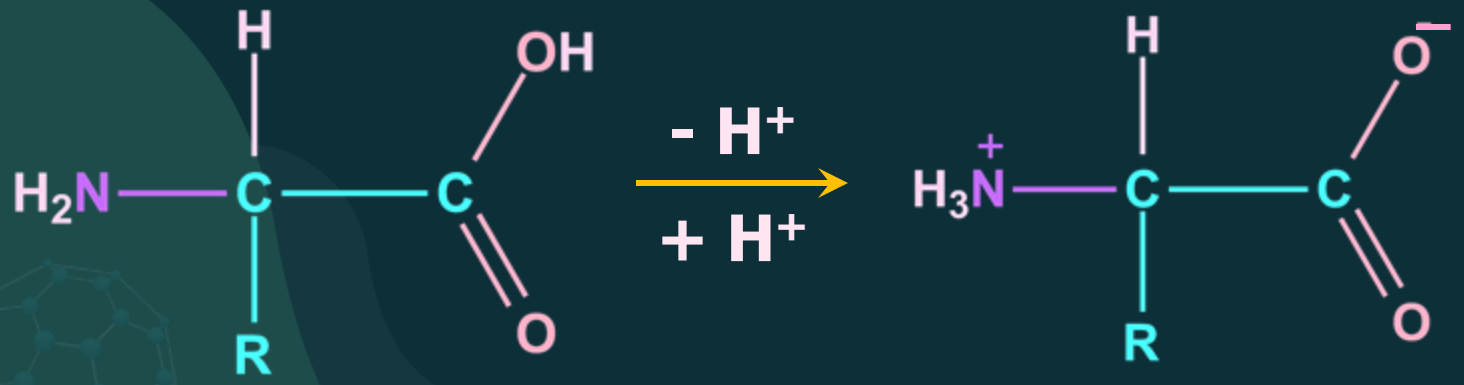
Non-essential amino acids:
Cys, Asn, Ala, Asp, Tyr,
Ser, Gln, Gly, Glu, Pro,

Note

In a **neutral amino acid** solution, the **–COOH loses a proton** and the **–NH_2** of the same molecule **picks up the proton.**

The resulting ion is **dipolar**, charged but overall, **electrically neutral**, is called **Zwitter ion.**

Zwitter Ion



Zwitter ion

Amino acids are **amphoteric** in nature.

A substance forms zwitter ion. It can have functional group:

a) $-NH_2$, – COOH

b) $-NH_2$, $-SO_3H$

c) Both

d) None of these

Peptides

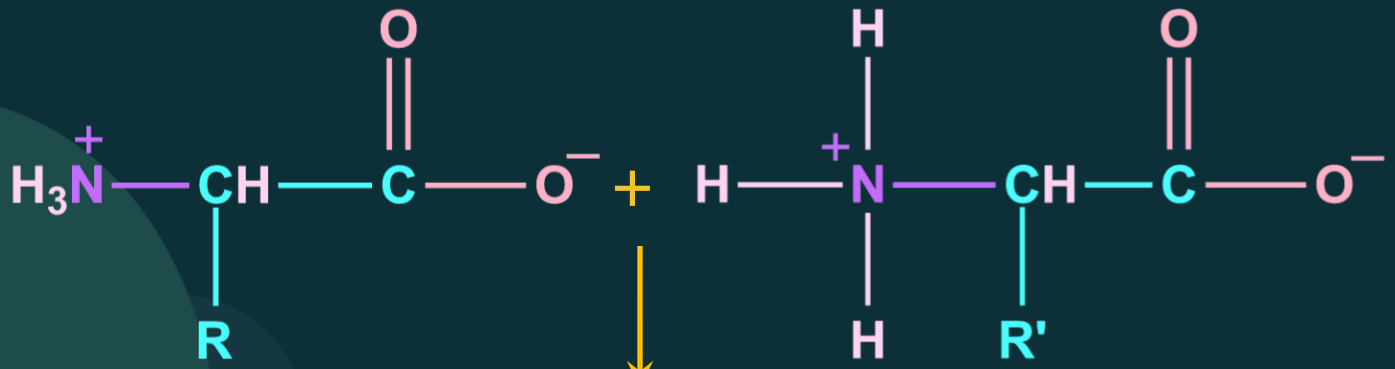
Peptides

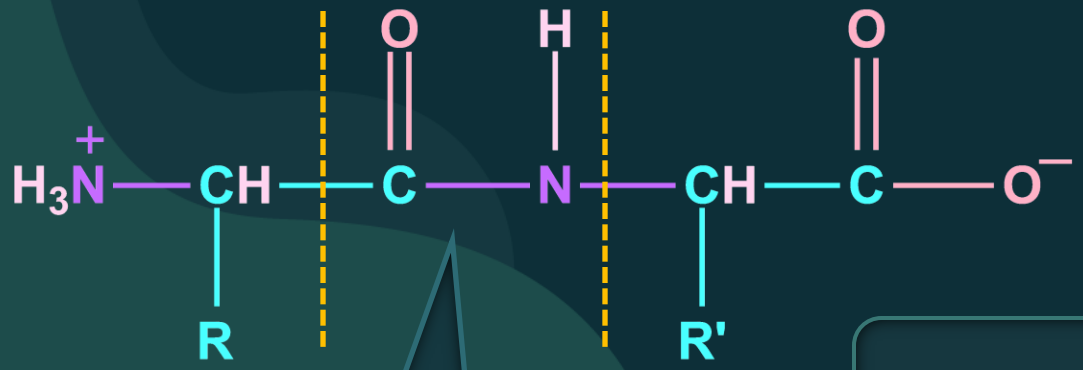
Compounds formed by **condensation** of amino group of one molecule of **α-amino acid** with the **carboxyl group** of the other molecule of same or different α–amino acid by elimination of **water**.

Amide linkages joining amino acids are called **peptide bonds or peptide linkages.**

Dipeptide

Amino acid

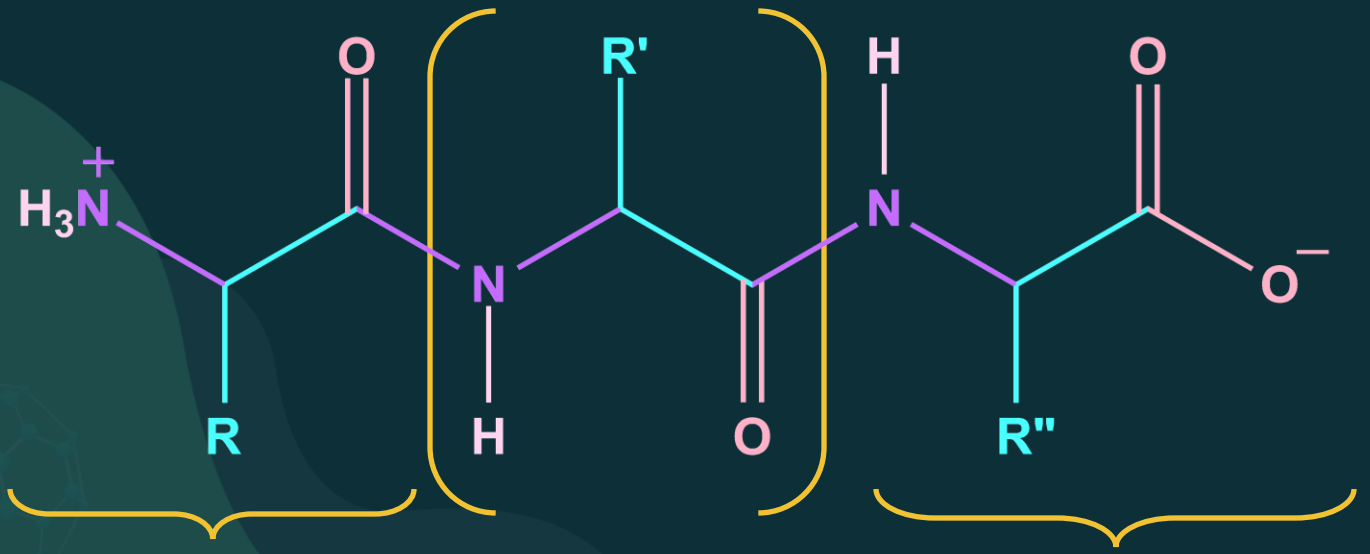




Peptide linkage

Dipeptide

Peptides



N-terminal residue

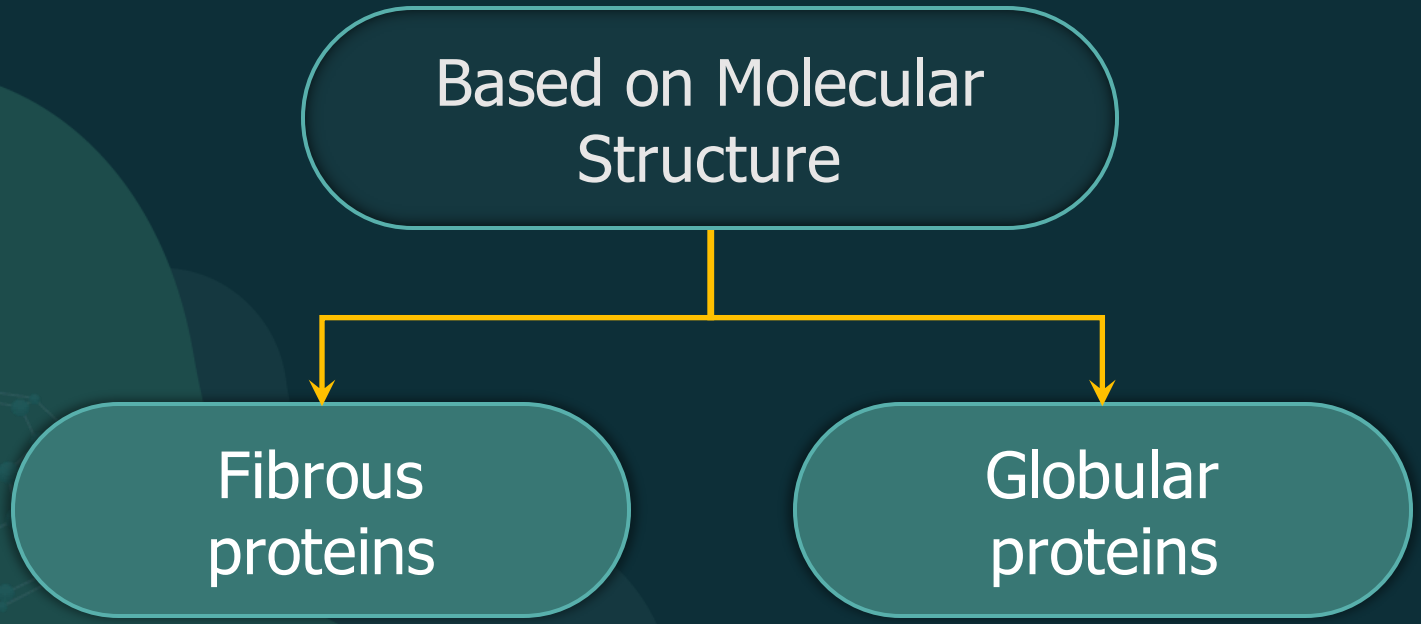
C-terminal residue

Peptides

At N-terminal or C-terminal further bond formation takes place and **tri, tetra, pentapeptides** are formed.

More than 10 amino acids joined together are called polypeptides.

Classification of Proteins



Fibrous Proteins

When polypeptide chain runs **parallel** to each other and has a **fiber like structure.**

Examples

Keratin, myosin

In fibrous protein, **chains** are held together by **hydrogen** & **disulphide bond.**

These are **insoluble** in water.

Globular Proteins

A **folded polypeptide** chain when forms a **spheroidal shape** is called a globular protein.

Soluble in water

Examples

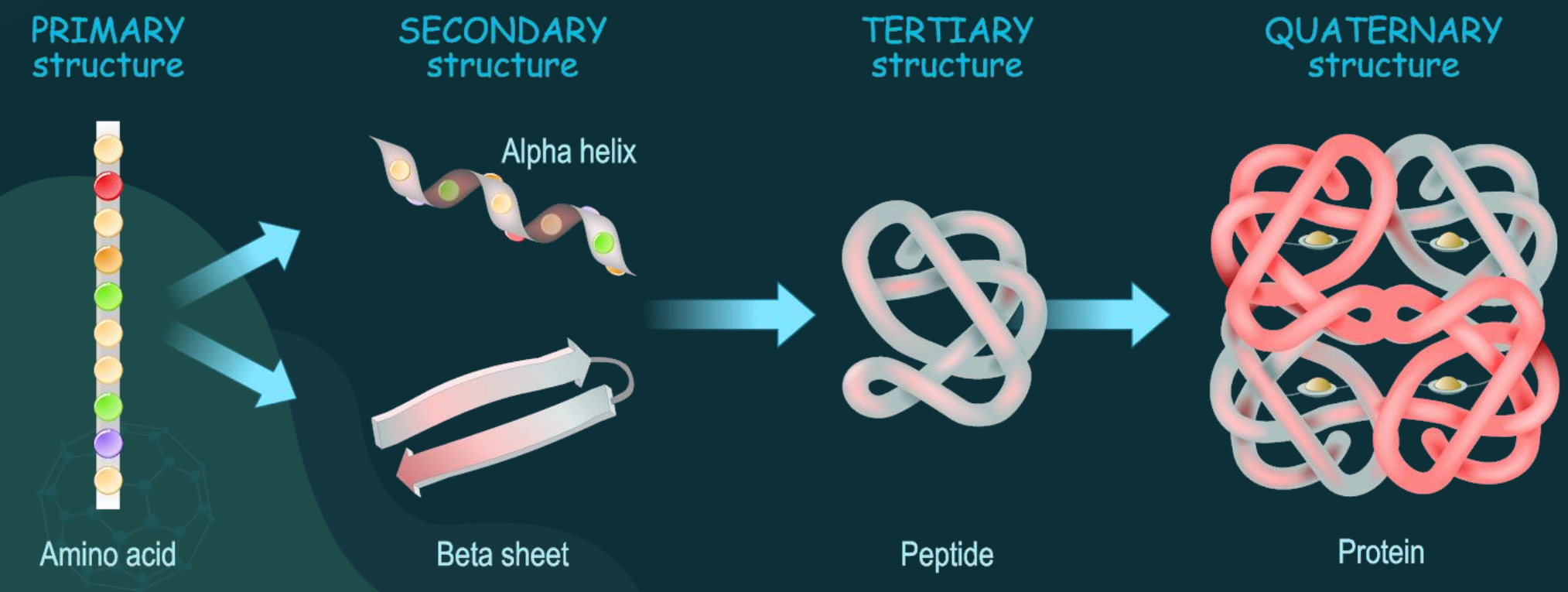
Insulin and albumins

Structure of Proteins

Structure of Proteins

Structure and shape of proteins can be studied at **four different levels,** i.e., primary, secondary, tertiary, and quaternary.

Structure of Proteins



The secondary structure of protein refers to:

a) α-Helical backbone

b) Hydrophobic interactions

c) Sequence of α-amino acids.

d) Fixed configuration of the polypeptide backbone

Denaturation of Proteins

Denaturation of Proteins

When protein in native form is subjected to a **physical change** like temperature or pH, the **hydrogen bonds** are **disturbed**.

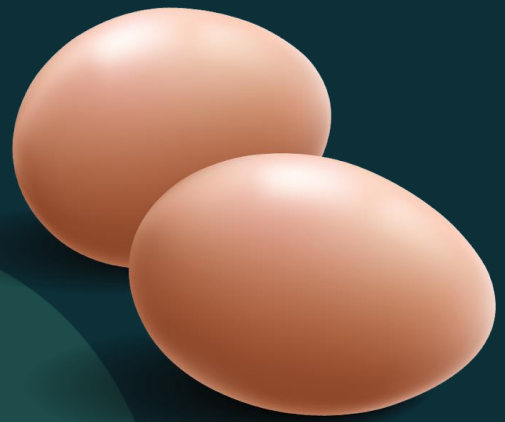
As a result, globules get unfold and helices get uncoiled therefore, **proteins lose its activity**.

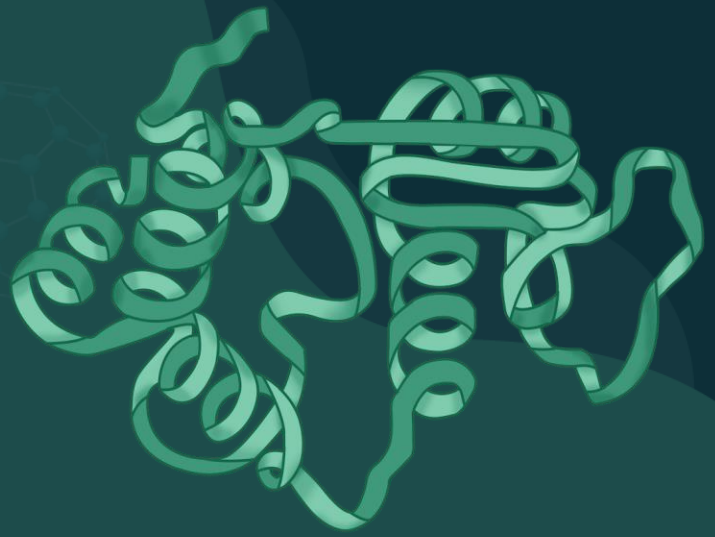
Denaturation of Proteins

During denaturation **2° and 3°** structures get **destroyed** but **1°** structure **remains the same**.

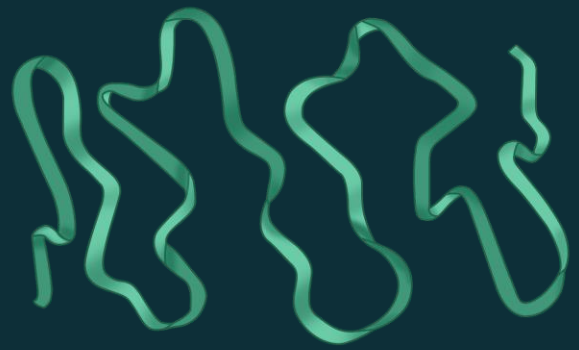
1. **Coagulation** of egg while on boiling.

2. **Curdling** of milk caused by bacteria present in milk.





Denaturation



The force of attraction between the neighboring peptide chains is:

a) van der Waals' force

b) Covalent bond

c) Hydrogen bond

d) Peptide linkage

Vitamins

Vitamins

Organic compounds required in the diet in **small amounts** to perform specific biological functions for normal maintenance of optimum growth and health of the organism.

Most of the vitamins **cannot** be synthesized in our body.

All the vitamins are generally available in our **diet**.

Classification of Vitamins

Based on **solubility** in water or fat

- Fat soluble vitamins
- Water soluble vitamins

Fat Soluble Vitamins

These are soluble in fat and oil but **insoluble in water**.

Examples: Vitamin A, D, E, and K

Water Soluble Vitamins

These are insoluble in fat and oil but **soluble in water**.

Examples: B group vitamins and vitamin C

Some Important Vitamins, Their Sources and Their Deficiency Diseases

Vitamin	Sources	Deficiency diseases
Vitamin A	Fish liver oil, carrots, butter, & milk.	**Xerophthalmia** (hardening of eye cornea), **night blindness**.
Vitamin B_1 (**Thiamine**)	Yeast, milk, green vegetables, and cereals.	**Beri beri** (loss of appetite and retarded growth).
Vitamine B_2 (**Riboflavin**)	Milk, egg white, liver, and kidney.	**Cheilosis** (fissuring at corners of mouth and lips), **digestive disorders,** and **burning sensation** of the skin

Vitamin	Sources	Deficiency diseases
Vitamine B_6 (**Pyridoxine**)	Yeast, milk, egg yolk, cereals, & grams.	**Convulsions**
Vitamin B_{12}	Milk, fish, egg, & curd.	**Pernicious anaemia** (RBC deficient in haemoglobin).
Vitamin C (**Ascorbic acid**)	Citrus fruits, amla, and green leafy vegetables.	**Scurvy** (bleeding gums).

Vitamin	Sources	Deficiency diseases
Vitamin D	Exposure to sunlight, fish, and egg yolk.	**Rickets** (bone deformities in children) and **osteo-malacia** (soft bones and joint pain in adults).
Vitamin E	Vegetable oils like wheat germ oil, sunflower oil.	**Increased fragility** of RBCs and muscular weakness.
Vitamin K	Green leafy vegetables.	Increased blood clotting time.

Deficiency of which vitamin causes osteomalacia?

NEET 2020

a) Vitamin A

b) Vitamin D

c) Vitamin K

d) Vitamin E

Nucleic Acids

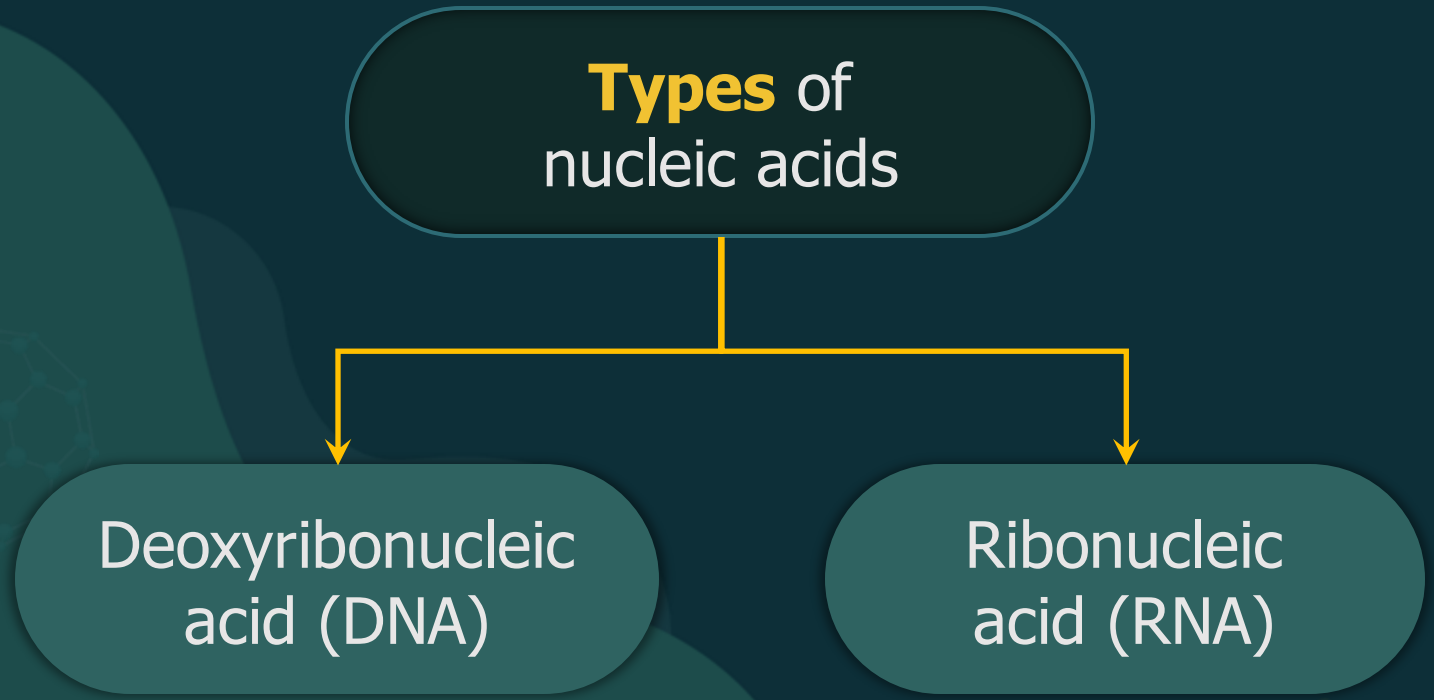
Nucleic Acid

Nucleus of a living cell is **responsible** for this transmission of inherent characters, also called **heredity**.

The **particles** in nucleus of the cell, **responsible** for heredity, are called **chromosomes**.

They are made up of proteins and another type of biomolecules called **nucleic acids**.

Nucleic Acid



Nucleic Acid

Nucleotide

Five-carbon monosaccharide

+

A heterocyclic (nitrogen containing) base

+

Phosphate ion

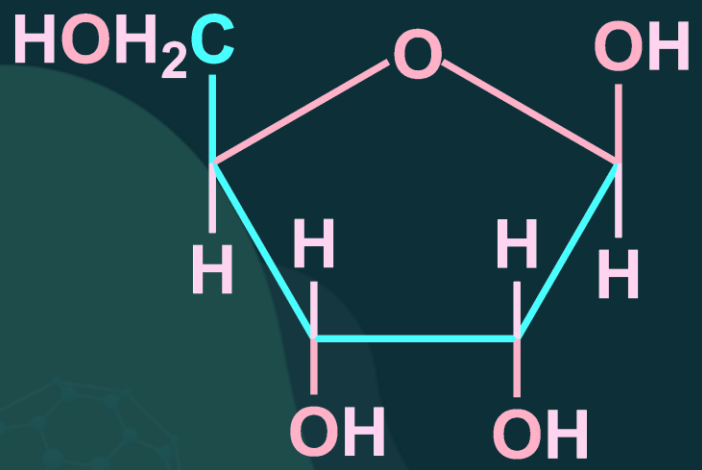
Nucleotides

Monomeric units of nucleic acids.

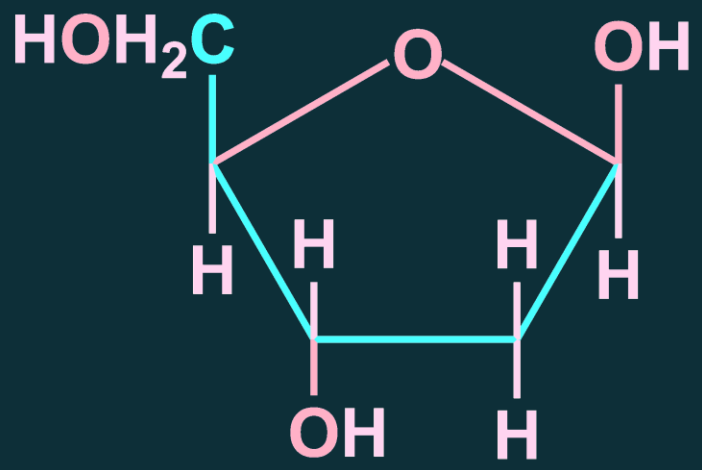
Nucleic Acid

DNA	RNA
The sugar moiety is **β-D-2-deoxyribose**.	The sugar moiety is **β-D-ribose**.

Nucleic Acid



β-D-ribose



β-D-2-deoxyribose

Four bases of **DNA**

- Adenine (A)
- Guanine (G)
- Cytosine (C)
- Thymine (T)

Four bases of **RNA**

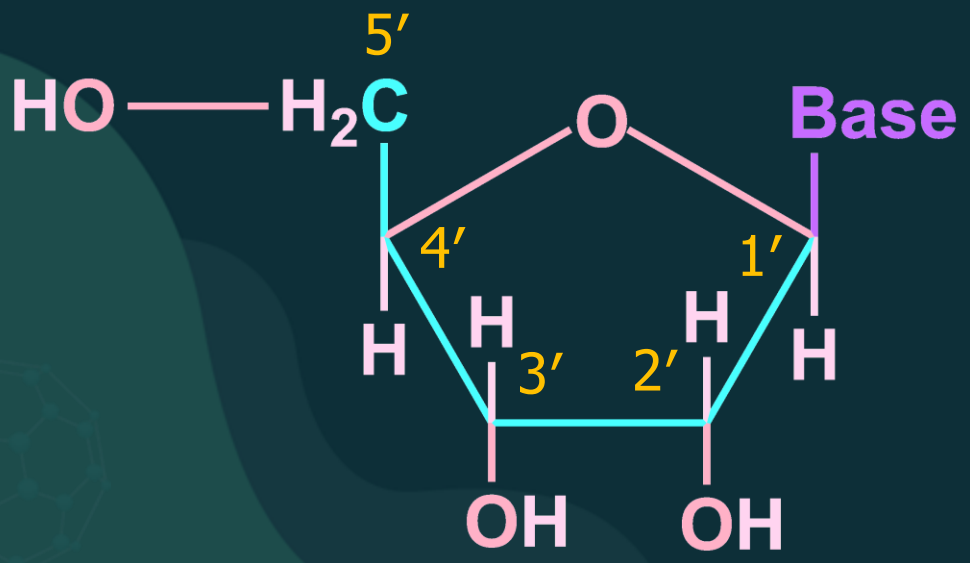
- Adenine (A)
- Guanine (G)
- Cytosine (C)
- Uracil (U)

Nucleoside

A unit formed by the attachment of a **base** to **1′** position of **sugar** is known as **nucleoside.**

In nucleosides, the **sugar carbons** are numbered as **1′, 2′, 3′,** etc., in order to distinguish these from the bases.

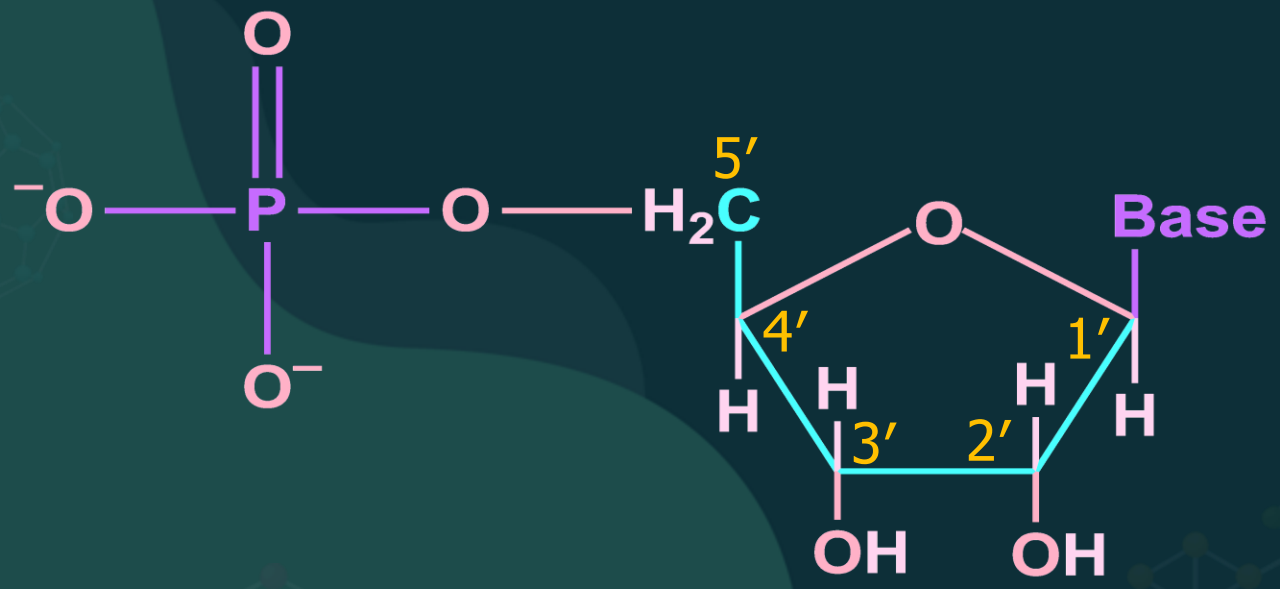
Nucleoside



Nucleoside

Nucleotide

The phosphate group is present as a **phosphate ester** & may be attached at **C5' or C3'** of nucleoside to form nucleotide.

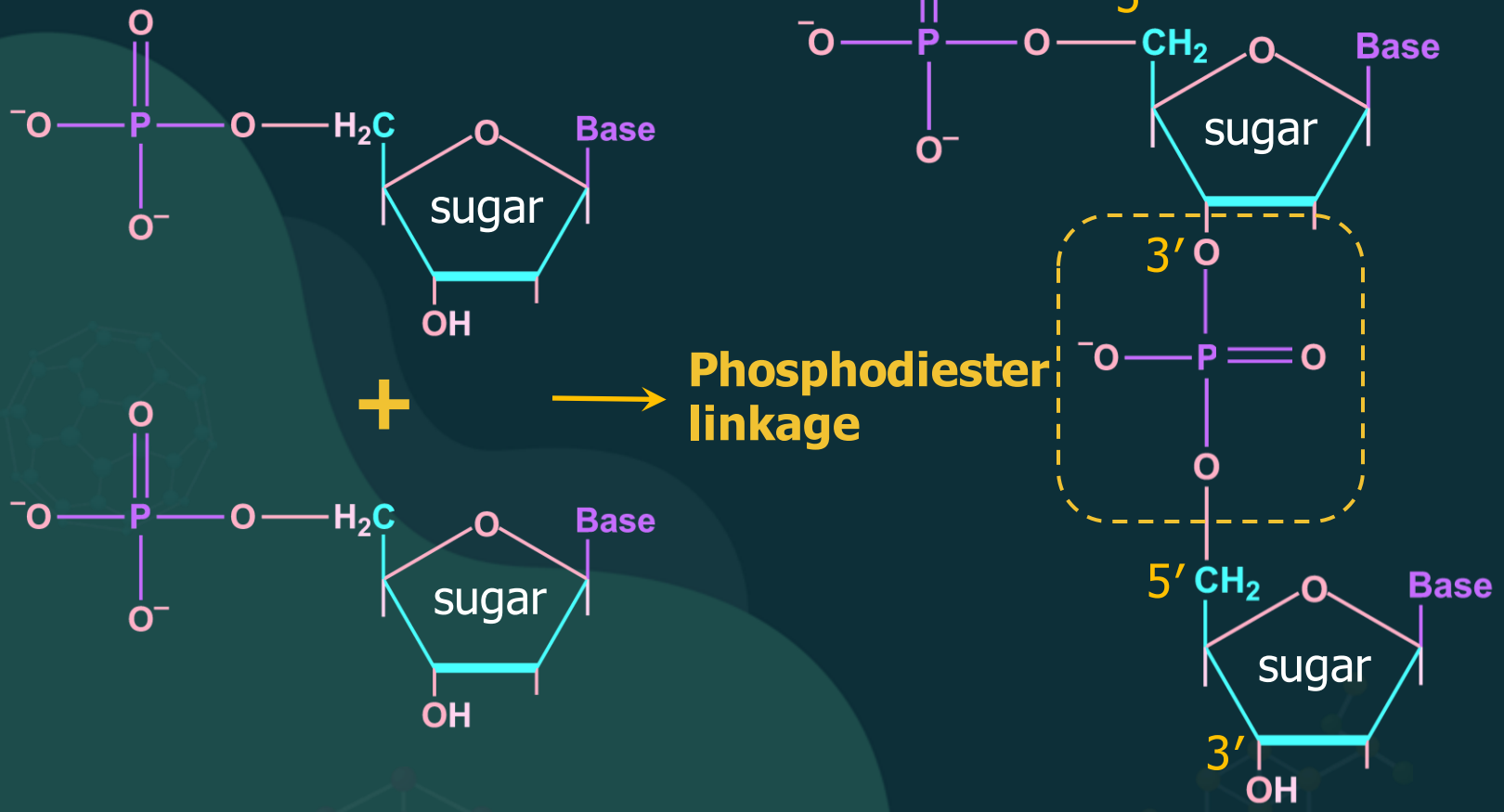


Nucleotide

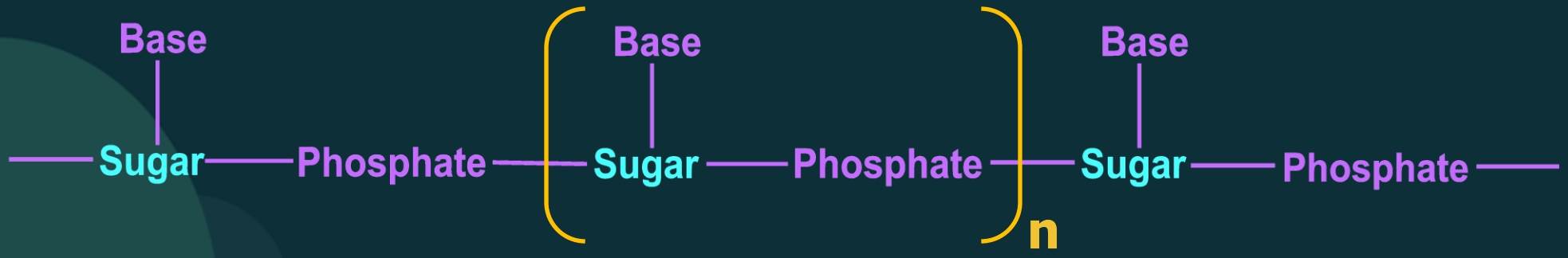
Structure of Nucleic Acids

Nucleotides are joined together by **phosphodiester linkage** between **5′** and **3′** carbon atoms of the **pentose sugar**.

Structure of Nucleic Acids



Structure of Nucleic Acids

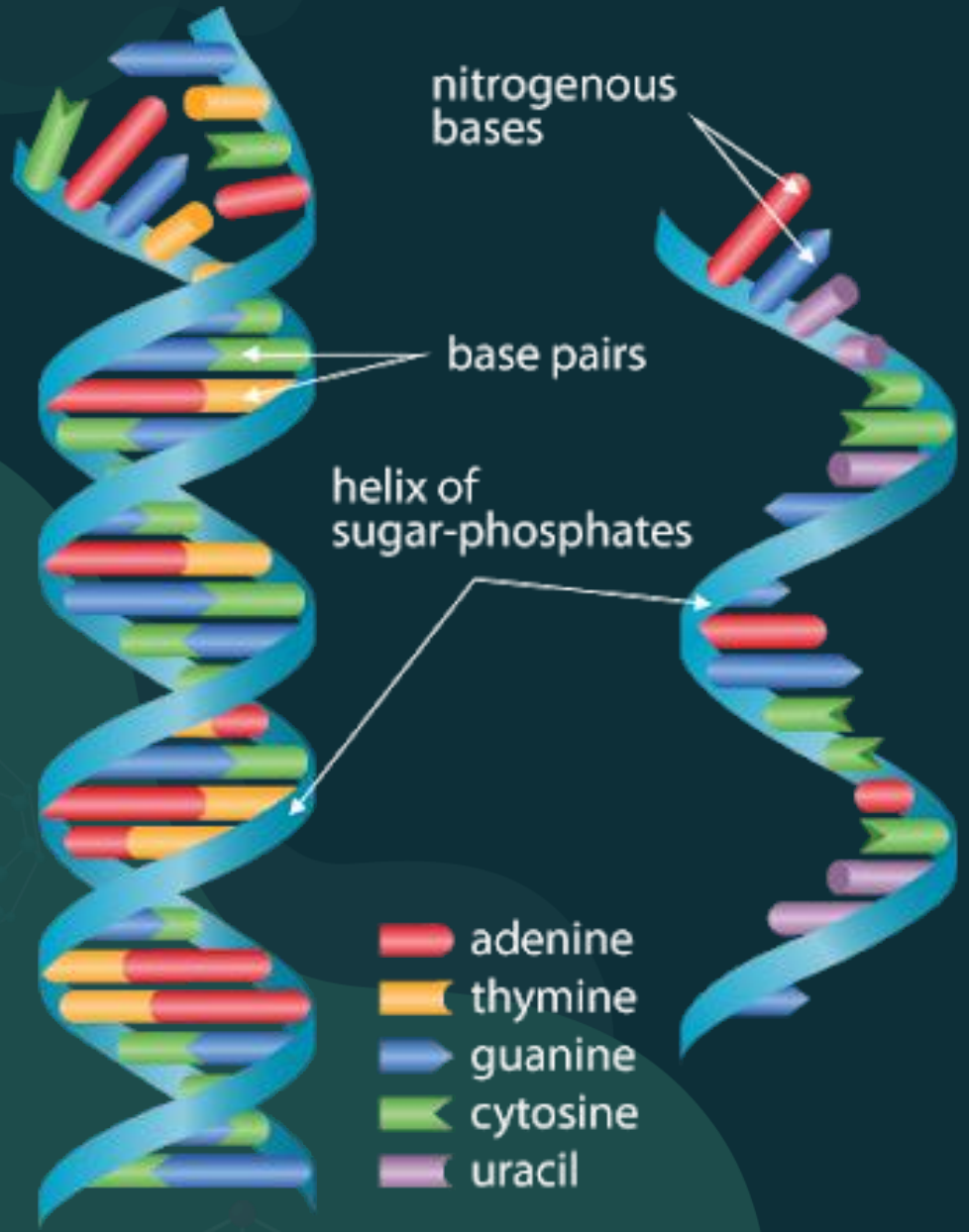


Simplified version of nucleic acid chain

Structure of Nucleic Acids

Information regarding the sequence of nucleotides in the chain of a nucleic acid is called its **primary structure.** Nucleic acids have a **secondary structure** also.

DNA & RNA


nitrogenous bases
base pairs
helix of sugar-phosphates
adenine
thymine
guanine
cytosine
uracil

DNA

RNA

The reason for double helical structure of DNA is the operation of:

a) Electrostatic attractions

b) van der Waals forces

c) Dipole-dipole interactions

d) Hydrogen bonding

The pyrimidine bases present in DNA are:

a) Cytosine and guanine

b) Cytosine and thymine

c) Cytosine and uracil

d) Cytosine and adenine

Deficiency of vitamin B_1 causes the disease:

AIPMT 2012

a) Convulsions

b) Beri-Beri

c) Cheilosis

d) Sterility

Assertion: Vitamin D cannot be stored in our body.
Reason: Vitamin D is a fat-soluble vitamin and is excreted from the body in urine.

AIIMS 2016

a) If both assertion and reason are correct and the reason is a correct explanation of the assertion.

b) If both assertion and reason are correct but the reason is not a correct explanation of the assertion.

Assertion: Vitamin D cannot be stored in our body.
Reason: Vitamin D is a fat-soluble vitamin and is excreted from the body in urine.

AIIMS 2016

c) If the assertion is correct but the reason is incorrect.

d) If both the assertion and reason are incorrect.

In a protein molecule, various amino acids are linked together by:

NEET-I 2016

a) Peptide bond

b) Dative bond

c) α-glycosidic bond

d) β-glycosidic bond.

The helical structure of protein is stabilised by:

AIPMT 2004

a) Dipeptide bonds

b) Hydrogen bonds

c) Ether bonds

d) Peptide bonds

“Stay Positive, Work Hard. Make It Happen!”

THANK YOU