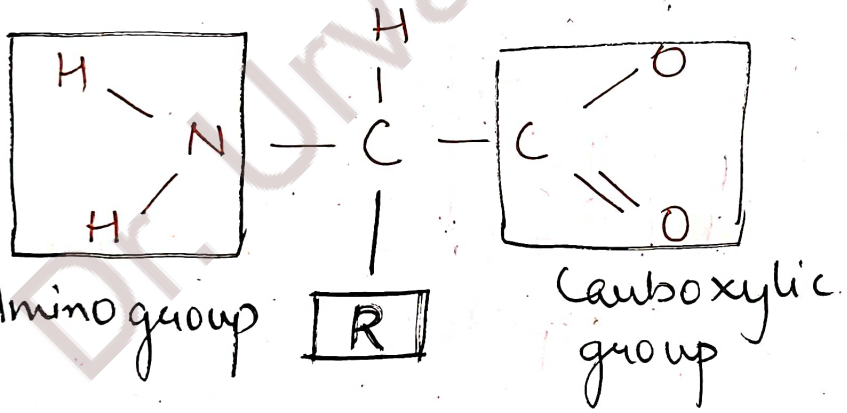
PROTEINS

→ Proteins are essential parts of organisms and participate in every process within cells.

→ They are the polymers of different types of amino-acids linked by a peptide bond.

→ All proteins are made of 20 different amino acids linked in different orders.

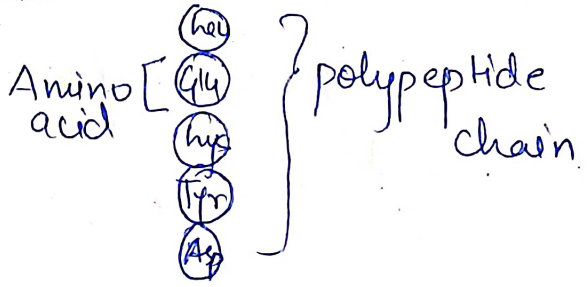
→ Proteins are used to build cells, act as hormones and enzymes and do much of the work in a cell.



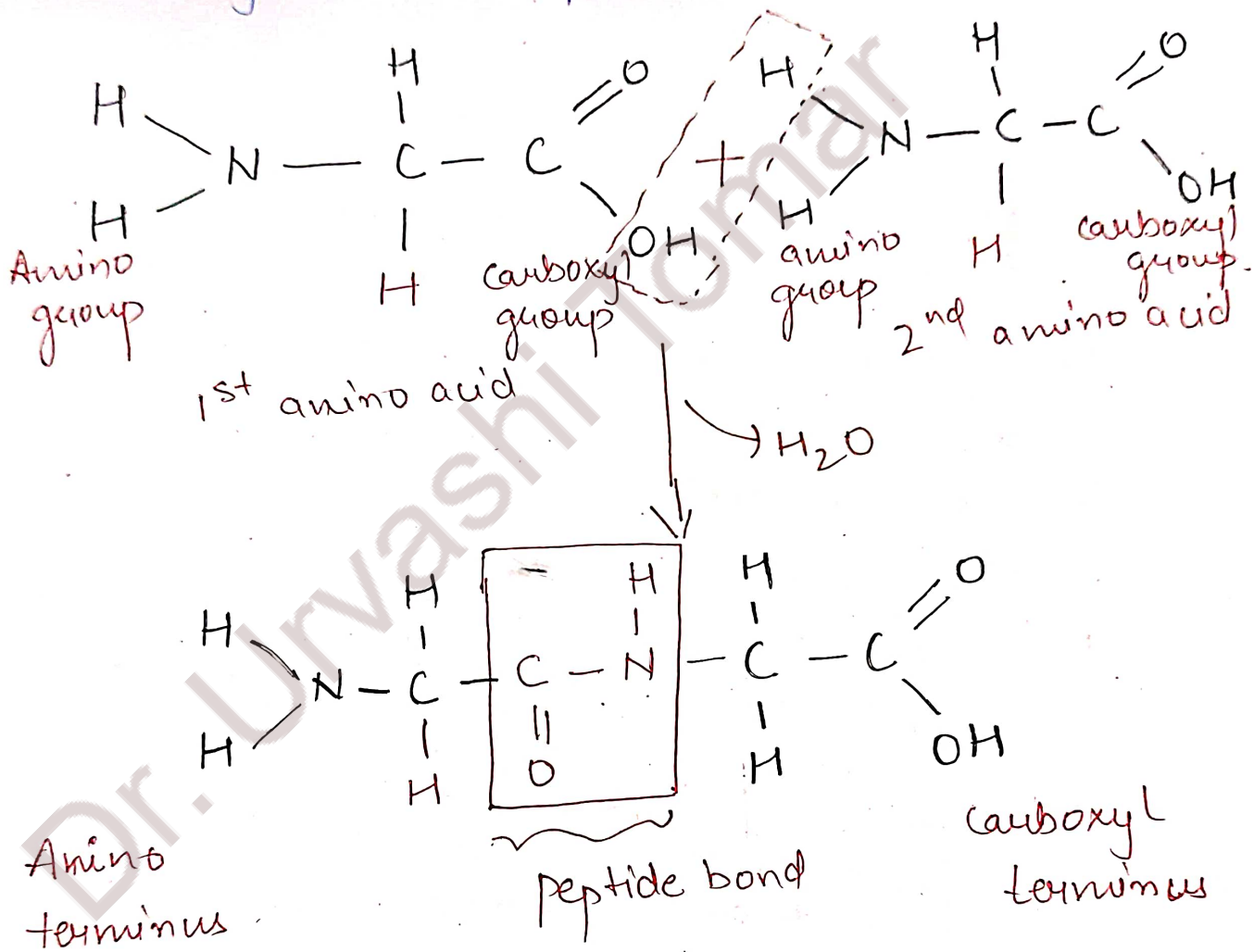
Proteins $\xrightarrow{\text{hydrolysis}}$ Peptides $\xrightarrow{\text{hydrolysis}}$ Amino-acids

Structure of protein :-

1) Primary protein structure :- sequences of amino-acids joined by peptide bonds.



Peptide Bond formation.



2) Secondary structure:

→ The conformation of polypeptide chain by twisting or folding referred to as secondary structure.

a) **α-helix** :- The α-helix is a right-handed coiled shaped.

→ The side-chain substitutes of the amino acid groups in α-helix extend to the outside.

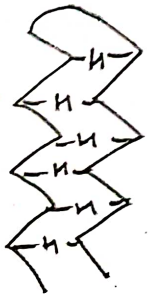
→ Hydrogen bonds form between the oxygen of the C=O bond of a aminoacid to hydrogen of the N-H group of the fourth amino acids below it in the helix.

β-pleated :-

→ The hydrogen bonding between the β-sheets is between strands (inter strand).

→ The sheet conformation consists of pairs of strands lying side-by-side.

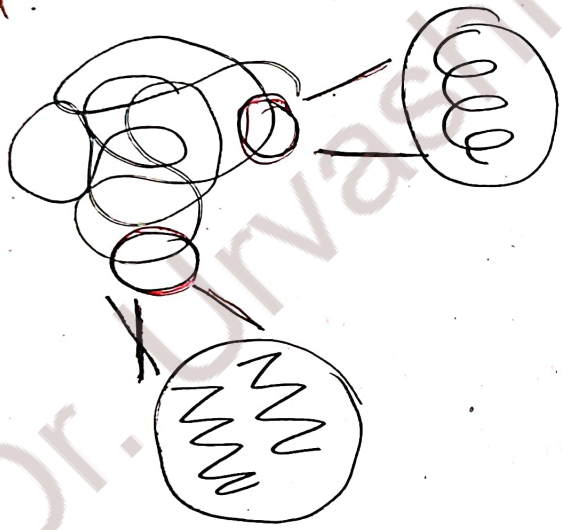
→ The carbonyl oxygens in one strand hydrogen bond with the amino hydrogens of the adjacent strands.



3) Tertiary structure

→ Tertiary structure refers to its overall 3-D conformation.

→ The interactions between amino acid residues that produce the 3-D shape of protein include hydrophobic interactions, electrostatic interactions & hydrogen bonds. Also a non-covalent & covalent disulphide bond can also occur.



4) Quaternary structure:

→ It refers to interaction of one or more subunits to form a functional protein, using the same forces that stabilize the tertiary structure.

→ It is special arrangement of sub-units in a protein that consists of more than one polypeptide chain.

Subunit-1 subunit 2

ENZYMES:

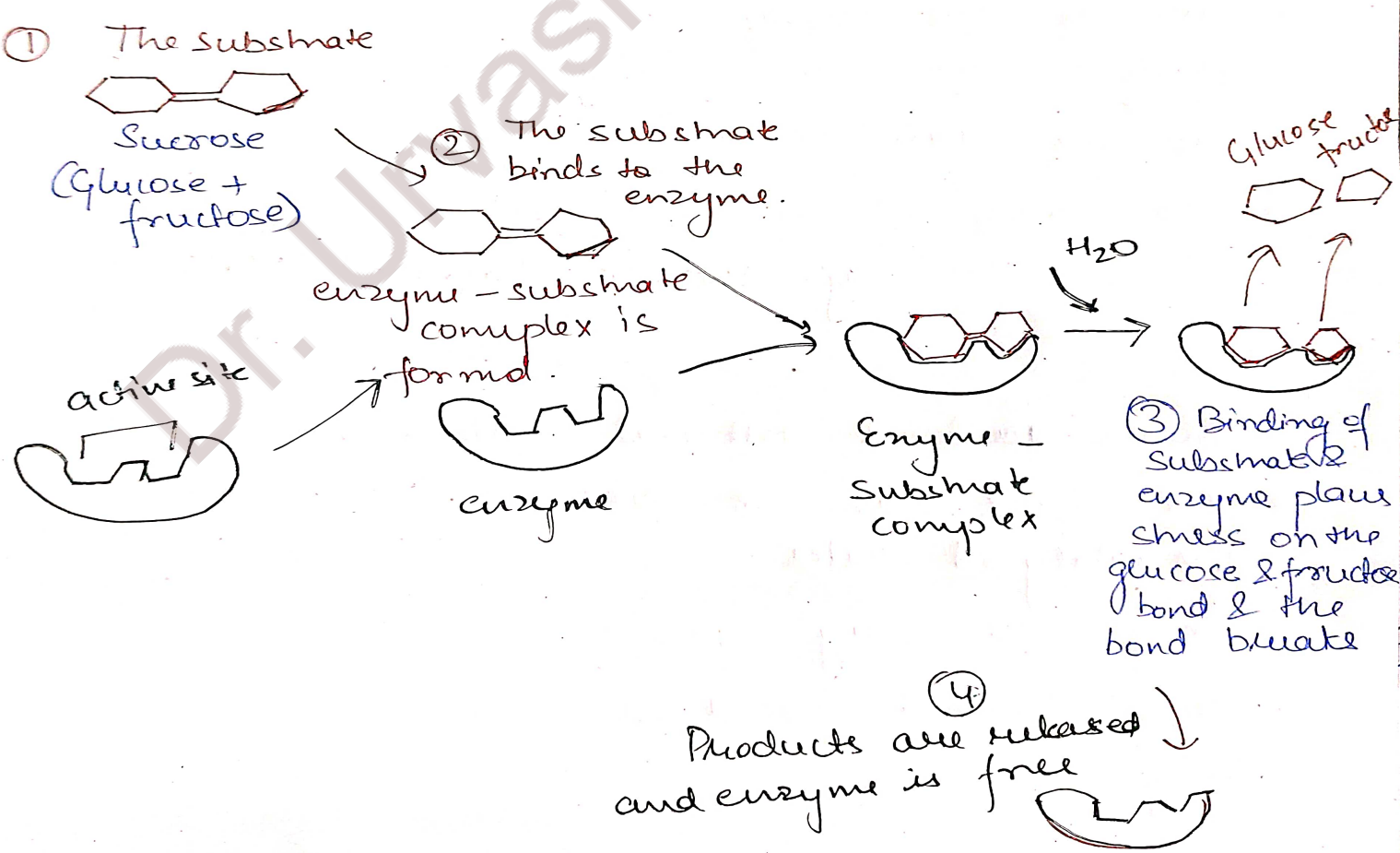
→ Most enzymes are proteins (tertiary and quaternary structures)
→ Enzyme acts as catalyst to accelerate the reaction.
→ Enzymes are not permanently changed in the process.
→ Enzymes are highly specific for what they will catalyse (or their substrates)
→ Enzyme can be reused.
→ The name of the enzyme ends in "ase".
eg:- Sucrase, lactase, Maltase.

Why enzymes are important?

→ They act as natural catalyst.
→ The speed can be accelerated to 10^{16} over un-catalyzed rates
→ They are very specific to each reaction
→ They permit reactions under mild conditions only.

→ Since, most reactions in our body cell need special enzymes, each cell contain thousands of different enzymes.

→ Enzymes let chemical reactions in the body happen millions of times faster than without the enzyme. As they are not part of product they can be recycled again & again.



Examples :-

Restriction Enzymes :-

→ They recognize specific base sequences in double-helical DNA and cleave at specific places, both strands of a duplex containing the recognized sequence.

→ It cleave the specific base pairs sequences in DNA and cleave it by hydrolyzing the phosphodiester bond.

→ It cut the 3'C' of first nucleotide and phosphate of second (next) nucleotide.

→ Restriction fragments ends have 5' phosphates & 3' hydroxyls.

→ These R.E's are naturally occuring in bacteria to protect them against viruses by cutting up viral DNA.

→ Bacteria protects their own DNA by modifying (methylatio the restriction sites

→ More then 400 R.E's have been isolated.

→ Names typically begin with 3 italicized letter

Enzyme	Source
EcoRI	E.coli R413
Hind III	Haemophilus influenzae Rd
Bam HI	Bacillus amyloliquefaciens H

Cut & ligate 2 DNAs with EcoR1

DNA1

5' G A A T T C 3'
3' C T T A A G 5'

DNA2

5' G A A T T C 3'
3' C T T A A G 5'

Cut with EcoR1 leaving sticky ends

5' G AATTC 3'
3' CTTAA G 5'

5' G AATTC 3'
3' CTTAA G 5'

5'-G A A T T C 3'
3'-C T T A A G 5'

5' G A A T T C 3'
3' C T T A A G 5'

Recombinant DNA molecules.

Applications

1) Pharmaceutical products
   - insulin – cheaper & safer
   - vaccine sub-unit (against hepatitis B)
   - DNA of vaccines against malaria, influenza etc.

2) Gene therapy
   - replacing defective or missing gene with normal gene

3) Gene silencing

HORMONES

- Cells in multi-cellular organisms communicate with one another to coordinate their growth and metabolism.
- Cell to cell communitate is mainly via Extracellular signalling molecules or Hormons.
- Hormons tend to coordinate various metabolic processi in the body.

Examply :-

1) Insulin :-

→ Insulin is a protein hormone secreted by Beta cells in Islets of hangorhans in Pancreas.

→ Insulin regulate Blood Glucose level.

→ It is a hydrophilic (hipophobic) hormone, thus it act via membrane receptor on target cells.

→ Target cell :- Skeletal Muscle and Adipose tissue.

→ lack of Insulin cause increase in blood sugar level called diabetes.

2) Glucagon :-

→ Glucagon is a hormone produced by α-cells in Pancreas.

→ Glucagon is an Insulin Counter-Regulatory Hormone.
→ Action of Glucagon is to increase Blood Glucose level from Low to Normal.
→ Glucagon acts mainly in the liver to stimulate the breakdown of

Glycogen —to→ Glucose, which is then released into the blood.

→ Production of Glucagon is stimulated by

- Hypoglycemia (Low Glucose level in blood)
  Increase absorbtion of Amino-acids in the blood
- High Blood Glucose level inhibits the production and release of Glucagon.