



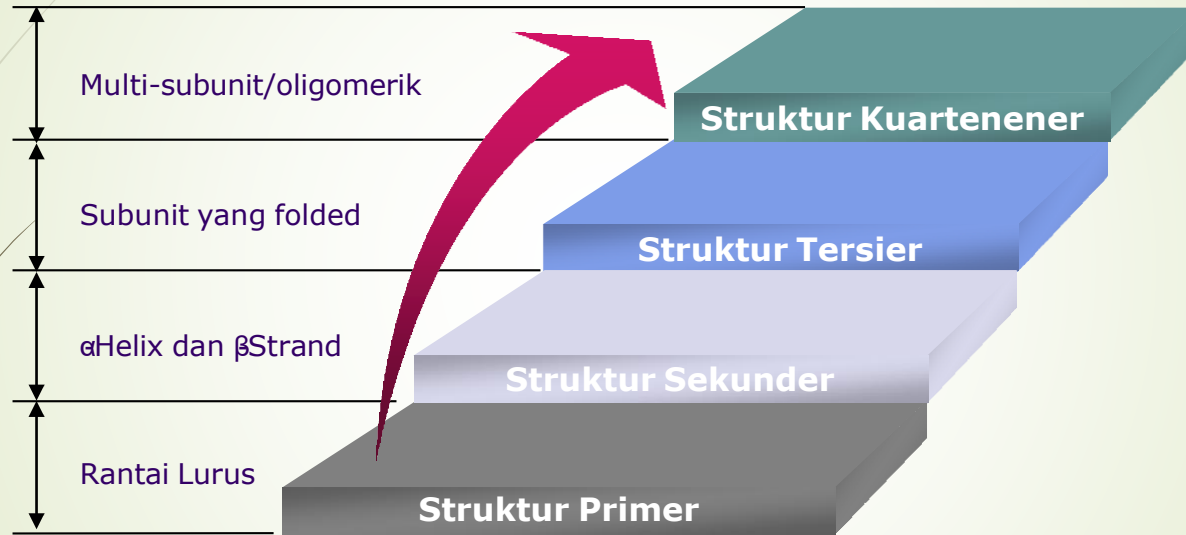
BIOLOGI SEL MOLEKULER

# FUNGSI ASAM AMINO

APT. DESI NOVITA R, M.FARM

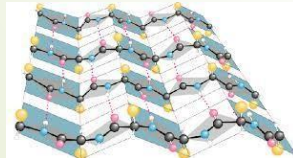
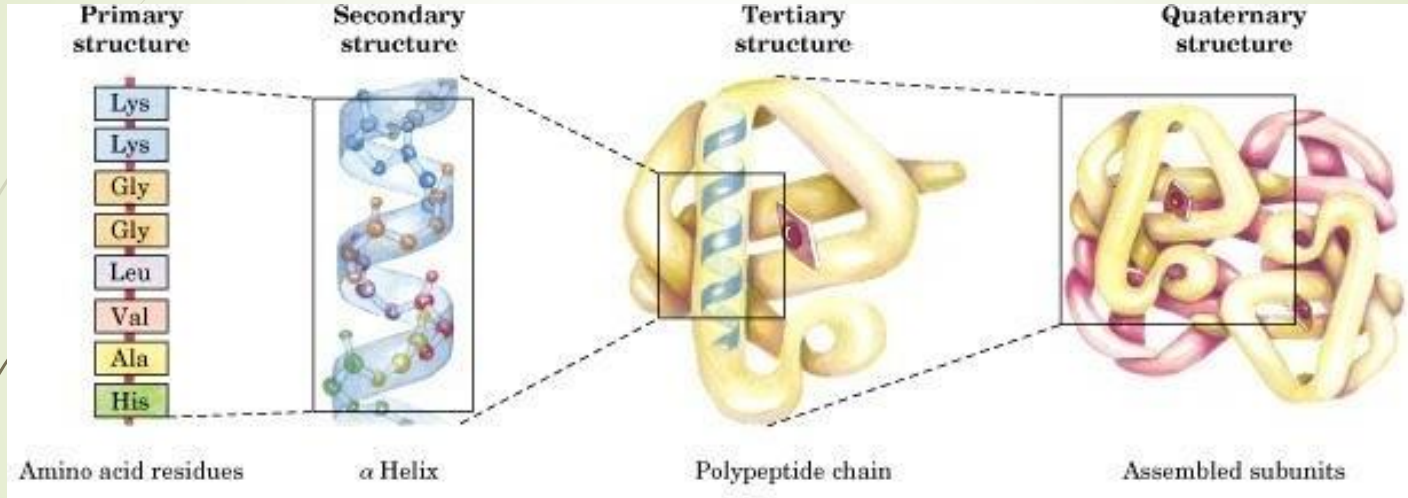
- Kata protein berasal dari bahasa Mesir “proteus” yang terjemahan kasarnya berarti “yang utama”.
- Protein adalah sumber asam-asam amino yang mengandung unsur-unsur C, H, O, dan N ada pula yang mengandung unsur S dan P.
- Protein tersusun dari beberapa asam amino yang saling berikatan.

# Struktur Protein



Asam amino penyusun → menentukan sifat/karakteristik protein

# Proteins (polypeptides)



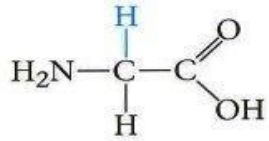
$\beta$ sheet

## SINGKATAN ASAM AMINO

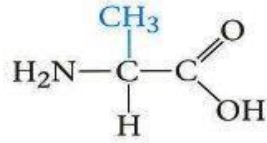
Asam Amino	3 Huruf	1 huruf		3 Huruf	1 huruf
Alanine	Ala	A	Leucine	Leu	L
Arginine	Arg	R	Lysine	Lys	K
Asparagine	Asn	N	Methionine	Met	M
(Asam) Aspartat	Asp	D	Phenylalanine	Phe	F
Cystein	Cys	C	Proline	Pro	P
Glutamine	Gln	Q	Serine	Ser	S
(Asam) Glutamat	Glu	E	Threonine	Thr	T
Glycine	Gly	G	Tryptophane	Trp	W
Histidine	His	H	Tyrosine	Tyr	Y
Isoleucine	Ile	I	Valine	Val	V

# Amino Acids - 1

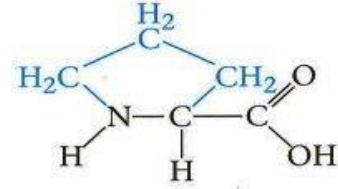
## Nonpolar R Groups (hydrophobic)



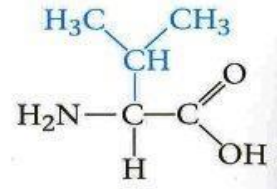
Glycine (gly)



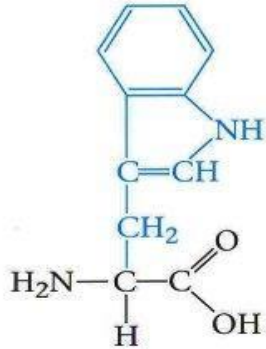
Alanine (ala)



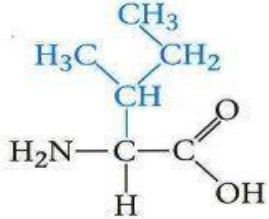
Proline (pro)



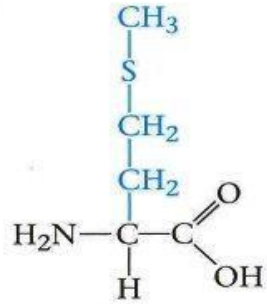
Valine (val)



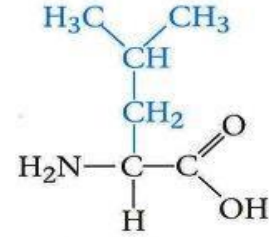
Tryptophan (trp)



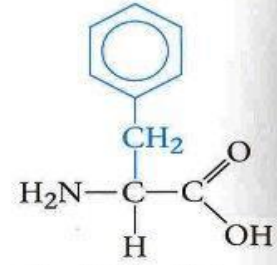
Isoleucine (ile)



Methionine (met)



Leucine (leu)



Phenylalanine (phe)

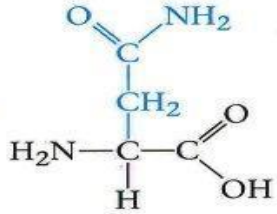
# Amino Acids - 2

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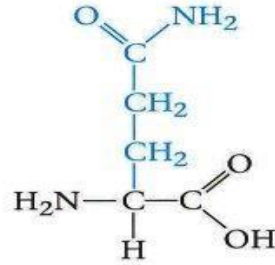
## Polar R Groups (hydrophilic)



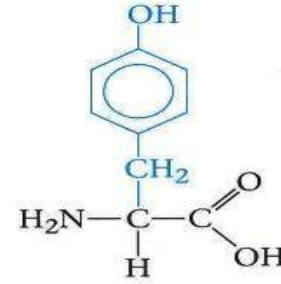
Serine (ser)



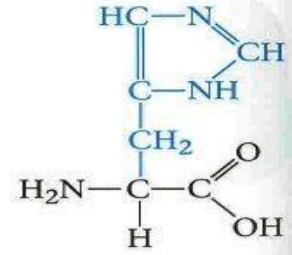
Asparagine (asn)



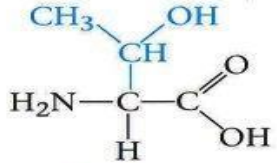
Glutamine (gln)



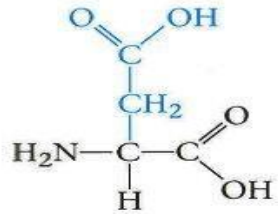
Tyrosine (tyr)



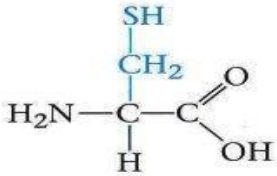
Histidine (his)



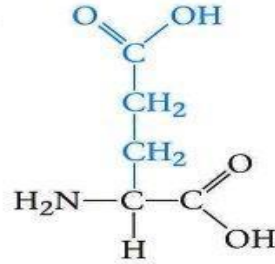
Threonine (thr)



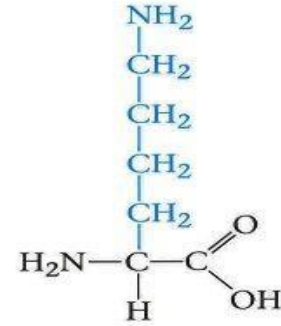
Aspartic acid (asp)



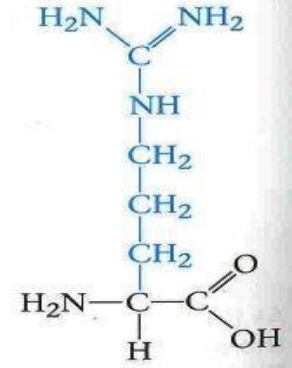
Cysteine (cys)



Glutamic acid (glu)



Lysine (lys)

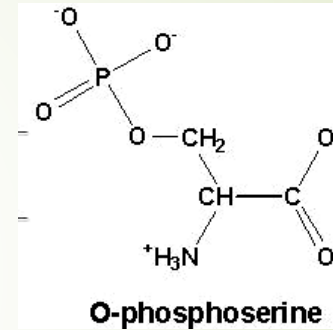


Arginine (arg)



# 8 Asam amino non standar

- Merupakan asam amino diluar 20 macam as. amino standar
- Terjadi karena modifikasi yang terjadi setelah suatu asam amino standar menjadi protein.
- Kurang lebih 300 asam amino non standar dijumpai pada sel



modifikasi serin yang mengalami fosforilasi oleh protein kinase



# Ikatan Peptida

- Berdasarkan konvensi ikatan peptida ditulis dengan asam amino yg mempunyai  $\text{NH}_3^+$  bebas (sebelah kiri) dan as. Amino dg gugus  $\text{COO}^-$  bebas (sebelah kanan)
- Molekul yang mengandung 2 asam amino dg 1 ikatan peptida disebut **dipeptida**
- Molekul mengandung 3 asam amino disebut tripeptida. Ada tetrapeptida, pentapeptida, dst.

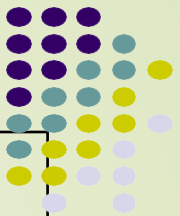
Proteins are commonly described as either being  
**fibrous or globular in nature.**

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**Fibrous proteins have structural** roles whereas **globular proteins are functional** (active in a cell's metabolism).

<b>Properties</b>	<b>Fibrous Protein</b>	<b>Globular Protein</b>
<i>Shape</i>	Long and narrow	Rounded / spherical
<i>Role</i>	Structural (strength and support)	Functional (catalytic, transport, etc.)
<i>Solubility</i>	(Generally) insoluble in water	(Generally) soluble in water
<i>Sequence</i>	Repetitive amino acid sequence	Irregular amino acid sequence
<i>Stability</i>	Less sensitive to changes in heat, pH, etc.	More sensitive to changes in heat, pH, etc.
<i>Examples</i>	Collagen, myosin, fibrin, actin, keratin, elastin	Catalase, haemoglobin, insulin, immunoglobulin

# Usage of proteins



Function	Description	Key examples
Catalysis	There are thousands of different enzymes to catalyse specific chemical reactions within the cell or outside it.	Rubisco
Muscle contraction	<b>Actin and myosin</b> together cause the muscle contractions used in locomotion and transport around the body.	Actin, myosin
Cytoskeletons	<b>Tubulin</b> is the subunit of microtubules that give animals cells their shape and pull on chromosomes during mitosis.	Tubulin
Tensile strengthening	<b>Fibrous proteins</b> give tensile strength needed in skin, tendons, ligaments and blood vessel walls.	Collagen
Blood clotting	Plasma proteins act as clotting factors that cause blood to turn from a liquid to a gel in wounds.	
Transport of nutrients and gases	Proteins in blood help transport oxygen, carbon dioxide, iron and lipids.	Hemoglobins

# Usage of proteins



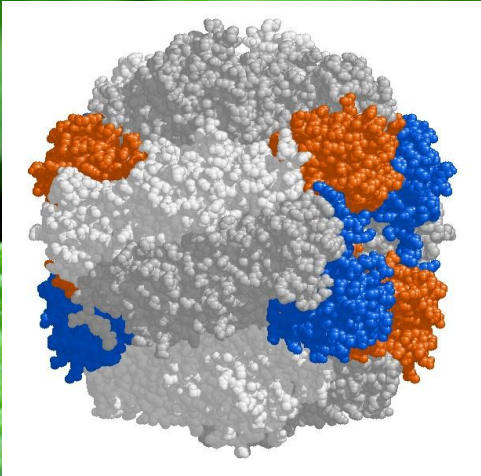
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Function	Description	Key examples
Cell adhesion	Membrane proteins cause adjacent animal cells to stick to each other within tissues.	
Membrane transport	Membrane proteins are used for facilitated diffusion and active transport, and also for electron transport during cell respiration and photosynthesis.	Protein transmembrane
Hormones	Some such as insulin, FSH and LH are proteins, but hormones are chemically very diverse.	Insulin
Receptors	Binding sites in membranes and cytoplasm for hormones, neurotransmitters, tastes and smells, and also receptors for light in the eye and in plants.	rhodopsin
Packing of DNA	Histones are associated with DNA in eukaryotes and help chromosomes to condense during mitosis.	Histone
Immunity	This is the most diverse group of proteins, as cells can make huge numbers of different antibodies.	immunoglobulins



# Rubisco

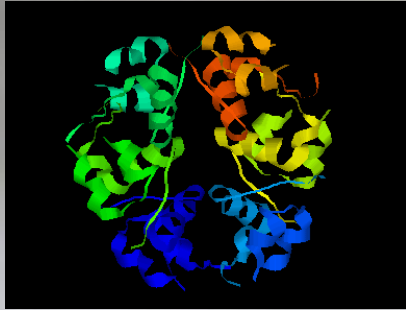
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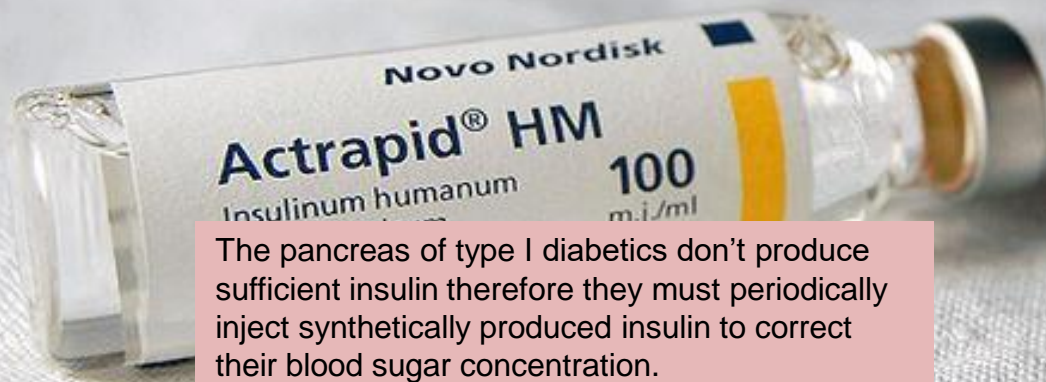
- Full name ribulose biphosphate carboxylase
- Enzyme - **catalyses the reaction that fixes carbon dioxide from the atmosphere**
- Provides the source of carbon from which all carbon compounds, required by living organisms, are produced.
- Found in high concentrations in **leaves and algae cells**

# Insulin

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- A hormone – signals many cells (e.g. liver cells) to absorb glucose and help reduce the glucose concentration of the blood.
- Affected cells have receptor (proteins) on their surface to which insulin can (reversibly) bind to.
- Secreted by  $\beta$  cells in the pancreas and transported by the blood.

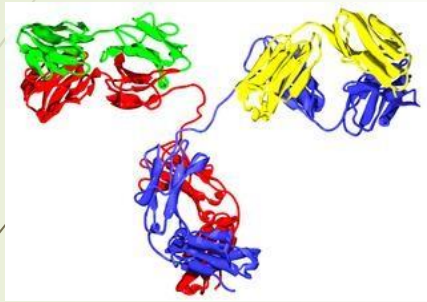


The pancreas of type I diabetics don't produce sufficient insulin therefore they must periodically inject synthetically produced insulin to correct their blood sugar concentration.

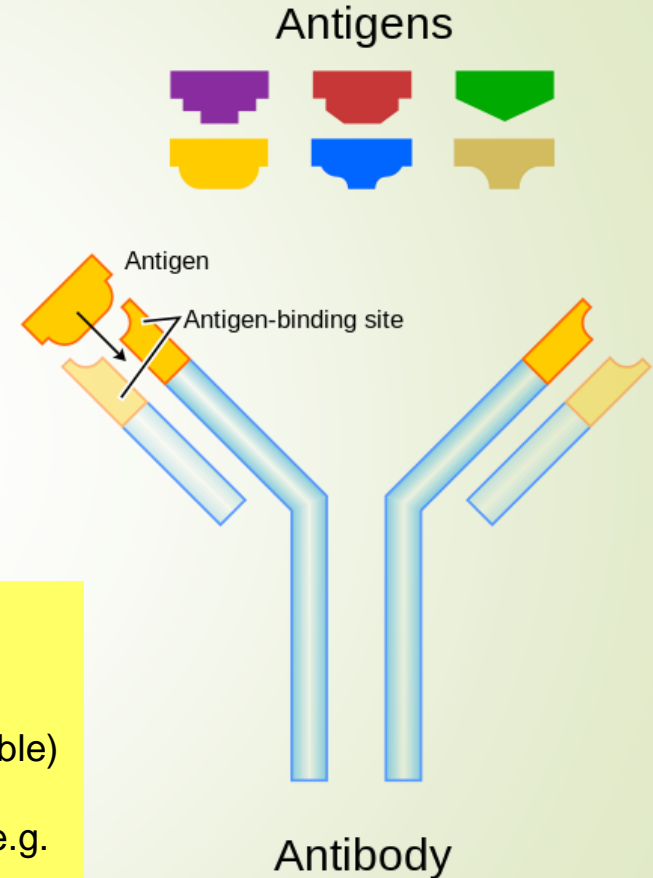


# immunoglobulins

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- Also known as antibodies.
- Two antigen (a molecule on the pathogen which provokes an immune response) binding sites - one on each 'arm'
- Binding sites vary greatly between immunoglobulins (hypervariable) to enable them to respond a huge range of pathogens.
- Other parts of the immunoglobulin molecule cause a response, e.g. acting as a marker to phagocytes (which engulf the pathogen)

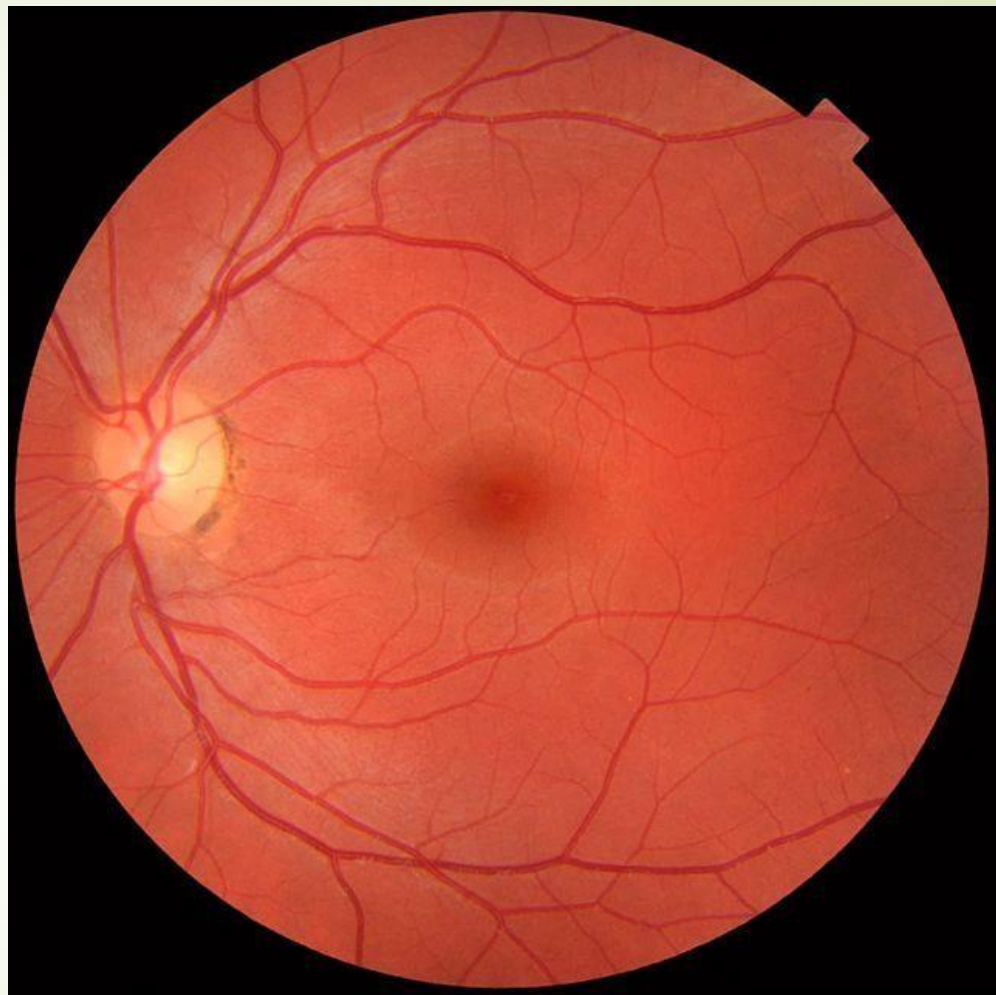




# rhodopsin

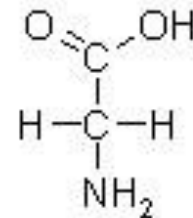
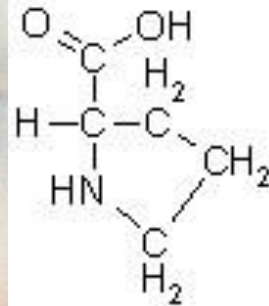
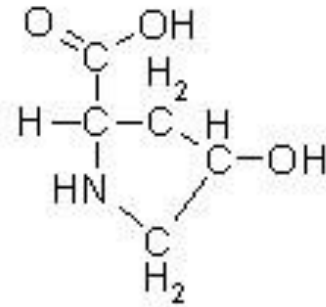
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- A pigment that absorbs light
- Membrane protein of rod cells of the retina (light sensitive region at the back of the eye)
- Rhodopsin consists of the opsin polypeptide surrounding a retinal prosthetic group
- retinal molecule absorbs a single photon of light -> changes shape -> change to the opsin -> the rod cell sends a nerve impulse to the brain
- Even very low light intensities can be detected.



# collagen

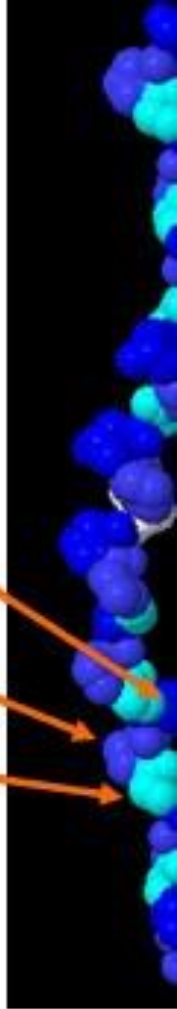
- A number of different forms
- All are rope-like proteins made of three polypeptides wound together.
- About a quarter of all protein in the human body is collagen
- Forms a mesh of fibres in skin and in blood vessel walls that resists tearing.
- Gives strength to tendons, ligaments, skin and blood vessel walls.
- Forms part of teeth and bones, helps to prevent cracks and fractures to bones and teeth



Hydroxyproline

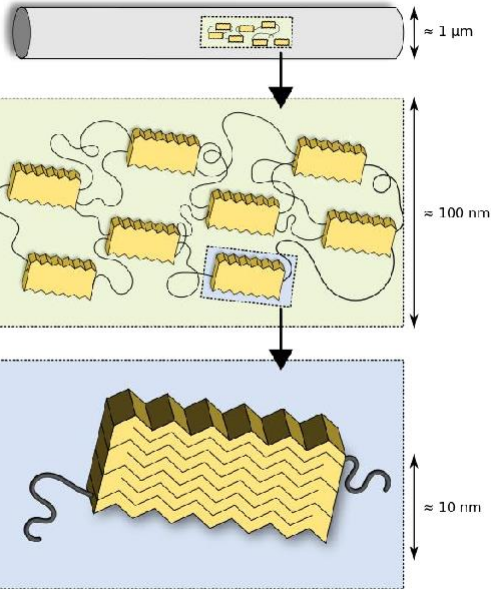
Proline

Glycine





# spider silk



- Different types of silk with different functions
- Dragline silk is stronger than steel and tougher than Kevlar
- When first made it contains regions where the polypeptide forms parallel arrays (bottom)
- Some regions seem like a disordered tangle (middle)
- When the stretched the polypeptide gradually extends, making the silk extensible and very resistant to breaking.

# Classification of proteins

## 1- Simple proteins:

i.e. on hydrolysis gives only amino acids

Examples:

**1- Albumin and globulins :** present in egg, milk and blood

They are proteins of high biological value i.e. contain all essential amino acids and easily digested.

**Types of globulins:**

**$\alpha$ 1 globulin :** e.g. antitrypsin

**$\alpha$ 2 globulin:** e.g. hepatoglobin: protein that binds hemoglobin to prevent its excretion by the kidney

**$\beta$ -globulin:** e.g. transferrin: protein that transport iron

**$\gamma$ -globulins** = **Immunoglobulins** (antibodies) : responsible for immunity.

**2- Globins (Histones):** They are basic proteins rich in histidine amino acid.

They are present in :      a - combined with DNA  
   b - combined with heme to form hemoglobin of RBCs.

**3 Gliadines are the proteins present in cereals.**

**4 Scleroproteins:** They are structural proteins, not digested.  
                                 include: keratin, collagen and elastin.

**a.  $\alpha$ -keratin:** protein found in hair, nails, enamel of teeth and outer layer of skin.  
It is  $\alpha$ -helical polypeptide chain, rich in **cysteine and hydrophobic** (non polar) amino acids so it is water insoluble.

**b. collagens:** protein of connective tissues found in bone, teeth, cartilage, tendons, skin and blood vessels.

c.

Elastin

n:

present in walls of large blood vessels (such as aorta). It is very important in lungs, elastic ligaments, skin, cartilage, ..

It is elastic fiber that can be stretched to several times as its normal length.

### Penyakit terkait protein elastin dan antitripsin :

**Emphysema:** is a chronic obstructive lung disease (obstruction of air ways) resulting from deficiency of  $\alpha$ 1-antitrypsin particularly in cigarette smokers.

#### Role of $\alpha$ 1-antitrypsin :

- a. Elastin is a lung protein. Smoke stimulate enzyme called elastase to be secreted form neutrophils (in lung). Elastase cause destruction of elastin of lung
- b.  $\alpha$ 1-antitrypsin is an enzyme (secreted from liver) and inhibit elastase and prevent destruction of elastin. So deficiency of  $\alpha$ 1-antitrypsin especially in smokers leads to degradation of lung and destruction of lung (loss of elasticity of lung, a disease called emphysema).

# Conjugated proteins

- ▶ i.e. On hydrolysis, give protein part and non protein part and subclassified into:

## 1. Phosphoproteins:

- ▶ These are proteins conjugated with phosphate group. Phosphorus is attached to oh group of serine or threonine. e.g. Casein of milk and vitellin of yolk.

## Functions:

- help lipids to transport in blood
  - enter in cell membrane structure helping lipid soluble substances to pass through cell membranes.
- ▶ These are proteins conjugated with lipids.



### **3. Glycoproteins:**

Proteins conjugated with sugar (carbohydrate)

e.g. :

- Mucin
- Some hormones such as erythropoietin

### **4. Nucleoproteins:**

These are basic proteins (e.g. histones) conjugated with nucleic acid (DNA or RNA).

e.g. :

- a. Chromosomes : are proteins conjugated with DNA
- b. Ribosomes : are proteins conjugated with RNA

## 5. Metalloproteins:

These are proteins conjugated with metal like iron, copper, zinc

### a. Iron-containing proteins:

Iron may present in heme such as in :

- hemoglobin (Hb)
- myoglobin ( protein of skeletal muscles and cardiac muscle)
- Cytochromes
- catalase, peroxidases (destroy H<sub>2</sub>O<sub>2</sub>)
- tryptophan pyrrolase (destroy indole ring of tryptophan).

Iron may be present in free state ( not in heme) as in:

- Ferritin: Main store of iron in the body. Ferritin is present in liver, spleen and bone marrow.
- Hemosidrin: another iron store.
- Transferrin: is the iron carrier protein in plasma.

e.g. - Ceruloplasmin which oxidizes ferrous ions into ferric ions  
- Oxidase enzymes such as cytochrome oxidase.

c. **Zn containing proteins:** e.g. Insulin and carbonic anhydrase

d. **Mg containing proteins:** e.g. Kinases and phosphatases.

## 6. **Chromoproteins:**

These are proteins conjugated with pigment.

e.g.

- All proteins containing heme (Hb, myoglobin)
- Melanoprotein : e.g proteins of hair or iris which contain melanin.

## **Derived proteins**

Produced from hydrolysis of simple proteins.

e.g. - Gelatin: from hydrolysis of collagen  
- Peptone: from hydrolysis of albumin



Thank you