- Number :

5

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CAUSES OF RESPIRATORY ACID – BASE DIORDERS

→The process of respiration plays an important role in the buffering of blood. In particular, increasing H^+ concentration can be obtained by raising the rate of respiration. Initially, the added hydrogen ion binds to bicarbonate ion, forming carbonic acid. $H^+(aq) + HCO_3^-(aq) \rightarrow H_2CO_3(aq)$

Increasing the levels of carbonic acid raises the levels of the dissolved car- bon dioxide, ultimately, gaseous carbon dioxide in the lungs.

$$H_2CO_3(aq) \rightarrow CO_2(aq) + H_2O(l)$$

High respiration rates removes excess carbon dioxide from lungs, starting a shift in the equilibrium positions of all the foregoing reactions. The removal of gaseous CO_2 decreases the amount of dissolved CO_2. Hydrogen ion reacts with HCO_3, and, in process, lowering the H^+ concentration of blood (back to its original levels). In this way, blood pH is kept constant.

→In contrast, **hysterical overbreathing** (excessively deep and rapid breathing) removes such large amounts of carbon dioxide from lungs in which raising the pH of blood. Sometimes, extremely high levels bring weakness and fainting .

In this case the equilibrium of the reaction will be shifted . the H^+ will react with bicarbonate ion , forming carbonic acid in order to cover the decrease in CO_2 , so the concentration of H^+ will decrease then the PH will increase (Alkalosis) .

As the doctor said in the lecture : **hysterical overbreathing** it is a panic attack and it is same as tachycardia (is a common type of heart disorder in which the heart beats faster than normal) .

2) Mechanical over ventilation.

Let's say that there is a patient in a hospital and he is breathing mechanically, if someone increases the rate of breathing the concentration of CO_2 will decrease, so the H^+ will react rapidly with bicarbonate ion to cover the decrease in CO_2 as a result the

concentration of H^+ will decrease as the concentration of CO_2 starts to increase then the PH value will increase too (Alkalosis)

3) Raised intracranial pressure.

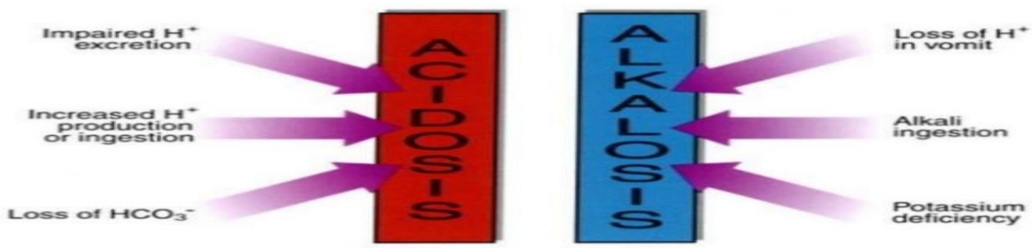
Acidosis

→In this case CO_2 concentration will increase in blood, accordingly the chemical equation is reflected → concentration of H^+ will increase → and that's why the PH value decreases.

Choking
Bronchopneumonia
COAD(Chronic obstructive airway disease **)**

→There are some metabolic processes that occur in the body and do not relate to the lungs these processes may cause ALKALOSIS or ACIDOSIS.

CAUSES OF METABOLIC ACID-BASE DISORDERS



Examples :

- Loss of H+ in vomit
- Alkali ingestion
- Potassium deficiency

These three points cause ALKALOSIS .

- Impaired H+ excretion
- Increased H+ production or ingestion
- Loss of HCO_3^- in the kidneys

These three points cause ACIDOSIS .

→→ In general If the H^+ concentration increases the PH decreases, this causes acidosis and vice versa.

COMPENSATION

→ the body should compensate the deficiency that happened accordingly it may be **complete compensation** if brought back within normal limits OR **partial compensation** if range is still outside normal limits .

→we can know if the body reaches the complete compensation according to the PH value (the normal PH range in the blood is from 7.35 to 7.45 , the optimum PH value is 7.4 → which means that the normal values of PH are(7.4-0.05 ,7.4+0.05) in which 7.4 is the optimum one)) .

FULLY COMPENSATED

$$H^+(aq) + HCO_3^-(aq) \rightleftharpoons H_2CO_3(aq) \rightleftharpoons H_2O(l) + CO_2(g)$$

	pH	pCO_2	HCO_3^-
Resp. acidosis	Normal But<7.40	↑	↑
Resp. alkalosis	Normal but>7.40	↓	↓
Met. Acidosis	Normal but<7.40	↓	↓
Met. alkalosis	Normal but>7.40	↑	↑

Acid-Base Disorder	Primary Change	Compensatory Change
Respiratory acidosis	pCO_2 up	HCO_3^- up
Respiratory alkalosis	pCO_2 down	HCO_3^- down
Metabolic acidosis	HCO_3^- down	PCO_2 down
Metabolic alkalosis	HCO_3^- up	PCO_2 up

$$H^+(aq) + HCO_3^-(aq) \rightleftharpoons H_2CO_3(aq) \rightleftharpoons H_2O(l) + CO_2(g)$$

For further understanding:

→In the state of respiratory acidosis because of bronchopneumonia , the concentration of CO2 increases (primary change) , so the body tries to compensate and according to the equation above CO2 will react with H2O to form H2CO3 and this will dissociate to H+ and HCO3- which means the concentration of HCO3- will increase (compensation).

→In the state of respiratory alkalosis as we mentioned before the concentration of CO2 decreases (primary change) because of rapid breathing that's why the body tries to compensate the deficiency that happened (compensation) , from the equation above : The H+ will react with the bicarbonate ion in order to cover the decrease in CO2 and HCO3- concentration decreases .

→In the state of metabolic acidosis that's happened for example because of the loss of HCO3- (primary change) , as we mentioned above the body tries to compensate the deficiency and from the equation above because of low concentration of HCO3- ,CO2 production will decrease.(compensation) .

→ in the state of metabolic alkalosis that's happened for example: due to H^+ loss by vomiting, the reaction with HCO_3^- will decrease, as a result we will have high concentrations of HCO_3^- (primary change), and as we have learned the body tries to compensate the deficiency , so while vomiting it's difficult to get the CO_2 out of your body which means the concentration of CO_2 will be high and according to the equation above, CO_2 will react with water to form H_2CO_3 and this will dissociate to form H^+ and HCO_3^- (compensation) .

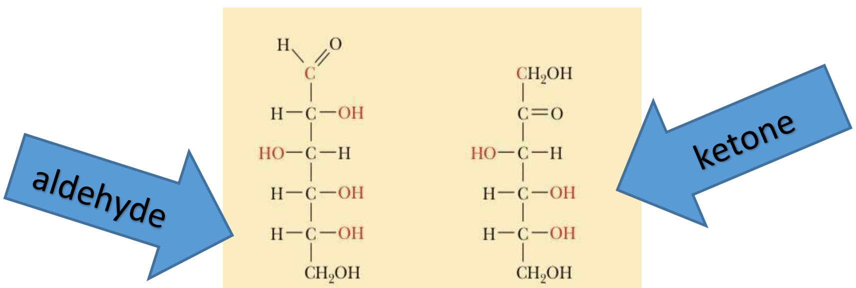
→ some comments about the tables in the previous page :
-->There is no difference in the primary changes and what happens in compensation in both tables, the only difference is that the compensation may be partial (the body tries to compensate the deficiency , but it cannot return the exact normal limits for PH) or complete one (the body brought back to the normal limits) .

→During compensation the equation goes forward or backward in order to return normal PH values, that leads to change in HCO_3^- and CO_2 concentration.

** يعني الجسم لما تتغير قيمة الرقم الهيدروجيني للأسباب المذكورة سابقًا التي تسبب اما
ALKALOSIS or ACIDOSIS يحاول الجسم ارجاع الرقم الهيدروجيني الي الوضع الطبيعي بتغير تركيز اما
CO_2 or HCO_3^-
والسير في المعادلة اما للأمام او للخلف
** ممكن الجسم مثلاً يعمل
Over breathing
او يقلل التنفس لتغيير التراكيز و ارجاع قيمة الرقم الهيدروجيني الى الوضع الطبيعي .

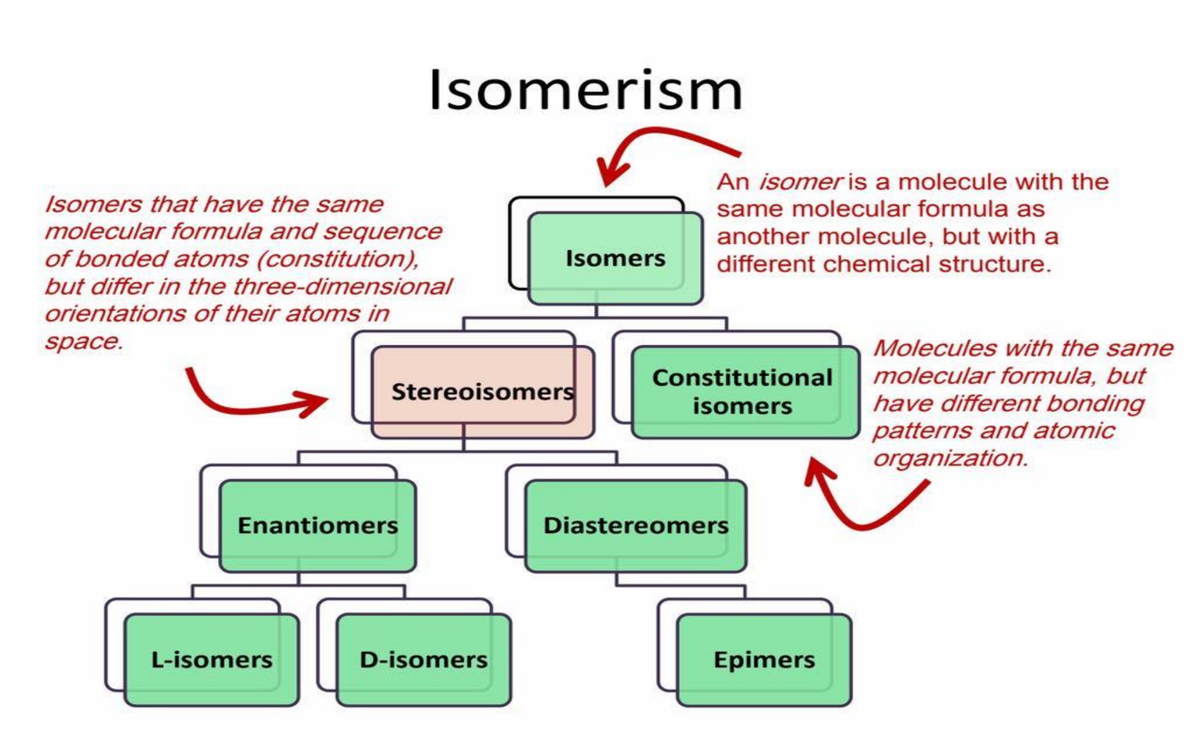
CARBOHYDRATES (SUGERS):

What does carbohydrates mean?
It means that each carbon binds with OH in one side and H on the other, that's why the carbohydrate molecule is defined as polyhydroxy molecule
→It may be polyhydroxy aldehyde or ketone.
→Any molecule that is a polyhydroxy aldehyde or ketone it is a carbohydrate molecule .



A polyhydroxy aldehyde is a molecule with carbon backbone chain with a carbonyl group on the endmost carbon atom, making it an aldehyde, and hydroxyl groups are

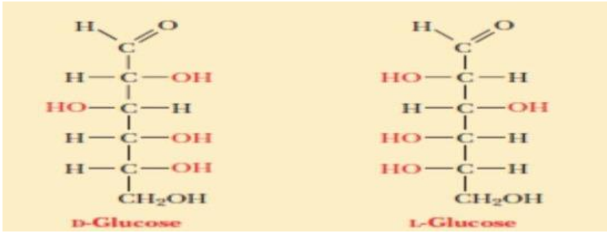
- connected to the rest carbon atoms. A polyhydroxy aldehyde can be distinguished from ketone , which has the carbonyl group away from the end of the molecule .



→stereoisomers are called geometric isomers .
→ Structural isomerism, or constitutional isomerism, is a type of isomerism in which isomers have the same molecular formula but with different arrangement of atoms within the molecule.

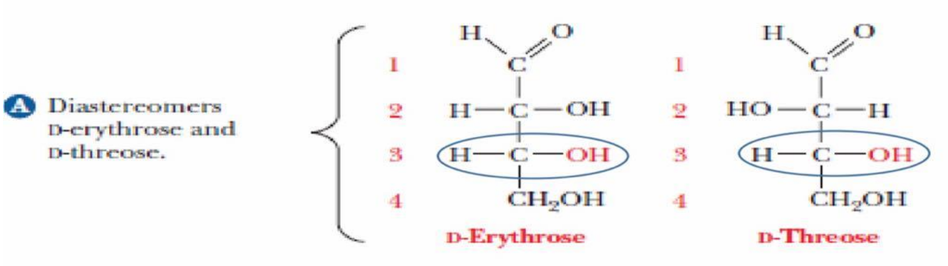
Constitutional isomers are compounds that have the same molecular formula and different connectivity. To determine whether two molecules are **constitutional isomers**, just count the number of each atom in both molecules and see how the atoms are arranged. If both molecules have the same number for **all** different atoms, **and** the atoms are arranged in different ways (their *connectivity* is different), the molecules will be constitutional isomers.

→Enantiomers: two molecules that are mirror images to each other
(non-supposable, much as one's left and right hands are mirror images of each other that cannot appear identical)



These two molecules are enantiomers , they have the same functional group , they are polyhydroxy aldehyde molecules , the OH group at C#3 on the left molecule is projecting to the left and the OH group at C#3 on the right molecule is projecting to the right ….. these two molecules are mirror images so they are enantiomers!

→If we have two molecules that have the same number and type of atoms with same functional groups , but they are not mirror images to each other → so we are talking about another type of stereoisomers which we call Diastereomers.



These two molecules are non-superimposable and non-mirror image stereoisomers, they are **Diastereomers**.

→Epimers: Diastereomers that differ from each other in configuration at **one** chiral carbon are called **epimers**.

Same as these two molecules above they are epimers, they only differ in C#2, so they are not mirror images of each other and they differ in only one carbon.

these two molecules are diastereomers, but it is better to say that they are epimers (since the change is only at one chiral carbon atom)!

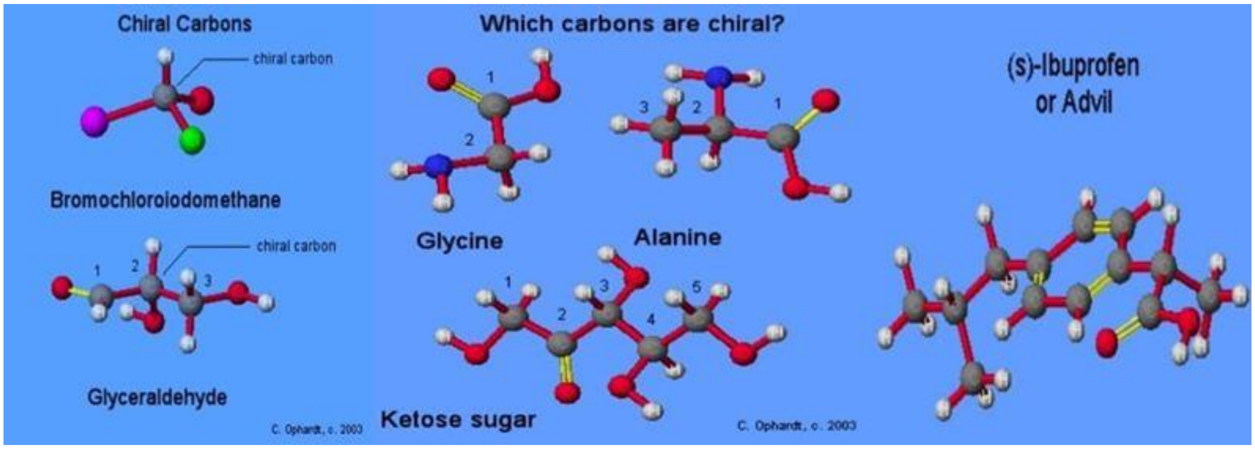
CHIRALITY:

Chiral carbon: means that the carbon atom binds to 4 different atoms or groups of atoms.

→If one of the bonds is a double bond, we lose the chirality.

→If the carbon atom binds to two similar groups or atoms, we lose the chirality.

In this state, we call the carbon atom an ACHIRAL carbon.



Glycine…..1&2 are achiral

Alanine…..1&3 achiral…..2 chiral

Glyceraldehyde….1&3 achiral…..2 chiral

Ketose sugar ….1&2&5 achiral…..3&4 chiral

Good Luck