Macromolecules

Organic Compounds

- **Compounds** that contain **CARBON** are called **organic**.

- **Macromolecules** are large **organic molecules**.

Carbon (C)

- Carbon has 4 electrons in outer shell.
- Carbon can form covalent bonds with as many as 4 other atoms (elements).
- Usually with C, H, O or N.
- Example: CH_4(methane)

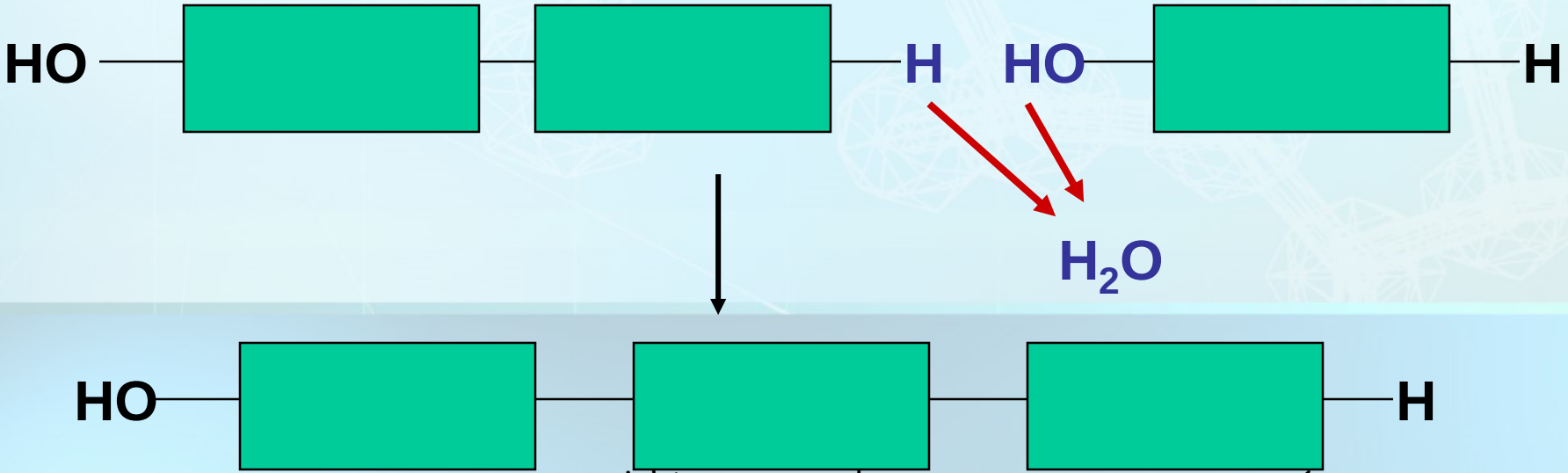
Macromolecules

- Large organic molecules.
- Also called POLYMERS.
- Made up of smaller "building blocks" called MONOMERS.
- Examples:
    1. Carbohydrates
    2. Lipids
    3. Proteins
    4. Nucleic acids (DNA and RNA)

Question: How Are Macromolecules Formed?

Answer: Dehydration Synthesis

- Also called "condensation reaction"
- Forms polymers by combining monomers by "removing water".

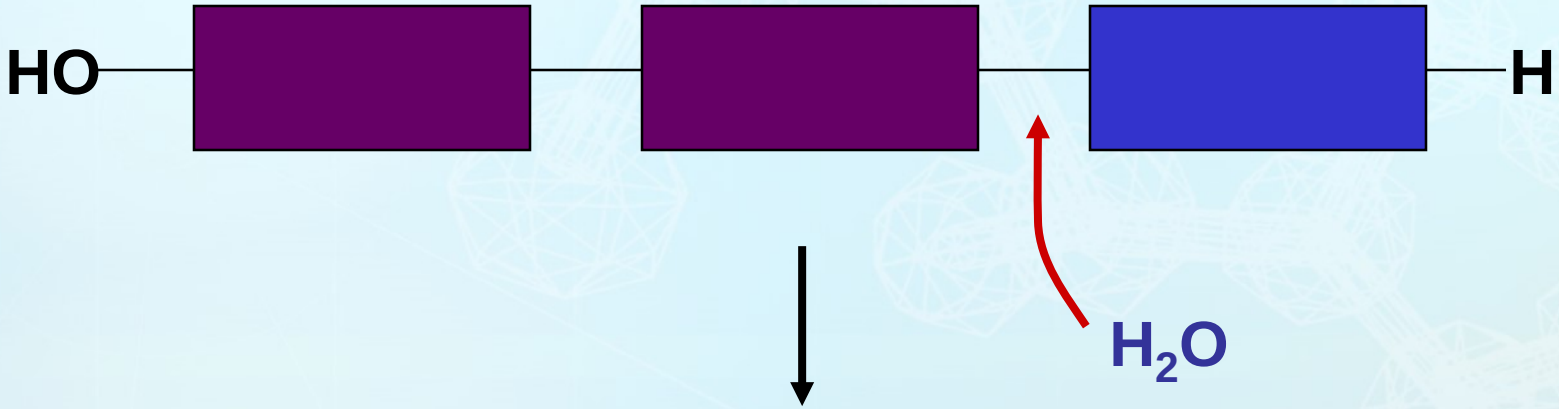


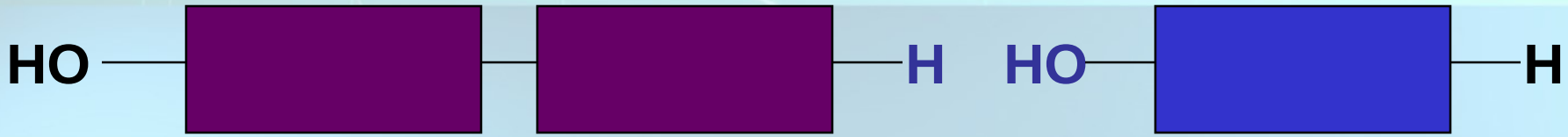
Question:

How are Macromolecules separated or digested?

Answer: Hydrolysis

- Separates monomers by "adding water"





Carbohydrates

Carbohydrates

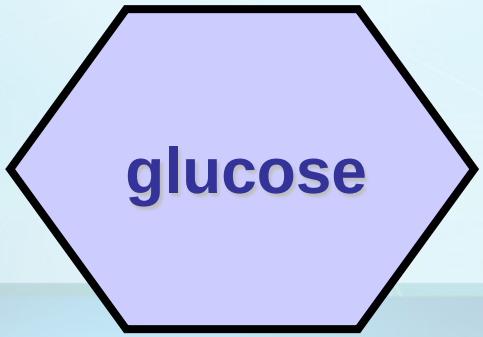
- Small sugar molecules to large sugar molecules.

- Examples:
  A. monosaccharide
  B. disaccharide
  C. polysaccharide

Carbohydrates

Monosaccharide: one sugar unit

Examples: glucose ($C_6H_{12}O_6$)
deoxyribose
ribose
Fructose
Galactose

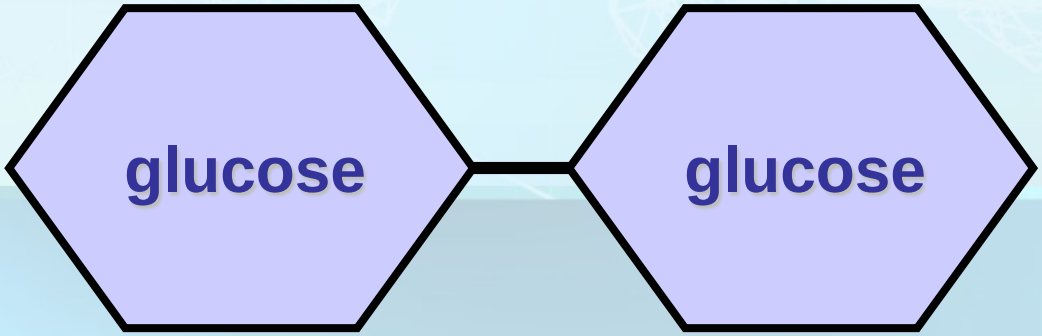


Carbohydrates

Disaccharide: two sugar unit

Examples:

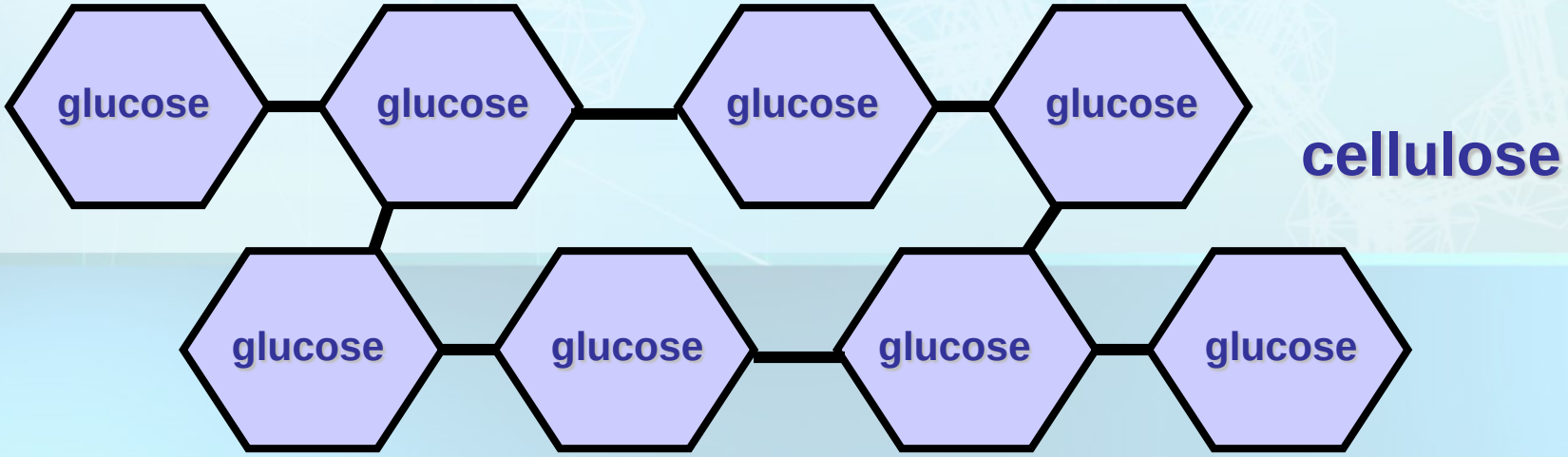
- Sucrose (glucose+fructose)
- Lactose (glucose+galactose)
- Maltose (glucose+glucose)



Carbohydrates

Polysaccharide: many sugar units

Examples: starch (bread, potatoes)
glycogen (beef muscle)
cellulose (lettuce, corn)



Lipids

Lipids

- General term for compounds which are not soluble in water.
- Lipids are soluble in hydrophobic solvents.
- Remember: "stores the most energy"
- Examples:
  1. Fats
  2. Phospholipids
  3. Steroid hormones
  4. Triglycerides
  5. Waxes
  6. Oils

Lipids

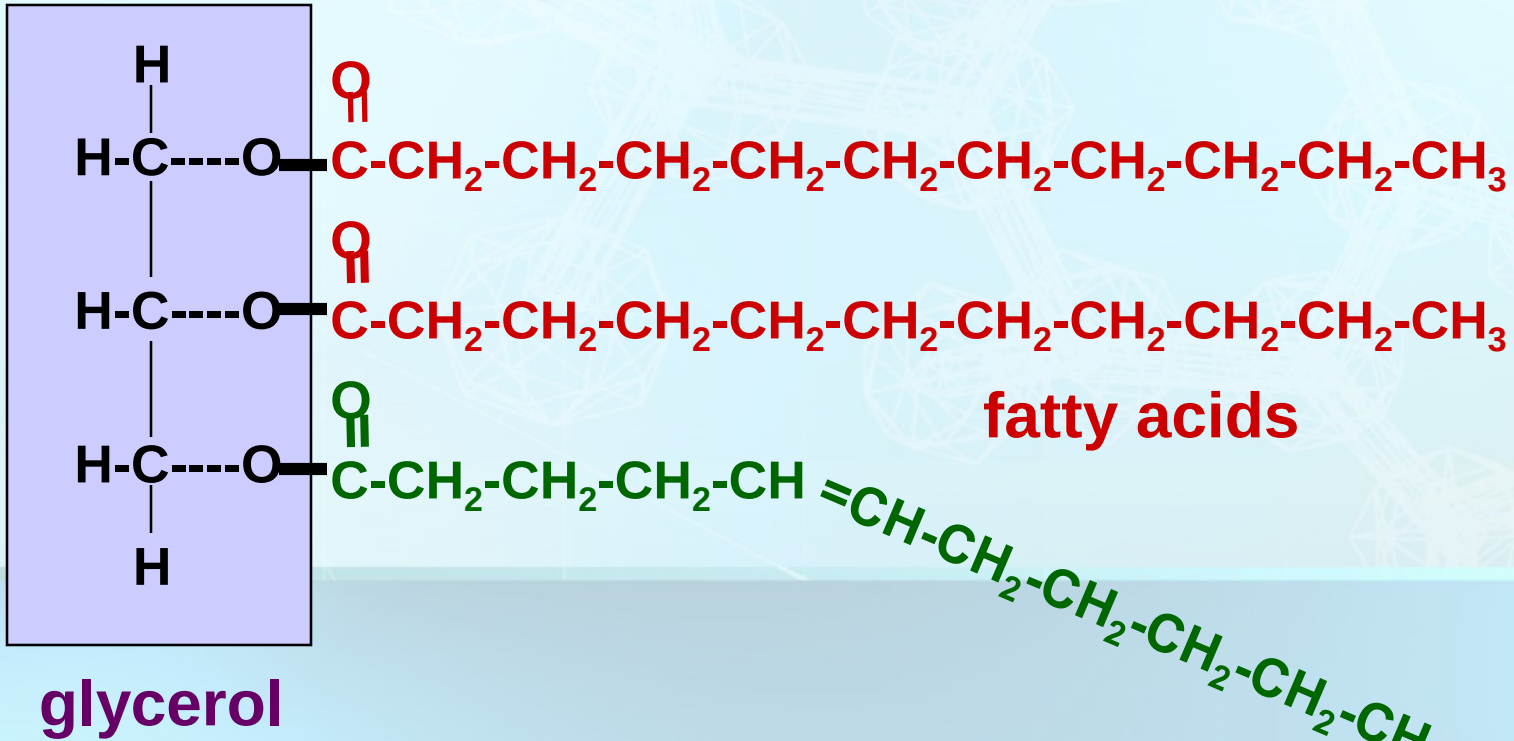
Six functions of lipids:

1. Long term energy storage
2. Protection against heat loss (insulation)
3. Protection against physical shock
4. Protection against water loss
5. Chemical messengers (hormones)
6. Major component of membranes

Lipids

Triglycerides:

composed of 1 glycerol and 3 fatty acids.



Fatty Acids

There are two kinds of **fatty acids** you may see these on food labels:

1. Saturated fatty acids: no double bonds (bad)

saturated $-C(=O)-CH_2-CH_2-CH_2-CH_2-CH_2-CH_2-CH_2-CH_2-CH_2-CH_3$

2. Unsaturated fatty acids: double bonds (good)

unsaturated $-C(=O)-CH_2-CH_2-CH_2-CH=CH-CH_2-CH_2-CH_2-CH_2-CH_3$

Bent

Proteins

Proteins (Polypeptides)

- Amino acids (20 different kinds of aa) bonded together by peptide bonds (polypeptides).

- **Six functions of proteins:**
  1. Storage: albumin (egg white)
  2. Transport: hemoglobin
  3. Regulatory: hormones
  4. Movement: muscles
  5. Structural: membranes, hair, nails
  6. Enzymes: cellular reactions

Proteins (Polypeptides)

Four levels of protein structure:

A. Primary Structure

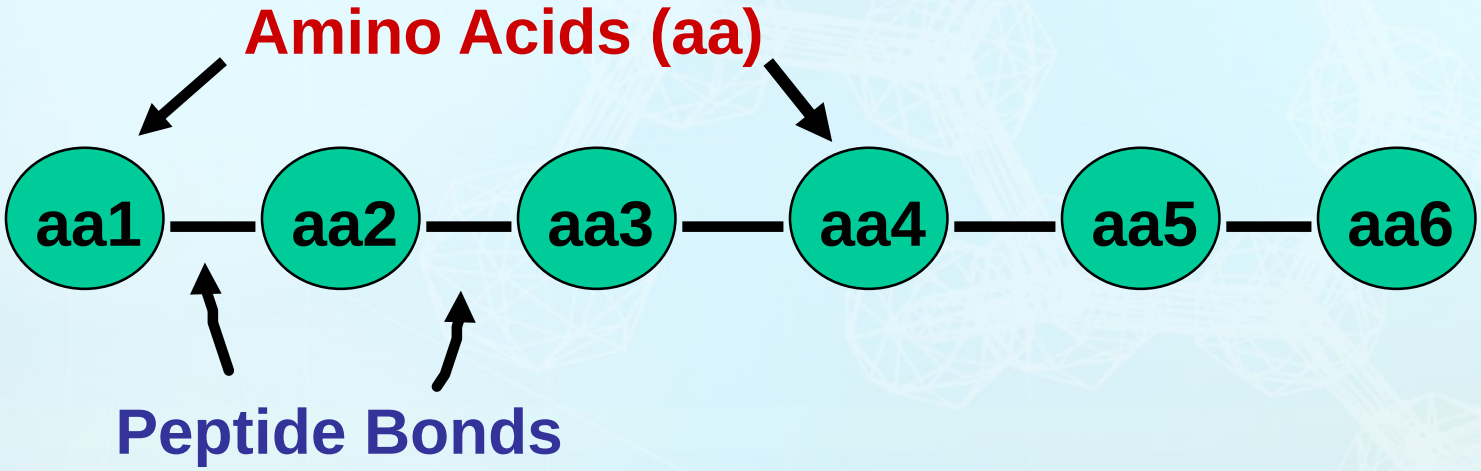
B. Secondary Structure

C. Tertiary Structure

D. Quaternary Structure

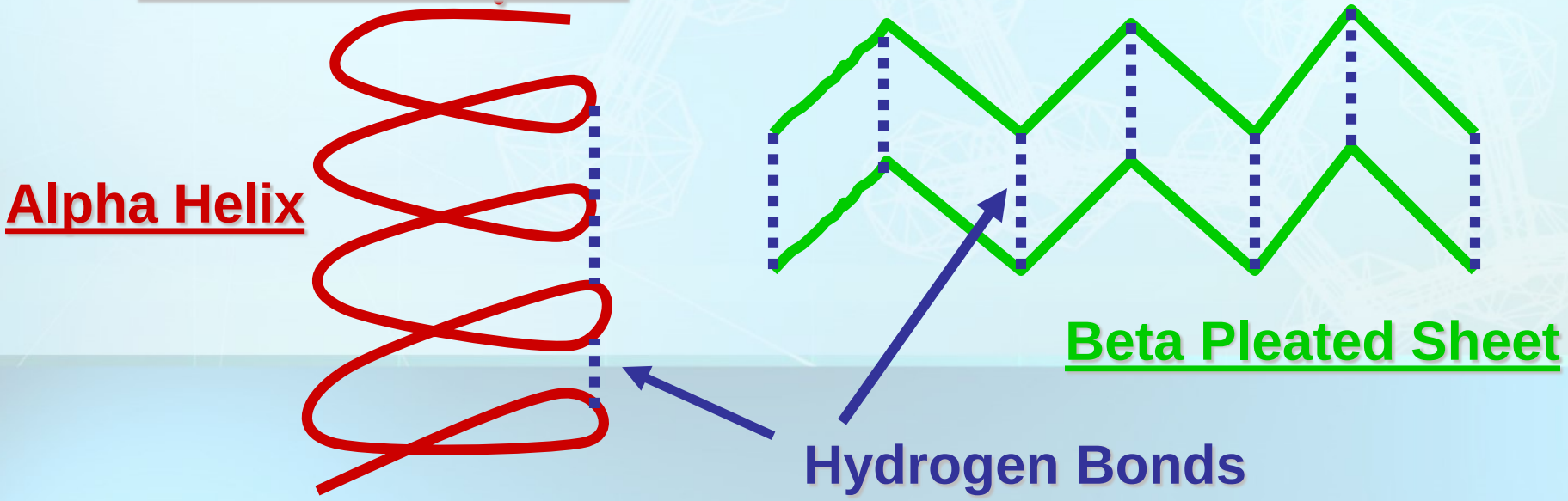
Primary Structure

Amino acids bonded together by peptide bonds (straight chains)



Secondary Structure

- 3-dimensional folding arrangement of a primary structure into coils and pleats held together by hydrogen bonds.
- Two examples:

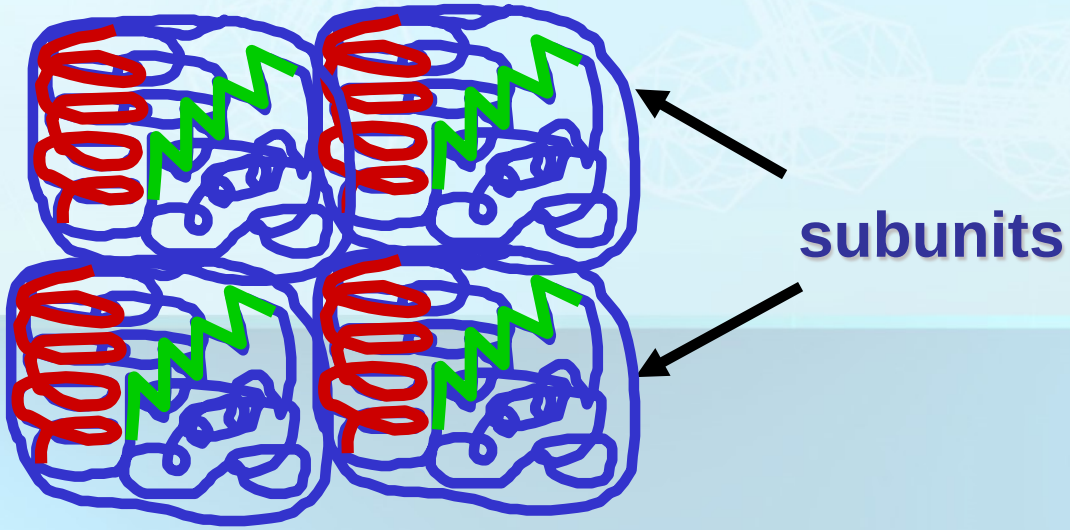


Tertiary Structure

- Secondary structures bent and folded into a more complex 3-D arrangement of linked polypeptides
- Bonds: H-bonds, ionic, disulfide bridges (S-S)
- Called a "subunit".

Quaternary Structure

- Composed of 2 or more "subunits"
- Globular in shape
- Form in Aqueous environments
- Example: enzymes (hemoglobin)



Nucleic Acids

Nucleic acids

- **Two types:**

  a. Deoxyribonucleic acid (DNA-double helix)

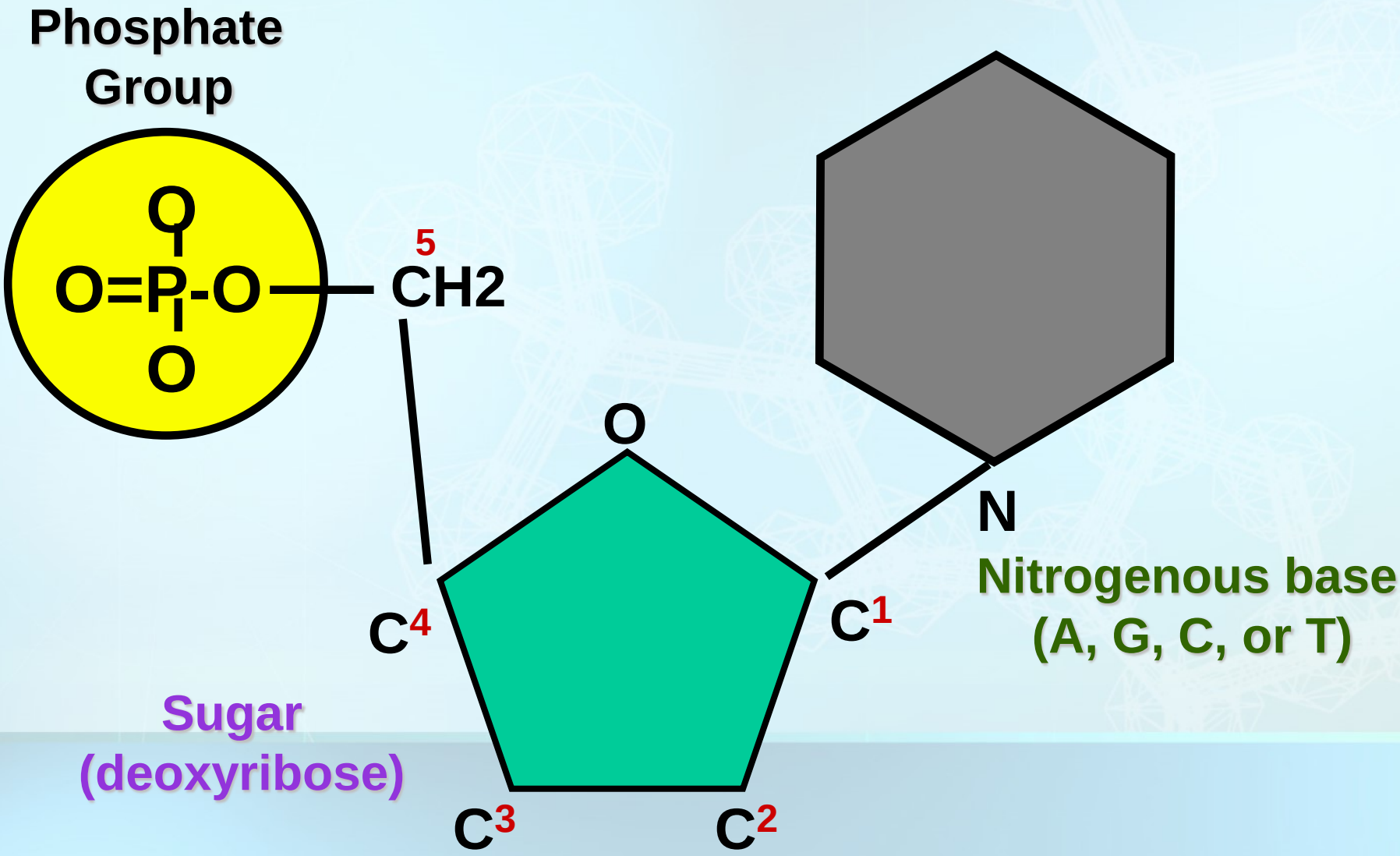
  b. Ribonucleic acid (RNA-single strand)

- **Nucleic acids** are composed of long chains of **nucleotides** linked by **dehydration synthesis**.

Nucleic acids

- Nucleotides include:
  - phosphate group
  - pentose sugar (5-carbon)
  - nitrogenous bases:
    - adenine (A)
    - thymine (T) DNA only
    - uracil (U) RNA only
    - cytosine (C)
    - guanine (G)

Nucleotide


Phosphate Group
O
O=P-O
O
5
CH2
O
N
Nitrogenous base (A, G, C, or T)
C4
C1
C3
C2
Sugar (deoxyribose)

DNA - double helix