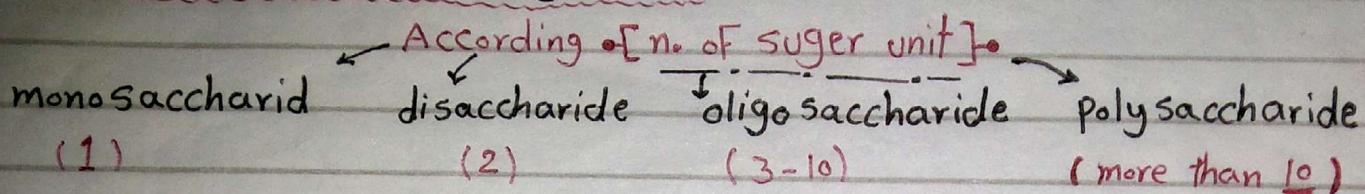


Carbohydrates: it's only normal source of energy (ATP), not lipids/protein

→ Classification of Carbohydrates:



① **monosaccharide** :

(no. of C)

(keton | Aldehyde)  
(C=O) | (CHO)

El Noah

A) According to number of Carbon atoms:

→ Trioses (3) → tetroses (4) → pentoses (5) → hexoses (6)

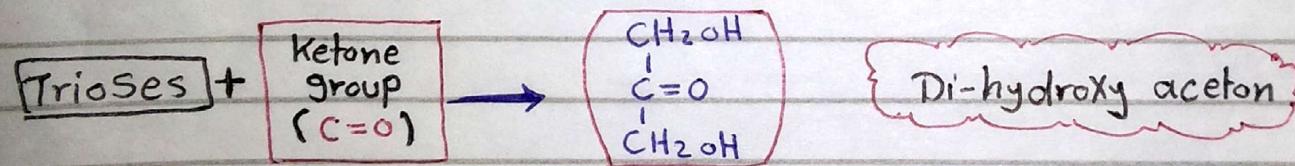
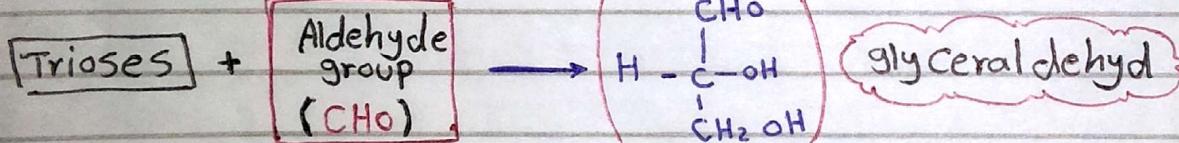
B) According to presence of (Ketone / Aldehyde) group.

Ketone group → Ketoses

أي رقم +

Aldehyde group → Aldoses

[هذا مثل رقم واحد له الجموعتين Trioses (3) و أحدهما Glyceraldehyde]



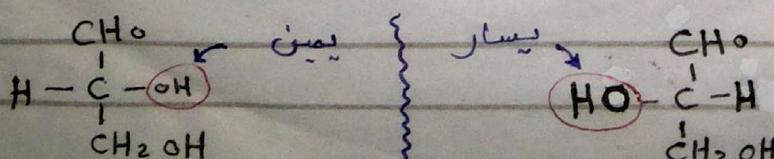
ذبيح في حوار أمهات [Isomers] حول

enantiomers (D & L) ex) glyceraldehyde

Isomers ↘ anomers (D / L) ex) glucose

الكريونة قبل الأخيرة

D enantiomers: Found in (C) one before the last



D-glyceraldehyde

L-glyceraldehyde

①

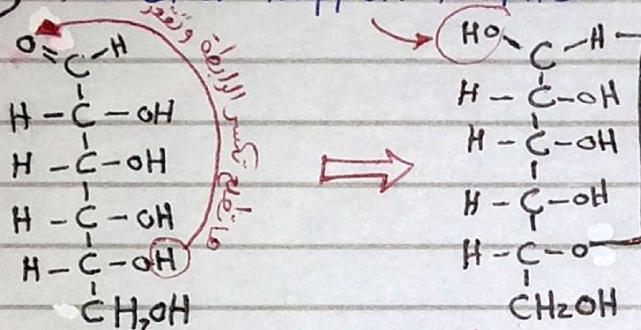
امتحان

**M.C.Q** [D & L]-glyceraldehyde] are example of enantiomers  
 يعني لو جالك أي مركب قبله [D & L] حاضتر ←

مذكرة : لو جالك سؤال اسرح enantiomer لازم ارسم المعالين السابقين

Anomers

Reaction happen in first Carbon.



(open chain) in solid

(close chain) in liquid

هنا OH على أول كربون يمكن تكون يمين أو شمال .

(OH) Right → α-glucose

(OH) left → β-glucose

وخد بالك أي مركب فيه [α/β] يبقى على خطوط

هاده تكرر مكان التفاعل للنوعين

سؤال ممكن ينزل مقارنة بين نوعين الisomer

ورسم enantiomer

Enantiomer

→ in carbon before the last

→ [D/L] (-OH) تفسر مكان

→ ترسم

→ in first Carbon ex glucose

→ [α/β] (-OH)

Anomer

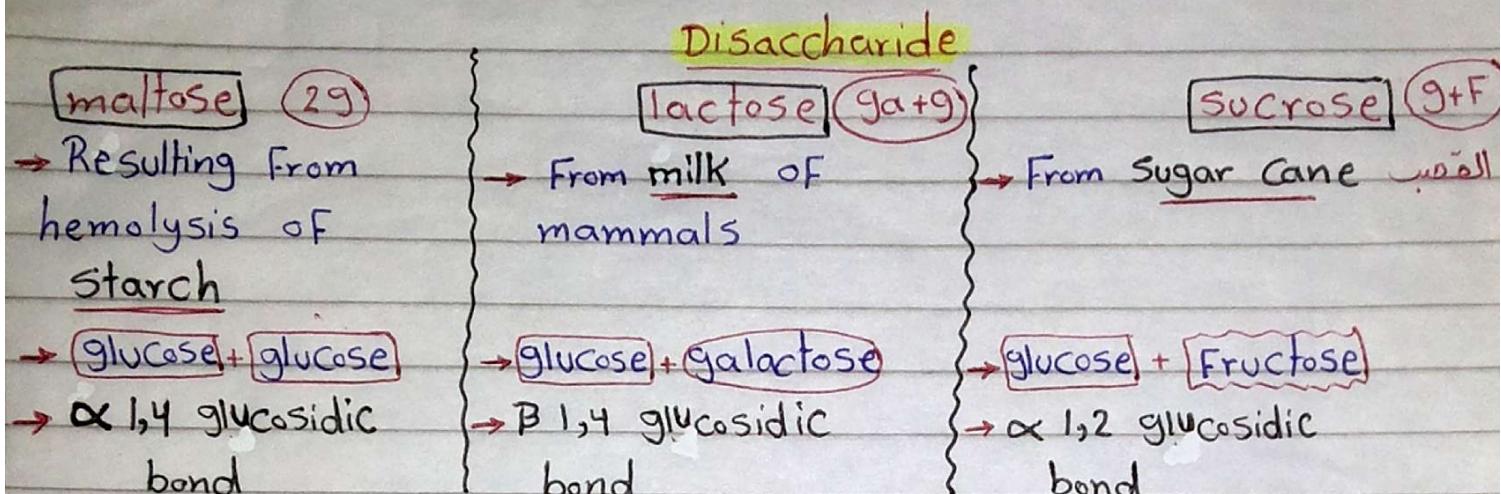
تفسر مكان



② Disaccharides:

- Consist of 2 sugar units bounded together by glucosidic bond.

②



### (3) Polysaccharide :

Consist of more than 10 sugar units bounded by glycosidic bond.

- متجانس  
Homopolysaccharide
- starch
  - glycogen
  - cellulose

### poly saccharide

### Heteropolysaccharide

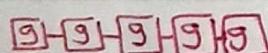
→ GaGS

### A) Homo Polysaccharide:

**Starch** → it's the storage form of carbohydrate in plants.

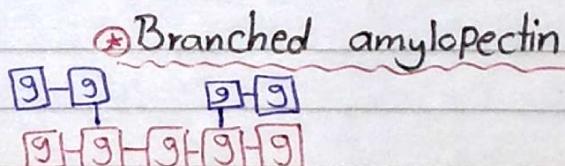
→ 2 types :

\* **unbranched amylose**



\* Straight chain

\* [ $\alpha$  1,4 glucosidic bond]



\* Branched part →  $\alpha$  1,6 glucosidic b.

\* Straight chain →  $\alpha$  1,4 glucosidic b.

\* have a branch every 30 unit

1) Starch Consist of \_\_\_\_\_ & \_\_\_\_\_

2) Compare between (amylose / pectin)

(3)

**glycogen** → storage form of carbohydrates in mammals.

→ consist of: Branched part ( $\alpha 1,6$  glucosidic bond)

                            Straight chain ( $\alpha 1,4$  glucosidic bond)

→ have a branch every 10 units

**Cellulose** → Found in (plants fibers & cell wall of plants)

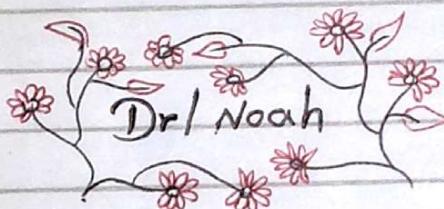
→ Have **(B)**  $1,4$  glucosidic bond. **undigested**

give reason?

→ used to prevent Constipation • الإمساك

Because Cellulose increase The bulk of food → increase  
intestine contractions) lead To [prevent Constipation]  
increase digestion

هذا يعني الأكل ينزل كقطع كبيرة للأمعاء ← قيود انتفاخها ← هايزد المضم  
وطرد قطع الطعام الباقي في الأمعاء المساعدة للإمساك .



④



## جامعة الزويا العزيزة

### Disaccharides

- |            |                          |
|------------|--------------------------|
| 1] maltose | $\alpha 1,4 \text{ g.B}$ |
| 2] lactose | $\beta 1,4 \text{ g.B}$  |
| 3] Sucrose | $\alpha 1,2 \text{ g.B}$ |

### Poly saccharides

((Homo polysaccharides))

#### 1] Starch

- unbranched amylose
- Branched amylopectine

$\alpha 1,4 \text{ g.B}$

→ Branched part:  $\alpha 1,6 \text{ g.B}$

→ straight chains:  $\alpha 1,4 \text{ g.B}$

→ Branched part:  $\alpha 1,6 \text{ g.B}$

→ straight chains:  $\alpha 1,4 \text{ g.B}$

$\beta 1,4 \text{ g.B}$

#### 2] glycogen

#### 3] Cellulose

مدونة للناس الذي يبحث عن غير فهم :-)

(g.B) → glycosidic bond

وأوعي تنس تكتبها // و أوعي تكتبها ماشي //

Dr/ Noah

(5)

- GAGs** - have protein Core except: Hyaluronic acid
- have sulfate in its composition

-(GAGs members)

Enumerate?

### ① Hyaluronic acid:

- \* No (Protein Core & Sulfate)
- \* Found in: (Synovial Joint) & (The fluid around The eye)

### ② Chondroitin sulfate:

- \* Found in: (Cartilage) & (Tendons) & (ligament)

### ③ Keratan sulfate:

- \* Found in: cornea of eye {Transparency}

### ④ Dermatan sulfate:

- \* Found in: skin {Flexibility} يحافظ على مرونة الجلد

### ⑤ Heparin:

- \* anti-Coagulant مانع تجلط

### ⑥ Heparan sulfate:

- \* Found in: Cell membrane
- \* Function: ① receptor ② cell-cell interaction.

# El-Noah

## Lipids

short note

Function: ① Important composition of Cell membrane

② energy reservoir مخزن للطاقة

③ Formation of vitamins & hormones

Bile salts (For lipid emulsification))

①

## Classification of lipids

### Simple

F.A + glycerol  
 F.A + Alcohol

(ex) → T.A.G  
 → Wax

### Compound

F.A + Alcohol + other group

(ex) → phospholipid  
 → Glycolipid

### Derived

hydrolysis of (simple & compound) lipids

(ex) → steroid  
 → Carotenoid  
 → Fat soluble vitamins

### Fatty acids

Explain

\*El-Noah

What's amphipathic nature of F.A?

→ it's general formula is [R - CoOH]

hydrophobic

hydrophilic

→ Classification of F.A:

#### "saturated"

long chain  
 [ > C<sub>10</sub> ]

short chain  
 [ C<sub>2</sub> - C<sub>10</sub> ]

(ex)

→ Butyric acid

C<sub>4</sub>

M.C.Q

→ palmitic acid

C<sub>16</sub>

→ stearic acid

C<sub>18</sub>

(N.b) Saturated F.A may be:

liquid

[ < C<sub>8</sub> ]

Solid

[ > C<sub>10</sub> ]

#### "unsaturated"

contain one or more [= bond]

(ex)

→ oleic acid [C<sub>18</sub> / 1] n. of -CoOH

→ linoleic acid [C<sub>18</sub> / 2]

→ linolenic acid [C<sub>18</sub> / 3]

→ Arachidonic acid [C<sub>20</sub> / 4]

M.C.Q

### Eicosanoid

\* (eicos) means (20)

→ (ex) arachidonic acid [C<sub>20</sub> / 4]

→ Classification:

M.C.Q

#### Cyclic

→ Prostaglandins  
 → Prostacyclins  
 → Thromboxanes

#### A Cyclic

M.C.Q

→ Leukotriens  
 → Lipoxins

②

## ① cyclic :

→ prostaglandin :

Synthesis: By most body tissue

Function: ① inhibit gastric secretion

② promote inflammation

uterine contraction

سوائل  
معانة

تضيق

## Thromboxanes :

Synthesis: By platelets



Function: ① vasoconstriction

② platelets aggregation.

② Inhibit platelet aggregation

③ platelets aggregation.

## ② A cyclic :

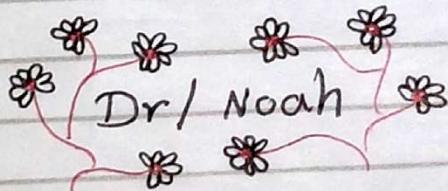
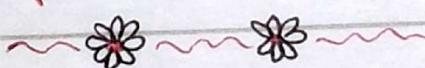
→ leukotriens :

Short note

Synthesis: By [leukocytes / platelets / mast cells]

(N.b) They are released during severe allergy

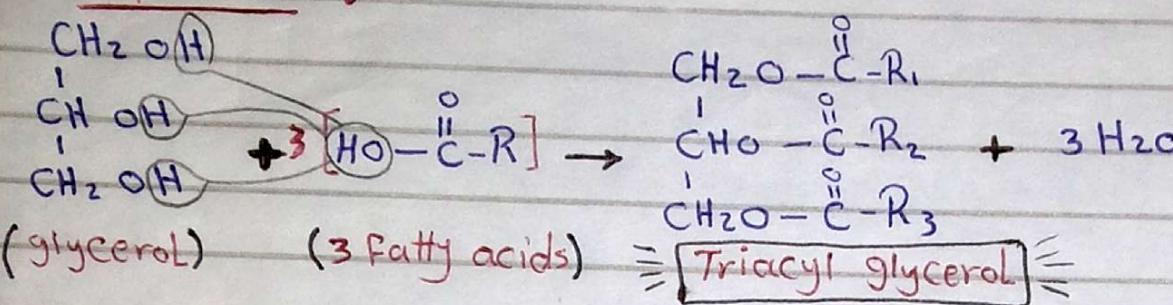
Function: produce (bronchospasm).



## ③

## Triacyl glycerol [TAG]

- Belong to Simple lipids.
- Preparation :



- classified into :

- 1) Unsaturated Fatty acid : oils الزيوت
- 2) Saturated fatty acid : Fats الدهون والشحوم

- Hardening : Converting of oils into fats by Hydrogenation  
oils (U.S.F.A)  $\xrightarrow{\text{H}_2}$  FATS (S.F.A)

## Phospholipids

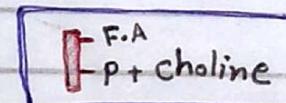
- Belong to Compound lipids.

- what's types of phospholipids ? على حسب نوع الأحوج   
it's classified according to type of [alcohol present] :

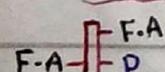
A) Sphingomyelin : Contain sphingosin alcohol

B) Phosphoglycerides : Contain glycerol alcohol, have 5 examples.

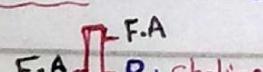
- A) Sphingomyelin:



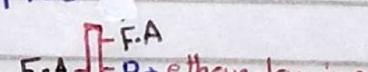
- B) Phosphoglycerides : 5 examples



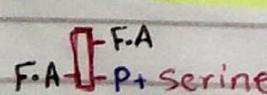
Phosphatidyl  
acid



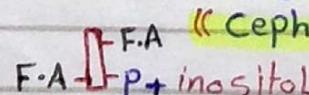
Licithin



Phosphatidyl ethanolamine



Phosphatidyl Serine



Phosphatidyl inositol

(Lipositol)

(1)

## Importance of Phospholipids :

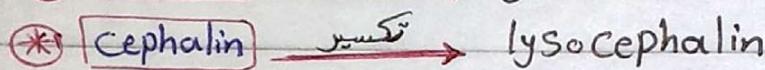
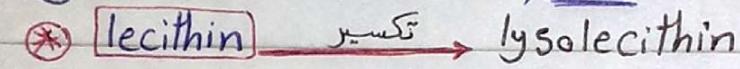
(F.A)

- 1) have [amphipathic nature] → Polar part + non-polar part
- 2) Fat emulsification
- 3) Cell membranes formation
- 4) Plasma protein formation

## Lysophospholipids :

الجانب الذي يكسرها في الجسم

we have **Phospholipase A<sub>2</sub>** in intestine which work on Fatty acids in Portion 2, like :-



سؤال مفتوح

**Snake venom** - Contain **lecithinase enzyme**

- when that enzyme enter to the blood  $\xrightarrow{\text{lead}}$  R.B.Cs hemolysis

Because that enzyme have the same effect of

((**Phospholipase A<sub>2</sub> enzyme**)) So lecithinase enzyme will Convert phospholipids of [R.B.Cs cell membrane] into **lysophospholipids** leading to R.B.Cs hemolysis and rupture

## Steroids

- Belong to derived lipids

- classified into : (found in)

1) cholesterol

2) bile acids

3) Steroid hormones

## Bile Acids

- Formation : ① Primary bile acids, from cholesterol in liver

② Then secondary bile acids by intestinal bacteria

③ finally Conjugation with [glycine or taurine] and Na To form Bile Salts

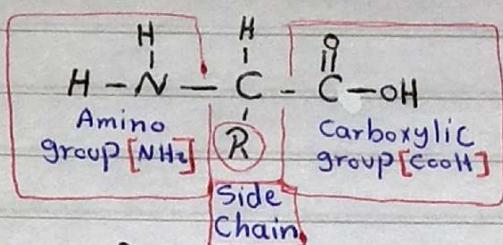
- Function : fat emulsification

②

El-Noah

④ The building units of protein are **Amino Acids (A.A)**

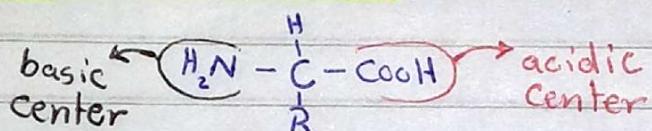
④ General Formula :



④ we have about {20 Types} of amino acids.

El-Noah

مقدمة  
what's {The Amphoteric nature} of amino acids ?



Amino acids have both [Basic & acidic] centers, So it can react with **Bases** as **acid**, and with **Acids** as **base**

### Classification of Amino Acids

① According to [Chemical Structure] (R) :-

**Aliphatic**

**Aromatic**

**Heterocyclic**

**neutral**

**Basic**

**Acidic**

④ Branched (A.A) :

④ valine

MCG

④ leucine    ④ Isoleucine

④ Hydroxy (A.A) :

④ Serine

(R)  
MCG

④ Threonine

MCG

④ Sulfur containing (A.A) :

④ Cysteine

MCG

④ methionine

①

القمة الفزائية

الغذاء العادي

2 According to nutritional value:

A) Essential (A.A) :

short note

→ They are amino acids which can't be synthesised in the body  
So we have to take it from diet

→ 8 types :-

→ 8 types :- (1) (valine / leucine / Isoleucine) (Threonine / methionine) (phenylalanine / tryptophan)

### B) Semi-essential (A.A.):

→ They are synthesised in the body

in adult → Sufficient « enough »

in Children → not sufficient «not enough»

→ 2 types:

## ① Arginine

## (c) Histidine

C) non-essential (A.A) :

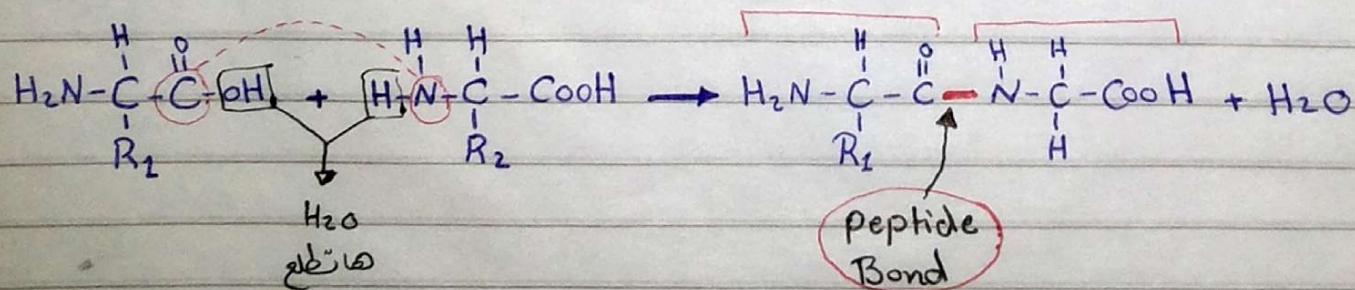
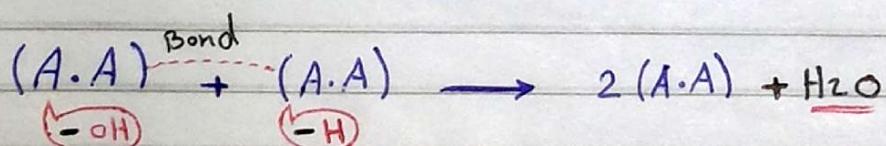
→ They are synthesised in the body with enough amount.

→ example: glycine

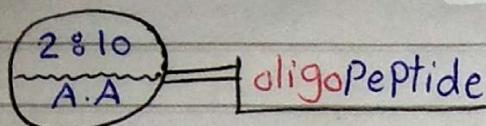
A decorative horizontal border consisting of a thin black line with four stylized pink flowers and green leafy vines at each end.

## ((The peptide bond))

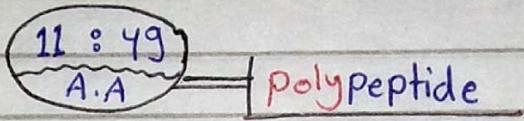
it's the bond between every 2 Amino acids .



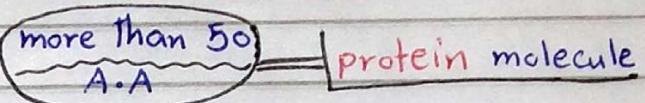
مش اُكِي ائْتَيْنَ (A.A) يُوْرِكُوا بِسَمِّيَّهُم بِروَيْنَ .



لَسْه مَا فَرَشَ أَقْوَلْ عَلَيْهِمْ  
برُوتِينَ



هَذِهِ أَفْرَأَنْ أَقْرَأَنْ أَسْمَيْهُم بِروَيْنَ



سُوْيَه بِروَيْنَانْ مُوجَدَه فِي جَسْمِنْ وَوَظِيفَتَهُ :

① glutathione

short note

\* It's tripeptide (A.A) [means: Consist of 3 units of A.A]

\* Consist of : [ glycine + glutamate + Cysteine ]

\* Function :

→ Anti-oxidation

→ Coenzyme

→ Cell-Cell interaction (Transport A.A only)

اجْلَه

② glucagon

③ insulin

→ Both of them secreted from pancreas

→ 29 (A.A) **Polyptide hormone**

→ 51 (A.A) **Protein hormone**

→ Function:

+ increase blood glucose level

**hyperglycemic**

→ Function:

- decrease blood glucose level

**Hypoglycemic**

③

## Protein structures

### 1 Primary:

→ Bonded together by Peptide bond

↓↓↓

### 2 Secondary:

→ Consist of 2 structures [Alpha-helices / beta-pleated sheets]

→ Bonded by Hydrogen bond.

↓↓↓

### 3 Tertiary:

→ give (3-dimensional shape)

N.B.

All bonded with peptide bond  
except secondary structure

### 4 Quaternary:

ex: Hemoglobin which Consist of (2 alpha globin + 2 beta globin)



## Protein Properties

### ① Solubility:

Soluble in water

### ② have amphoteric nature:

[سیدر و سیدر]

→ (Iso-Electric point) → At Certain pH, protein molecule carries

↓↓↓

++ =

(equal)

(negative & positive) Charges

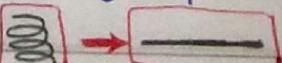
### ③ Denaturation of Protein:

Final short note

→ happen when we put proteins in (Heat / pH / Salt Concentration)  
That will destroy all types of bonds except peptide bond

→ Effects of denaturation: ① loss of biological activity

② Decrease solubility Due to Appearance of hydrophobic (R) groups

③ Increase viscosity Due to expansion of molecules 

④ Increase digestability Due to Unfolding of polypeptide chains

what are types of bond / Interactions of tertiary & Quaternary

(1) **Hydrophobic bond:**

→ Between: the nonpolar (R) groups

(2) **(Electro-Static / Ionic) bond:**

→ between:  $\text{NH}_3^+$  groups and  $\text{COO}^-$  groups

(3) **Hydrogen bond:**

→ Between: The polar (R) groups / Polar (R) group and water

(4) **Van der waals forces:**

→ It's attractive & repulsive forces -

(5) **Disulfide bond:**



## General functions of vitamins:

- 1] Acts as Co-factors for enzymes reactions.
- 2] Don't produce energy for the body
- 3] Can't be synthesized in the body [except vit. K], and they must be taken from diet.
- 4] Their deficiency causes diseases.

Classified into:

Fat-soluble vit: ex) vit. (A, K, E, D)

Water-soluble vit: ex) vit. (C, B complex)

### Vitamin A

- have 3 chemical names: Retinol, Retinal, Retinoic acid

- Its common name: (Anti-xerophthalmia)

- Source: From (milk, egg, animals liver) and from (Carotenoids) in an inactive form called: Provitamin A

(Function)

(Deficiency)

① The healthy of body epithelium and prevent keratinization

Hyperkeratinization of body epithelium

Skin → Roughness      Kidney → stone formation

Lacrimal gland → Xerophthalmia

night blindness

② Formation of Rhodopsin which responsible for night vision

Increase Risk of Cancer

③ Anti-oxidant vitamin  
(means: Reduce Risk of Cancer)

problems in C.T [Bone/Teeth]

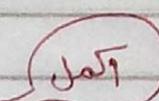
④ The healthy of C.T [Bone/Teeth]

## vitamin D

- Its chemical name: calcitriol - 2 types: D<sub>2</sub>, D<sub>3</sub>
- Source: from (milk, egg, animals liver)

Source of Vit. D<sub>2</sub> → Ergosterol

Source of Vit. D<sub>3</sub> → 7-dehydrocholesterol



**N.B.** Both (Ergosterol & 7-dehydrocholesterol) are Inactive forms, They can be activated by ultra-violet Irradiation.

**Function** ① absorption of [Ca<sup>++</sup>]

② also responsible for absorption of [phosphate]

③ mineralization of bone with ((Ca<sup>++</sup> & phosphate))

**Deficiency** → Children  
→ adult

Final short note

④ In children: Causes ((rickets)), which characterized by:

→ Improper/bad mineralization of bone, so it will become soft and have many deformation, like: 1) Bow legs 2) Square face 3) Delayed eruption of tooth and closure of fontanells.

⑤ In adult: Causes ((osteomalacia)), which characterized by:

→ demineralization of body bone leading to Increase softness

Fracture

plateau effect

جذب

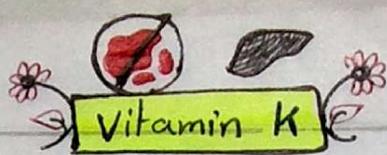
- Function: anti-oxidation

## vitamin E

سوالات ممرين :-

1) Types of anti-oxidant vitamins are: A, E, C

2) Types of vit. which its deficiency causes anemia K, C, B6, B12, Folic acid

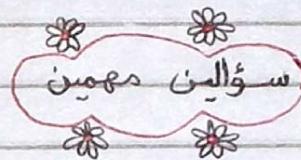


The only vitamin, which is synthesized in our body  
by ((Intestinal bacteria))

**Function** Activation of (blood Clotting Factors) of liver, which Prevent bleeding and hemorrhage.

### Deficiency

Increase the chance of bleeding & hemorrhag  $\xrightarrow{\text{lead to}}$  Anemia

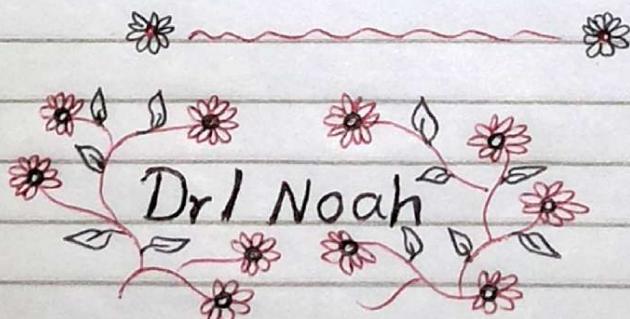


1 vit. k deficiency Causes: Anemia

2 Causes of vit. K deficiency are:

- ① liver disease
- ② In newborns
- ③ Prolonged Intake of antibiotics
- ④ Prolonged Intake of anti-coagulant drugs

[ رُكِنْ أَوْيَ عَنْ الْأَذْوَى مَلَاهَا ] نَقْعُدُ الْقِيَامِينَ دَهْ بِيْسِيلَكْ إِيهْ ؟ !  
[ زَمَّا الْمَائِنَةَ بَتْقُولْ ] إِيهْ أَسْبَابُ نَقْعُدُ الْقِيَامِينَ دَهْ فِي جَسْدَكْ ؟ !



## Vitamin C

- Chemical name: Ascorbic acid
- Source: Fresh Fruits & green vegetables, without heating or storage for long time.
- Function:
  - 1 Anti-oxidant (reduce the risk of Cancer)
  - 2 Reducing agent ( $F^{+3} \rightarrow Fe^{+2}$ ), For absorption of Iron From Food
  - 3 Co-Factor For:
    - Hydroxylation reaction of Poline  $\rightarrow$  Hydroxy Poline
    - Lysin  $\rightarrow$  Hydroxy Lysine
- Both of Them are Principal Component of C-T. and C-T Important for wound healing
- ✓ Tyrosine  $\xrightarrow{\text{metabolism}}$  epinephrine Hormone
- ✓ Cholesterol  $\rightarrow$  Bile acids
- Formation of Steroid Hormones.

Final !!

Deficiency: Cause scurvy disease, characterized by:

- 1 Increase risk of Cancer
  - 2 ↓ Iron in blood  $\xrightarrow{\text{lead}}$  Capillary fragility  $\xrightarrow{\text{lead}}$  Bruised skin  $\xrightarrow{\text{كمان العصارة}}$
  - 3 ↓ Hydroxylation Reactions  $\xrightarrow{\text{lead}}$  unhealthy C-T  $\xrightarrow{\text{lead}}$  Delay in wound healing (bleeding)  $\xrightarrow{\text{lead}}$  Anemia
  - 4 osteoporosis  $\xrightarrow{\text{vit C}}$
- ↓ Vit D  $\rightarrow$  osteomalacia  
 ↓ Vit C  $\rightarrow$  osteoporosis

## vit B1

Deficiency: Cause Beri-Beri, characterized by:

- 1 GIT: nausea / vomiting
- 2 N.S: muscle fatigue / neuritis
- 3 C.V.S: Heart Failure / edema

## Vitamin B<sub>Complex</sub>

↓

## **vit B3**

مرض  
الغالاجين

B-3

د. د. د.

⊗ Formed in the body by : {Tryptophan A.A}

⊗ Deficiency : Cause [pellagra], characterized by :

1 diarrhea 2 dermatitis التهابات في الجلد 3 dementia نسيان

**Vit B6** ⊗ Responsible For Heme / blood synthesis.

⊗ Deficiency : Cause [Anemia]

## **folic acid**

⊗ Responsible For RBCs formation



⊗ Deficiency : Cause [megaloblastic Anemia]

## **Vit B12**

⊗ Responsible For blood Cells Formation

⊗ Deficiency : Cause [pernicious anemia]

Thrombocytopenia + leucopenia + Anemia  
↓ RBCs      ↓ WBCs      ↓ blood

platelets  
WBCs  
RBCs



**Vit B6**   **Vit C** → Anemia

**Vit B1** → Beri-Beri

**Vit B3** → Pellagra

**Vit B12** → Pernicious anemia

**Folic acid** → megaloblastic anemia

## The nitrogenous (nucleic) bases: ((Pyrimidine / purine))

In DNA

① Pyrimidine: Thyamine  
T C      [Cytosine]

② Purine: Adenine  
A G      [Guanine]

In (RNA)

① Pyrimidines: Uracil  
U C      [Cytosine]

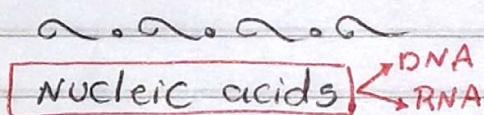
② Purine: Adenine  
A G      [Guanine]

أمثلة

- All of the following are Pyrimidine except:  
((Thyamine - Adenine - Cytosine - Uracil))

لأخذ كل الماء في حرف «السين» في النقطة السابعة

→ n.b The nitrogenous bases in DNA & RNA are almost the same  
But different in Pyrimidine base. DNA → T RNA → U



	DNA	RNA
<u>Bases</u>	① Pyrimidine ( T C ) ② Purine ( A G )	① Pyrimidine ( U C ) ② Purine ( A G )
<u>Shape</u>	Double Strand - helix  ↗ So Stable	Single strand  ↗ So Less stable
<u>length</u>	longer	shorter
<u>Function</u>	② Genetic Formation ③ (RNA) Formation	④ protein Formation

## [DNA]

- Double strand - helix shape
- Carry Genetic Information
- Replicate and give DNA. ("Replicate = give Copies")
- most DNA found in **nucleus**, and small amount found in **mitochondria**
- Consist of 2 Strands (double strand):  

G T A C A G	Coding strand
C A T G T C	Template strand

① **Template strand:** It's the strand which is copied during **RNA Synthesising**

② **Coding strand:**

- It's Complementary to template strand. (**opposite to DNA strand**)
- That strand has a (base sequence) which is **identical** to The (base sequence) of newly formed RNA **except** **T** present instead of **U**

**Gene Expression:**

DNA → Protein  
many processes

- It's the process by which we use the **stored** (Genetic information) of **DNA** to **Synthesis protein**, Through 3 steps.

- **Steps:**

DNA → DNA  
Replication "1"

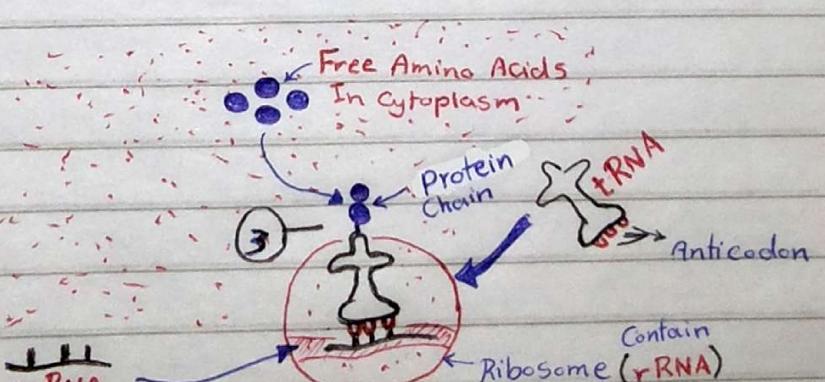
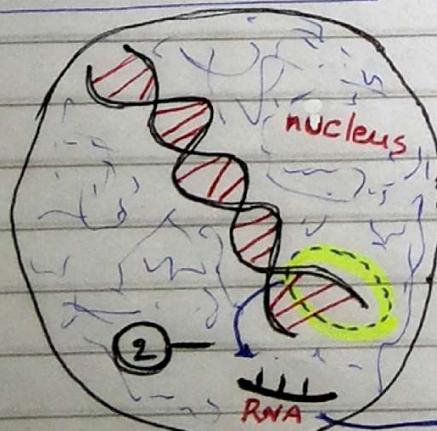
Transcription "2"

Translation "3"

Protein

- [1&2] → in nucleus

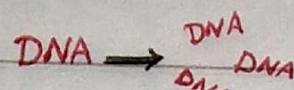
- [3] → in Ribosome



و ما يترافق مع الخطوات دعوه خطوات دلوقت

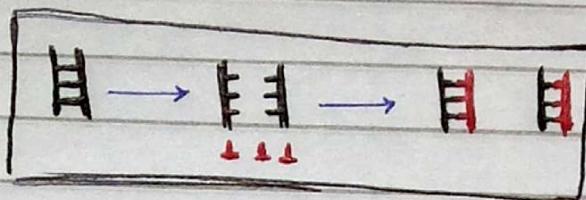
(2)

## ① Replication (douplingation)



→ Function: provide genetic Informations required by daughter Cells From Parent Cells.

→ Happen In nucleus.



## ② Transcription (RNA synthesis)



→ It's the process In which **RNA** Strand will be synthesised From **DNA** by **[RNA Polymerase enzyme]**

→ only one of the Two DNA Strands acts as **(Template strand)**

For **RNA** Synthesising and The other strand of DNA will be Called:

**Coding strand**, which has the same base sequence as the newly formed RNA with **exception** of **T** present instead of **U**

→ happen in nucleus

## ③ Translation (protein synthesis)

RNA → Protein

→ The process in which **protein** will be synthesised From **mRNA** in **ribosomes**

→ This process require all 3 classes of RNA :

① **mRNA** It Carries RNA strand From nucleus to **Ribosomal RNA (rRNA)**  
الرسمنجي التي تابعه الريبوسوم عمان يبدأ التناقل عليهما

② **rRNA** It's a specific position in ribosome which carry mRNA

الكتلة التي تابعه على الريبوسوم

③ **tRNA** - It contain **anticodon** (which complementary to RNA Codon)

It attach to specific Area on RNA Then Transfer its suitable Amino Acids From Cytoplasm Then It will form (growing chain of that A.A)

Finally by the help of **[peptidyl transferase enzyme]** From Ribosome Formation of **peptid bonds** between that chain of A.A → Forming **Protein**

③

سؤال سهل  
نعم !!

تعريف  
أسباب  
أنواع

Gene mutation (mutation = change)

a-a-a-a-a-a-a-a-a-a-a-a

شكل عام هو خلل في الـ DNA في أنسجة  
خطوة في عملية [gene expression]

→ It's permanent change in DNA

### Causes:

- 1 Uncorrected DNA errors (during replication)
- 2 Toxic chemicals (like: Insecticides)
- 3 Irradiation

### Types:

Point mutation

- mis-sense
- non-sense
- Silent

Insertion & deletion mutation

- (one or two or multiplication) bases
- (Three or multiplication) bases

### 1 Point ((single)) mutation :

- means replacement of single base by another one.

#### Types:

A) mis-sense mutation:

cause disease

- mutation in base no. 17 (in the 6<sup>th</sup> A.A) of β-hemoglobin lead to  
Change of glutamic Acid into valine, finally That will  
Cause Sickle anemia (RBC)

B) non-sense mutation:

- it's mutation in DNA lead to Formation of Stop Codons

Formation of False protein (It's a protein with shorter A.A chain)

UAA  
UAG  
UGA

lead to

C) silent mutation:

- It's mutation, occurs If the resulted Codons are code for the same Amino Acid.

الكodon الذي ظهر نفسه كور لاً ميتو أسي

## 2 Insertion & deletion mutation:

- means Adding or deleting bases in DNA  $\xrightarrow{\text{lead To}}$  shifting

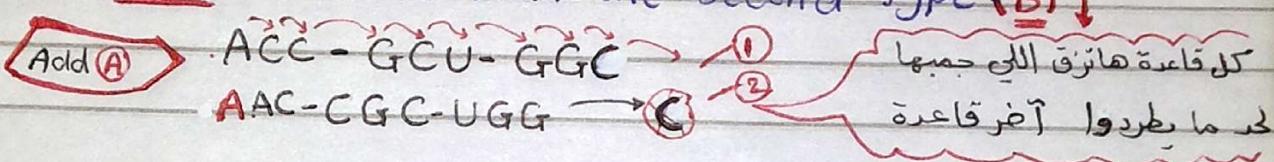
### Types:

A) Insertion or deletion of (one or two) bases and their multiplications:

- That will lead to Shifting of every single base in DNA  $\xrightarrow{\text{lead To}}$  produce new Amino Acid

That type is more serious than the second type (B) ↓

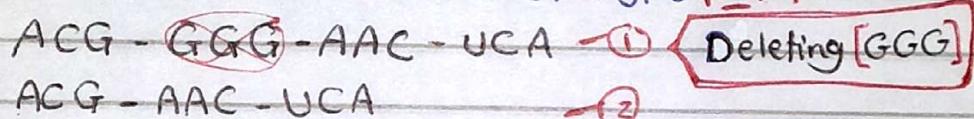
#### Example



B) Insertion or deletion of (Three or more) bases and their multiplications:

- That type is less serious than the first type (A) ↑

#### Example



## The polymerase chain reaction

PCR

- It's Replication of small fragment of DNA outside the body.

فـ

### Applications:

- 1 Diagnosis of genetic disease
- 2 Detection of viral infections (virus C)
- 3 Detection of bacterial infection (TB)
- 4 In Forensic Analysis of DNA العدل الشرعي
- 5 Synthesis of many proteins, used in medical field (Insulin)