ACID-BASE BALANCE & DISTURBANCES

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Advance Clinical Biochemistry I (MA 407)

Summer Semester

Lecture Four

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Outlines

- Objectives
- Introduction
- Acid-base balance
- pH scale and its important
- Maintenance of acid-base balance
- Buffering system in human body
- Acid-base disturbances
- Summary

Objectives

- At the end of the lesson, the students should be able to understand:

✓The importance of acid-base balance in the body

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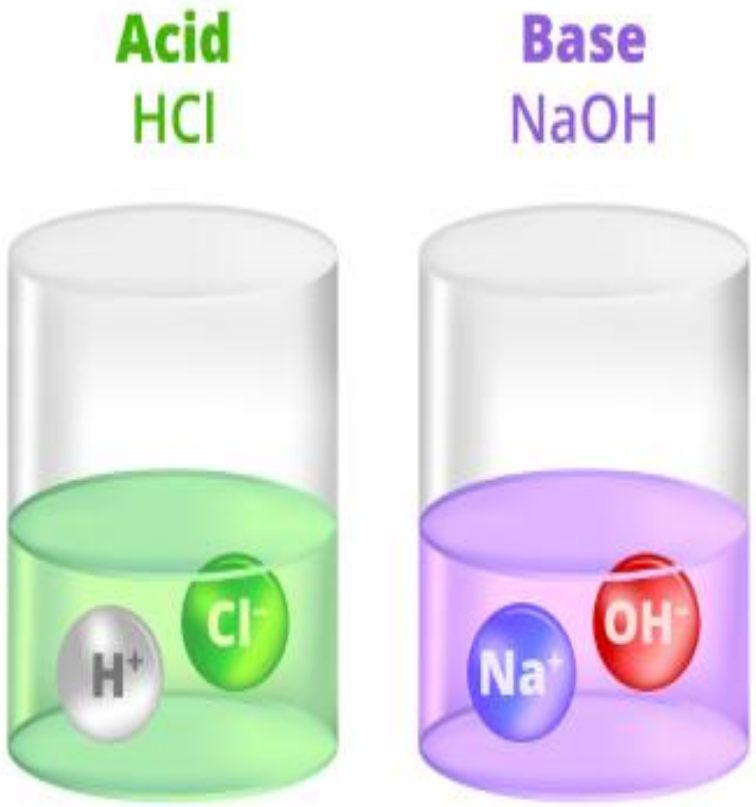
✓ The pH scale, pH values, and its Physiology significance.

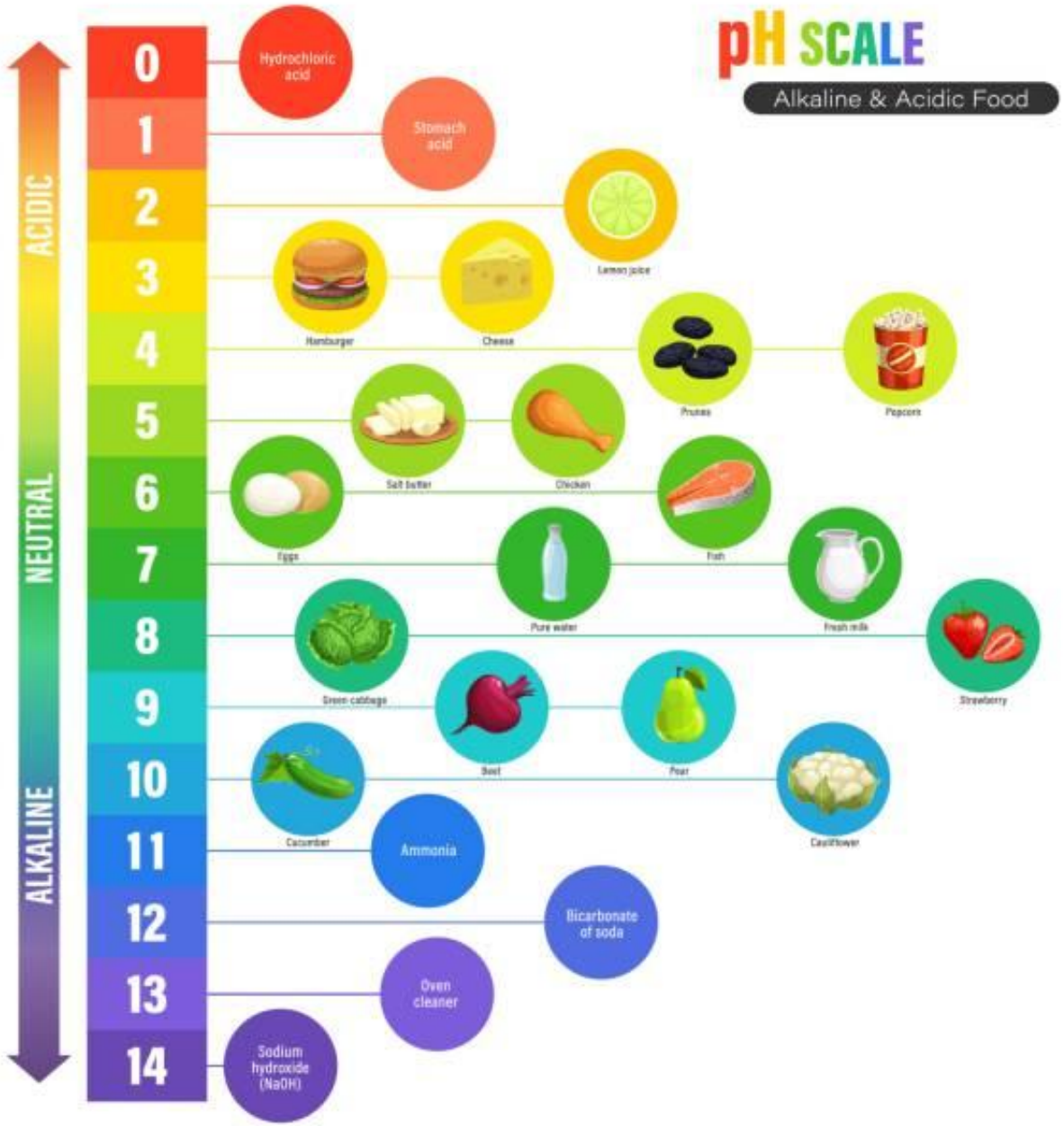
✓ The human body buffering system and its importance.

✓The conditions associated with acid-base imbalance (disturbances) and their implications.



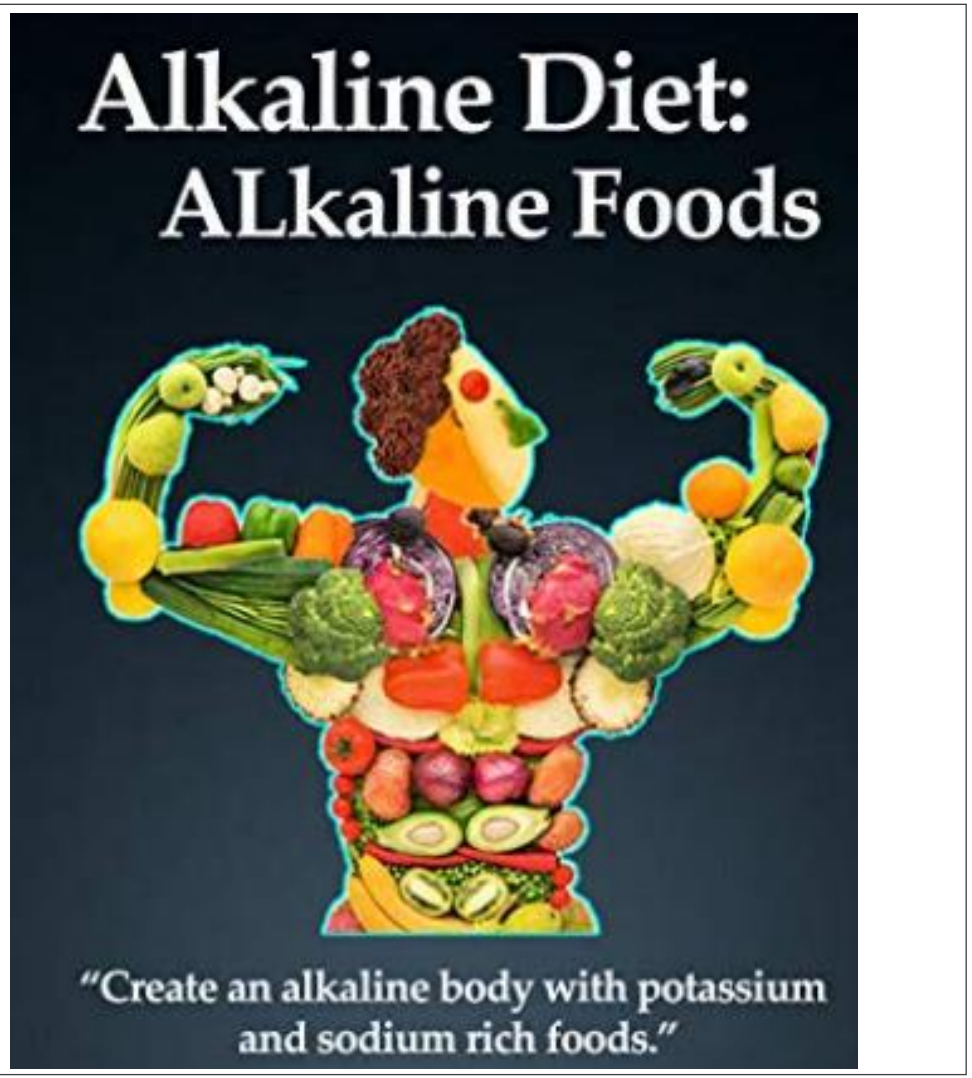
Introduction

- An acid is any hydrogen-containing substance that is capable of donating a proton (hydrogen ion) to another substance.
- A base is a molecule or ion able to accept a hydrogen ion from an acid.



Acid-base balance

- Is the process by which the body maintains a proper acid-base equilibrium.
- Your blood needs the right balance of acidic and basic (alkaline) compounds to function properly (This is called the acid-base balance).
- Your kidneys and lungs work to maintain the acid-base balance.



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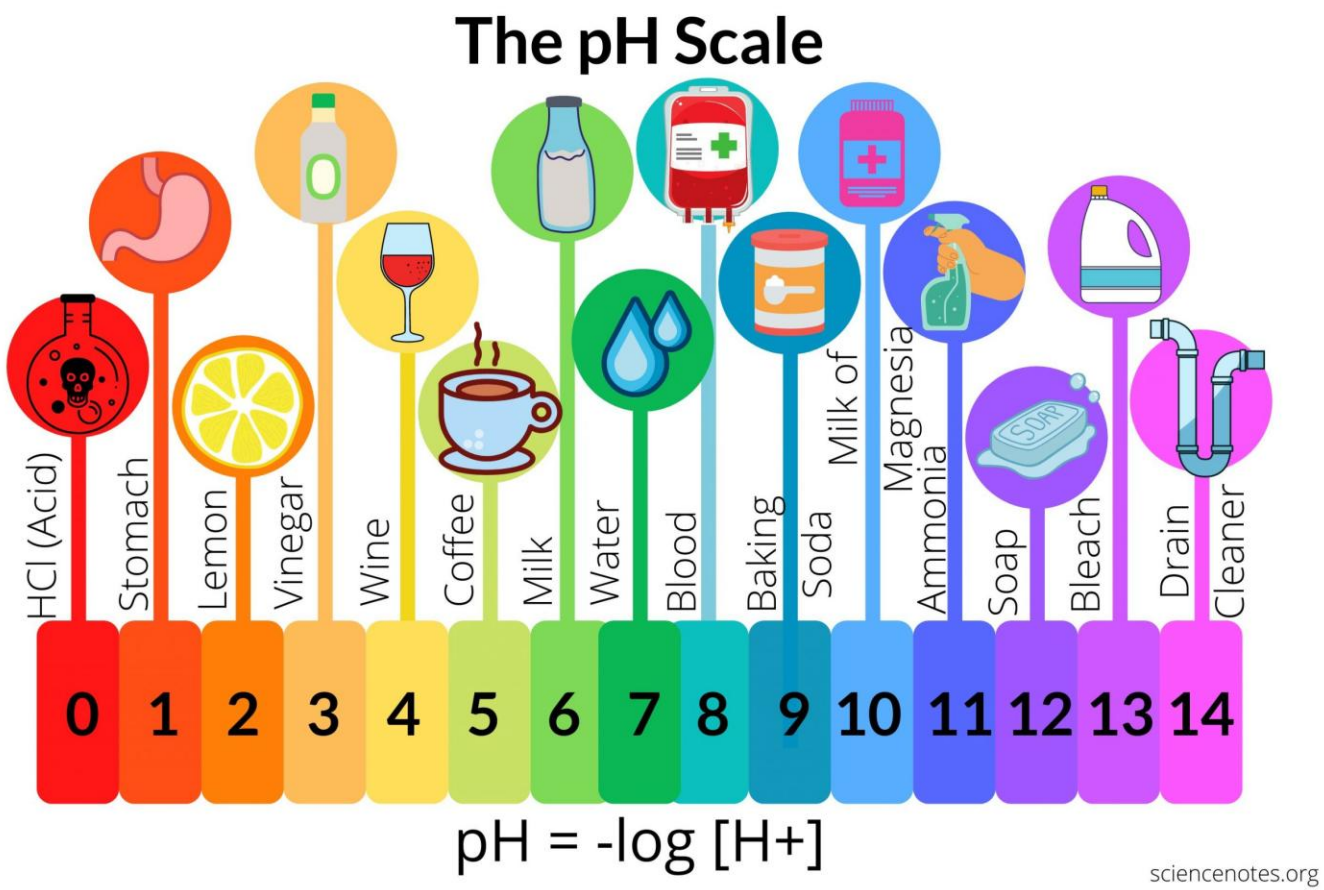
- Even slight variations from the normal range can have significant effects on the vital organs.

- Acid and alkaline levels are measured on a **pH scale which is the degree of acidity and alkalinity in the body**.

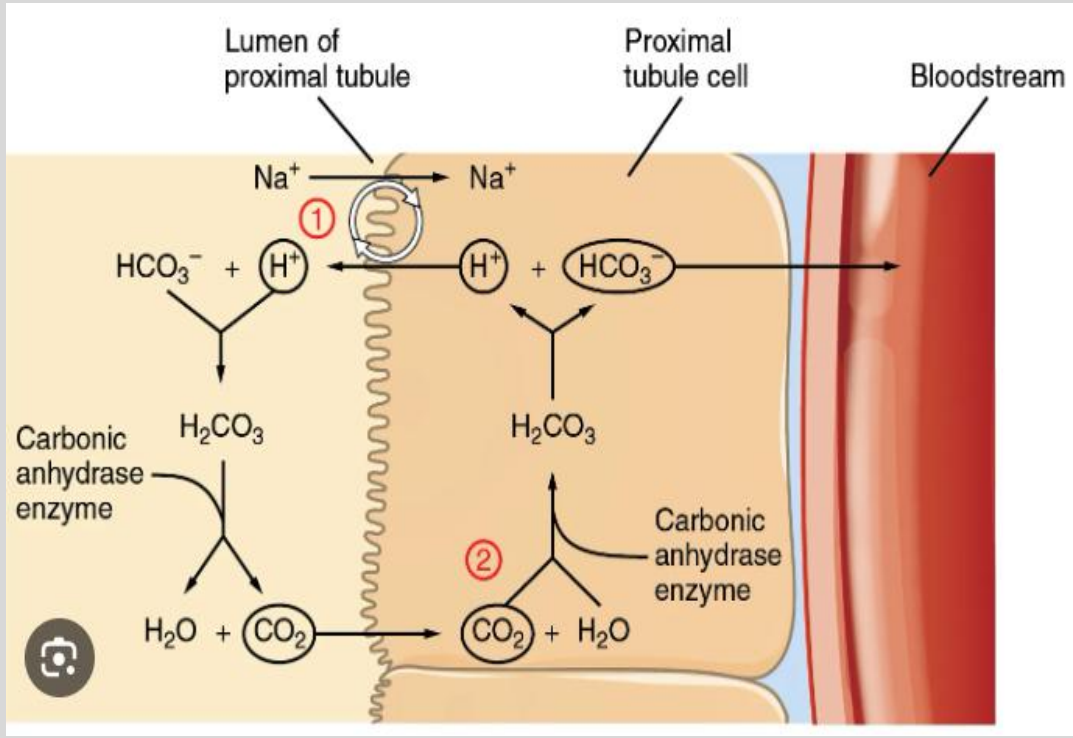


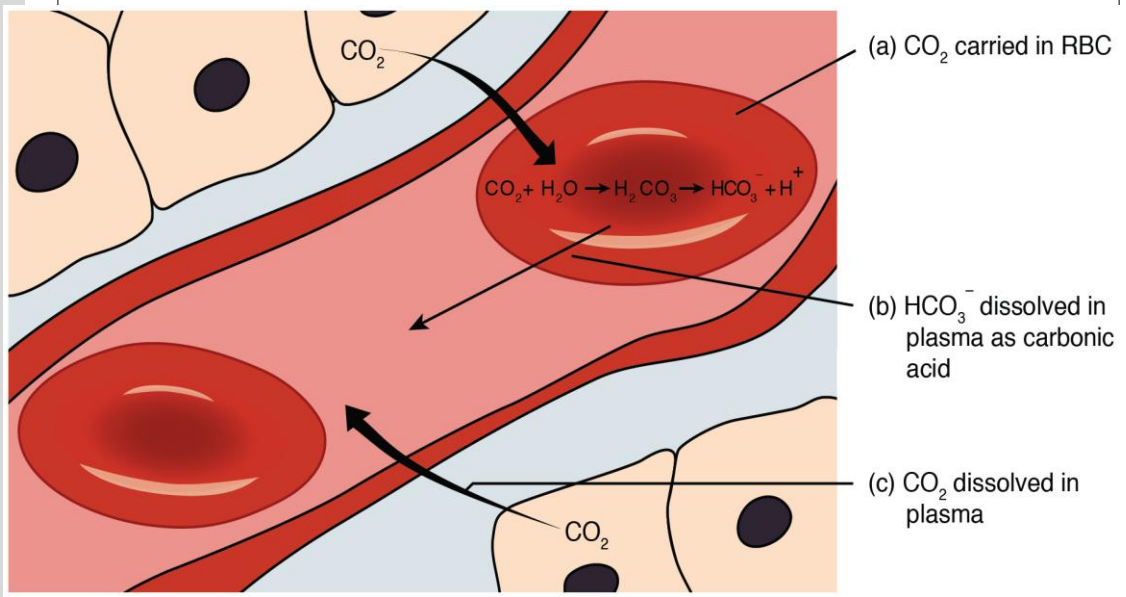
pH scale and important values

- Blood in the human body is typically slightly more alkaline than acidic.
- Normal body pH: 7.35 - 7.45
- Acidosis: low plasma pH
- Alkalosis: high plasma pH
- Acidemia: plasma pH < 7.35
- Alkalemia: plasma pH > 7.45 5.

Maintenance of Acid-Base Balance by the Body

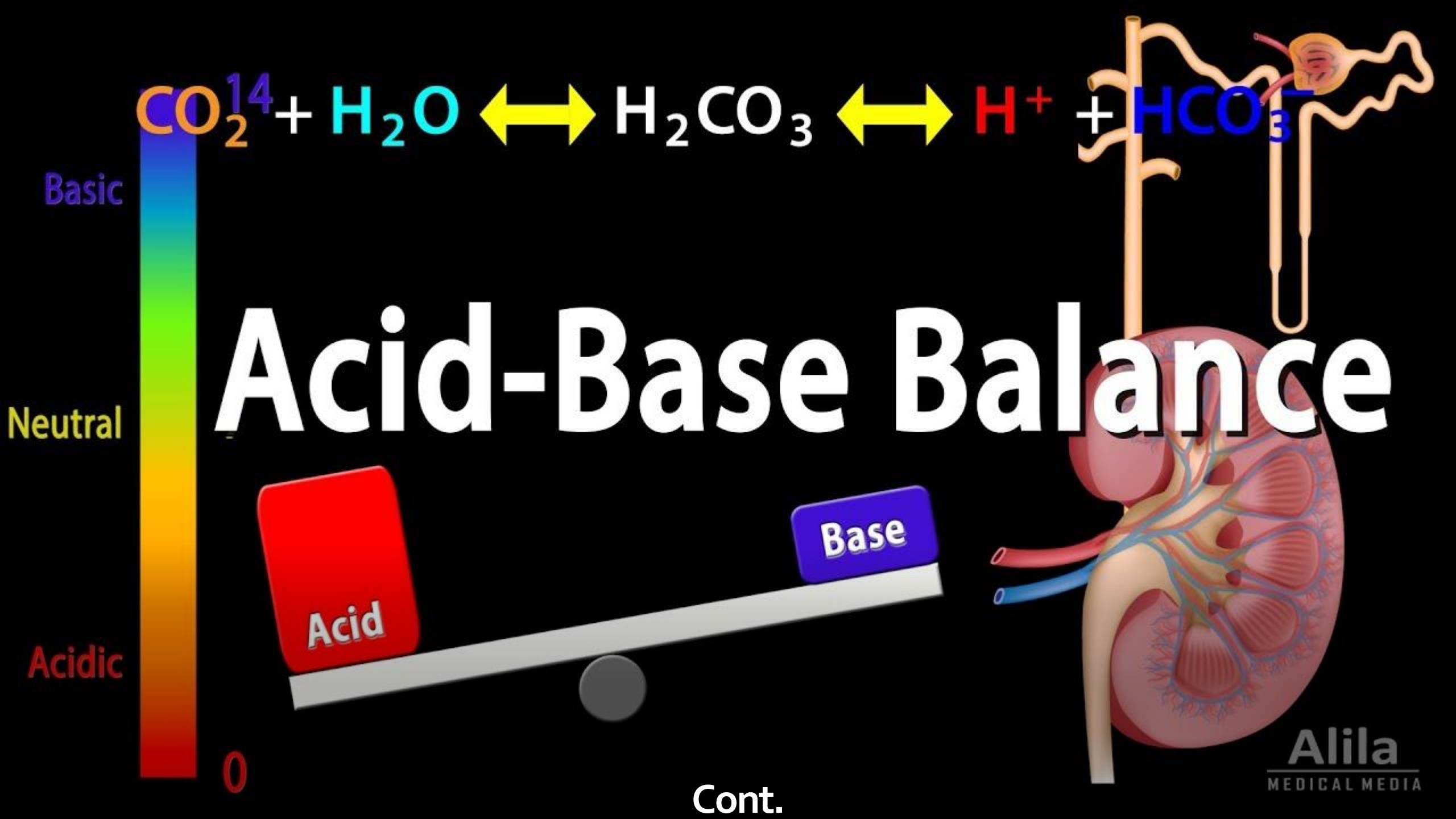
- This is referred to as maintenance of an adequate level of acid and base in blood.
- For the body to be in acid-base balance, the level of hydrogen ions must reach equilibrium.
- The kidneys maintain acid-base homeostasis by excreting hydrogen ions and generating bicarbonate.
- This phenomenon maintains blood plasma pH within the normal range.
- Which two body systems contribute to the acid-base balance of blood? **Respiratory, Excretory & Buffer Systems**



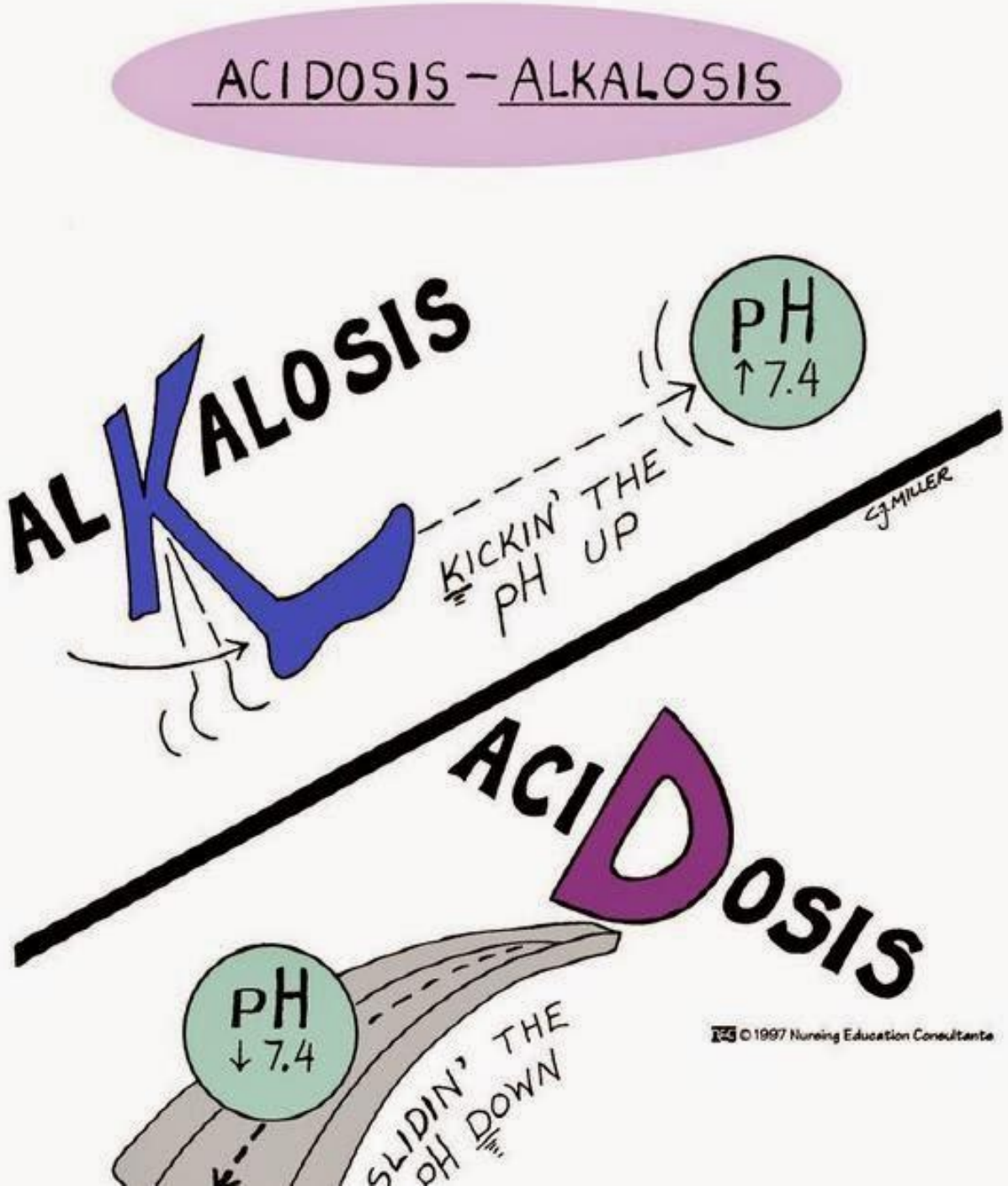


Buffering system in human body

- When any acidic substance enters the bloodstream, the bicarbonate ions neutralize the hydronium ions forming carbonic acid and water.
- Carbonic acid is already a component of the buffering system of blood.
- Thus, hydronium ions are removed, preventing the pH of blood from becoming acidic and vice vasa.


$CO_2^{14} + H_2O \leftrightarrow H_2CO_3 \leftrightarrow H^+ + HCO_3^-$
Basic
Neutral
Acidic
0
Acid-Base Balance
Acid
Base
Alila
MEDICAL MEDIA

Cont.



Acid-base Disturbances

- There are two types of abnormalities when it comes to maintaining acid-base balance:

- Acidosis
- Alkalosis

- **Acidosis** means that the blood has either too much acid or not enough bases, which results in a decreased pH.

- **Alkalosis** means that the blood has too many bases or not enough acids, which results in a decreased pH.

Acid-Base Disturbances

- **Respiratory** acidosis or alkalosis occurs when the lungs are removing too much or too little carbon dioxide due to a clinical condition of the lungs.

- **Metabolic** acidosis or alkalosis occurs when there is an imbalance in the production of acids or bases that results from a lack of excretion by the kidneys.

Four Acid-Base Disorders:

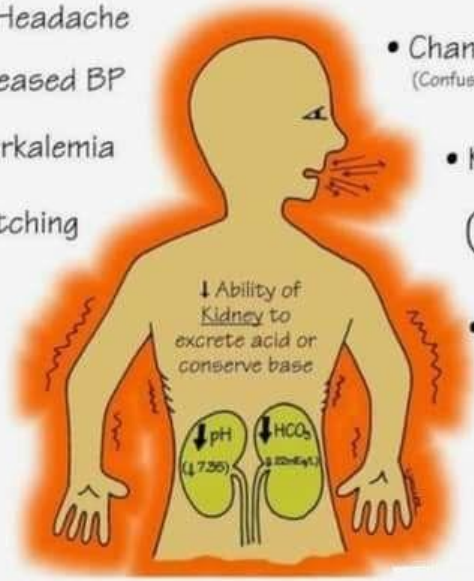
Respiratory

Metabolic

↑ CO_2	Acidosis
↓ CO_2	Alkalosis
↑ HCO_3^-	Alkalosis
↓ HCO_3^-	Acidosis

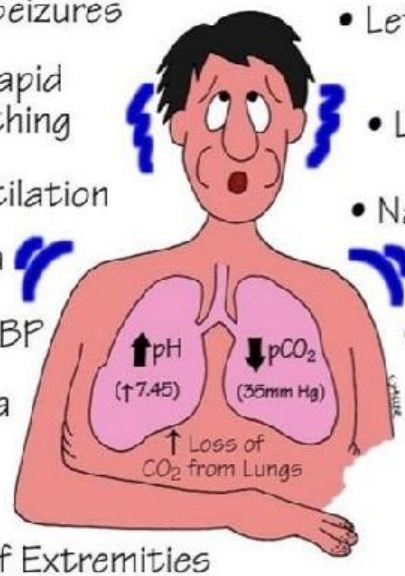
METABOLIC ACIDOSIS

- Headache
- Decreased BP
- Hyperkalemia
- Muscle Twitching
- Warm, Flushed Skin (Vasodilation)
- Nausea, Vomiting Diarrhea
- Changes in LOC (Confusion, ↑drowsiness)
- Kussmaul Respirations (Compensatory Hyperventilation)
- Causes: DKA, Severe Diarrhea, Renal Failure, Shock



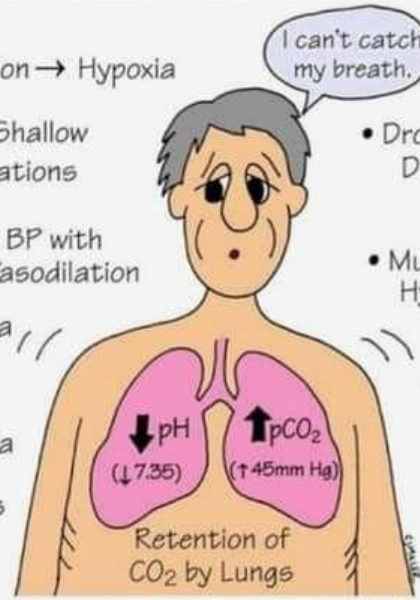
RESPIRATORY ALKALOSIS

- Seizures
- Deep, Rapid Breathing
- Hyperventilation
- Tachycardia
- ↓or Normal BP
- Hypokalemia
- Numbness & Tingling of Extremities
- Lethargy & Confusion
- Light Headedness
- Nausea, Vomiting
- Causes: Hyperventilation (Anxiety, PE, Fear), Mechanical Ventilation



RESPIRATORY ACIDOSIS

- Hypoventilation → Hypoxia
- Rapid, Shallow Respirations
- ↓BP with Vasodilation
- Dyspnea
- Headache
- Hyperkalemia
- Dysrhythmias (↑K)
- Drowsiness, Dizziness, Disorientation
- Muscle Weakness, Hyperreflexia
- Causes: ↓Respiratory Stimul (Anesthesia, Drug Overdose), COPD, Pneumonia, Atelectasis



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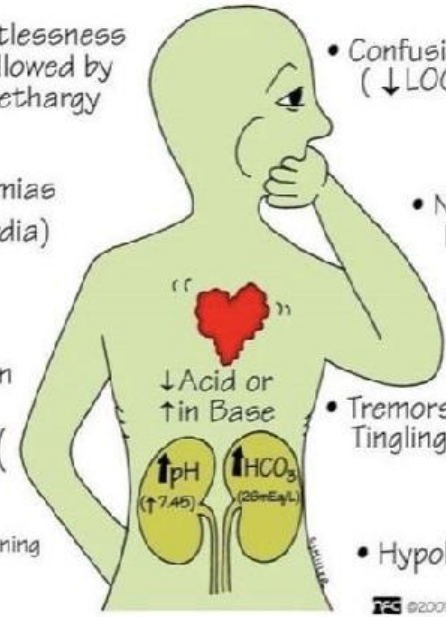
METABOLIC ALKALOSIS

- Restlessness Followed by Lethargy
- Dysrhythmias (Tachycardia)
- Compensatory Hypoventilation
- Causes: Severe Vomiting, Excessive GI Suctioning, Diuretics, Excessive $NaHCO_3$
- Confusion (↓LOC, Dizzy, Irritable)
- Nausea, Vomiting, Diarrhea
- Tremors, Muscle Cramps, Tingling of Fingers & Toes
- Hypokalemia



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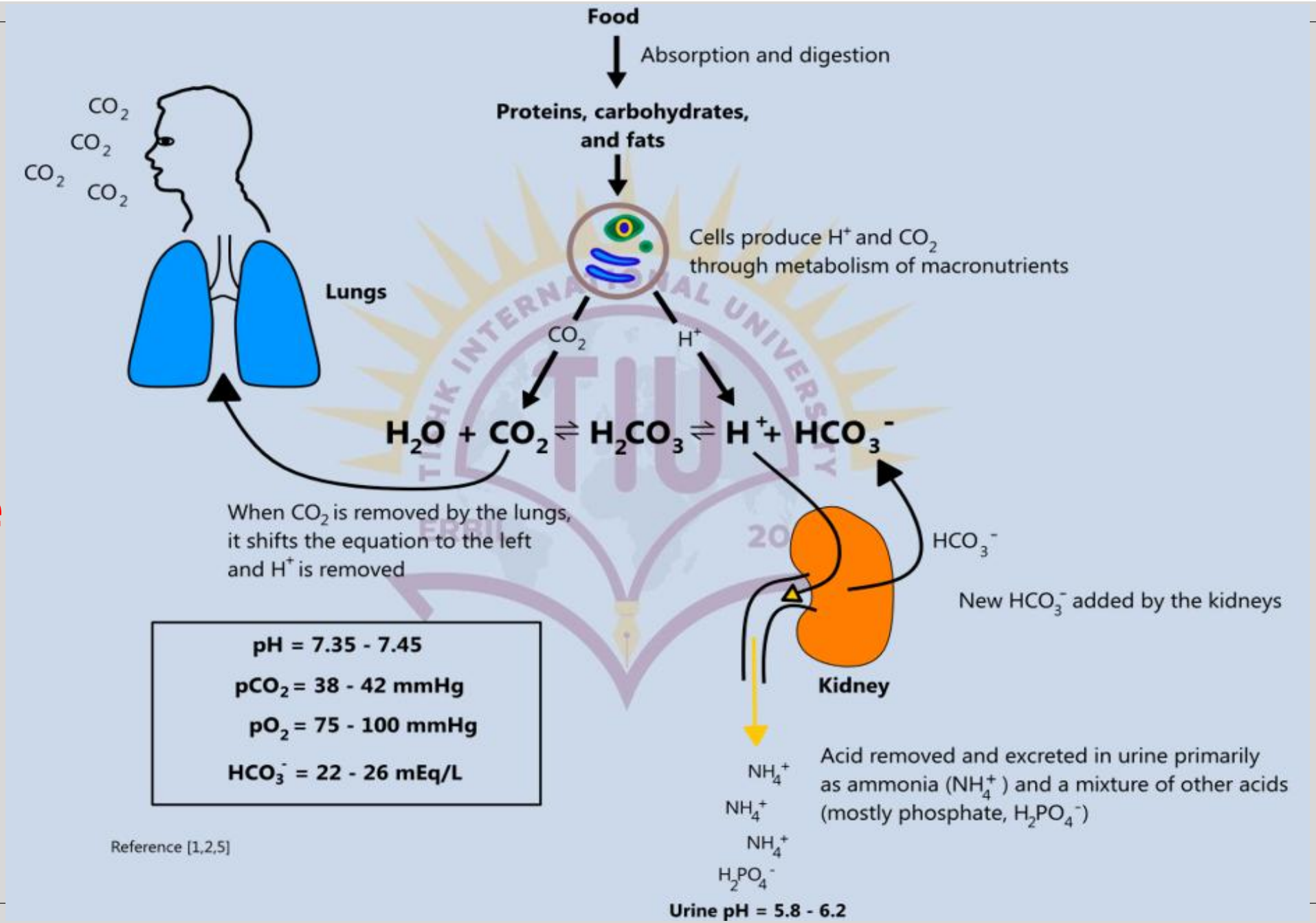
Scheme



Reference [1,2,5]

Next Lecture

Metabolic Diseases of GIT


Questions
Comments
Feedback