

## ACID AND BASE

### ✓ pH Scale:

The pH scale measures the acidity or basicity of a solution, ranging from 0 to 14

- **pH < 7:** Acidic
- **pH = 7:** Neutral (like pure water)
- **pH > 7:** Basic (alkaline)

### ✓ Acids:

**Definition:** Acids are substances that donate protons (H<sup>+</sup> ions) when dissolved in water.

### ✓ Bases:

**Definition:** Bases are substances that donate hydroxide ions (OH<sup>-</sup>) when dissolved in water.

### ✓ Strong Acids and base

**Definition:** Strong acids or base completely dissociate into water.

### ✓ Weak Acids and base

**Definition:** Weak acids or base only partially dissociate in water

## Blood pH

- The pH of human blood typically ranges between 7.35 and 7.45, making it slightly alkaline.
- Maintaining this narrow pH range is crucial for proper bodily functions. Any significant deviation can lead to serious health issues:
- Acidosis: Blood pH below 7.35 (too acidic).
- Alkalosis: Blood pH above 7.45 (too alkaline).
- The body regulates blood pH through mechanisms involving the lungs, kidneys, and buffer systems.

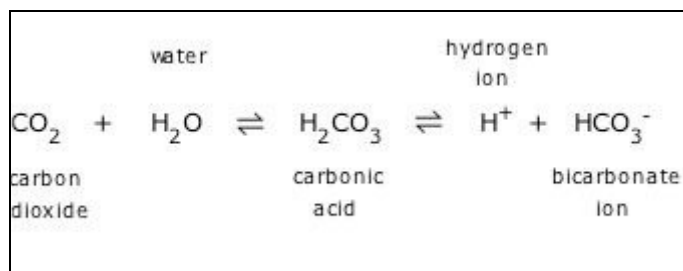
### ✓ Homeostatic Mechanism

The state of steady internal physical and chemical conditions maintained by living systems.

### Sources of acid and base

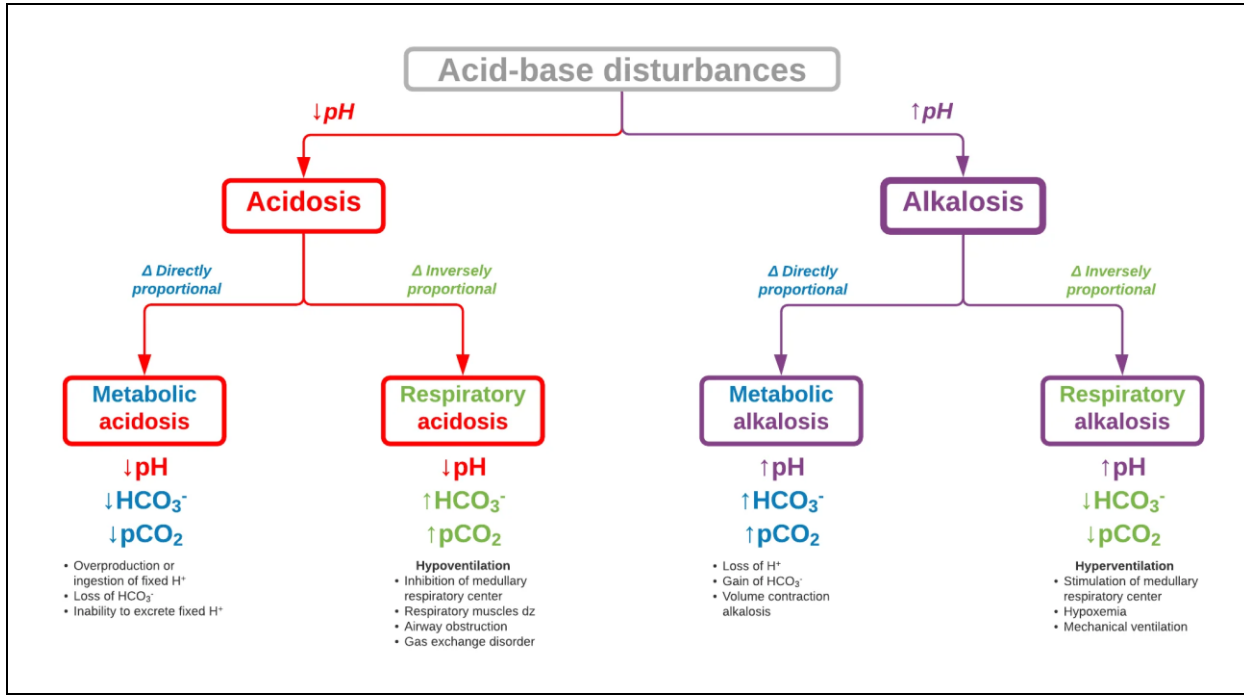
- **Acid:** Metabolism of Carbohydrates, Fats, and Proteins (H<sup>+</sup>) and Oxidation CO<sub>2</sub>.
- **Base :** Metabolism and Cellular Activity

### ✓ Balance of Acidosis and Alkalosis



✓ **Imbalance of Acidosis and Alkalosis**

Acidosis and alkalosis are conditions caused by an imbalance in the body's acid-base levels, disrupting the normal pH of the blood.

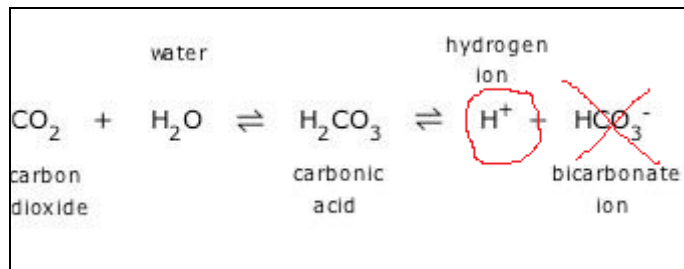


**1. Acidosis:**

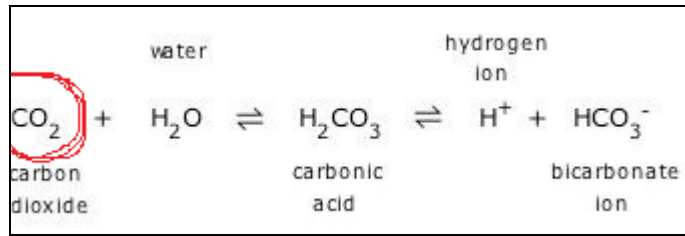
Definition: A condition where the blood pH *drops below 7.35*, making it too acidic.

✓ **Types:**

- **Metabolic Acidosis:** Caused by an increase in acid or a loss of bicarbonate due to conditions like kidney failure, diabetic or severe diarrhea.



- **Respiratory Acidosis:** Caused by the accumulation of CO<sub>2</sub> due to impaired lung function (e.g., chronic obstructive pulmonary disease, asthma).



✓ **Symptoms:**

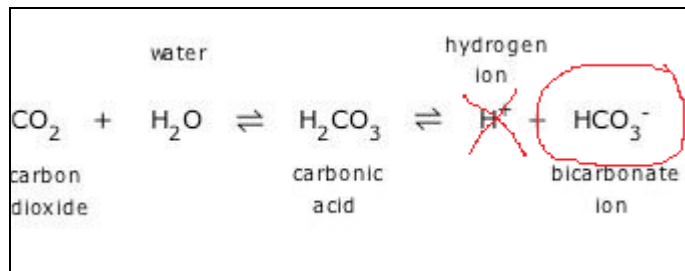
- Fatigue, confusion
- Shortness of breath
- Increased heart rate
- Headaches

**2. Alkalosis:**

Definition: A condition where the blood pH rises above 7.45, making it too alkaline.

✓ **Types:**

- **Metabolic Alkalosis:** Caused by a loss of acid or excessive bicarbonate due to vomiting, diuretic use, or overuse of antacids.



- **Respiratory Alkalosis:** Caused by excessive loss of CO<sub>2</sub> due to hyperventilation (e.g., anxiety, high altitude).

✓ **Symptoms:**

- Muscle twitching, cramps
- Dizziness, lightheadedness
- Numbness or tingling
- Confusion

**Consequences:**

- Acidosis: Severe cases can lead to shock, coma and even death if untreated.
- Alkalosis: Severe cases can cause arrhythmias, muscle spasms and convulsions.

### **Compensation and Treatment:**

- The body attempts to compensate for these imbalances through respiratory adjustments or kidney function.
- Medical treatment may involve addressing the underlying cause, administering IV fluids or medications to correct pH levels.

Examples of test results associated with the four main acidosis and alkalosis conditions are provided in this table.

<b>pH</b>	<b>Bicarbonate</b>	<b>Carbon Dioxide (PCO<sub>2</sub>)</b>	<b>Condition</b>
Low	Low	Low	Metabolic acidosis
High	High	High	Metabolic alkalosis
Low	High	High	Respiratory acidosis
High	Low	Low	Respiratory alkalosis

## **Anion gap**

The **anion gap** is a value calculated from the results of an electrolyte blood test and is used to help identify the cause of metabolic acidosis, a condition in which the blood is too acidic.

### **Anion Gap Formula:**

Anion Gap Formula:  $(\text{Na}^+ + \text{K}^+) - (\text{Cl}^- + \text{HCO}_3^-)$

Where:

- $[\text{Na}^+]$ : Sodium concentration
- $[\text{Cl}^-]$ : Chloride concentration
- $[\text{HCO}_3^-]$ : Bicarbonate concentration

### **Normal Anion Gap:**

- The normal range is usually between **8 to 12 mEq/L** (can vary slightly depending on the laboratory).

### **Types of Metabolic Acidosis Based on Anion Gap:**

#### ✓ **High Anion Gap Metabolic Acidosis:**

Occurs when there is an increase in unmeasured anions (e.g., lactate, ketones).

**Causes:**

- Diabetic ketoacidosis (DKA)
- Lactic acidosis
- Renal failure

Toxic ingestions (e.g., methanol, ethylene glycol)

#### ✓ **Normal Anion Gap (Hyperchloremic) Metabolic Acidosis:**

Occurs when bicarbonate is lost and replaced by chloride, keeping the gap normal.

**Causes:**

- Diarrhea
- Renal tubular acidosis
- Excessive administration of saline

## **Clinical Significance:**

- **High Anion Gap:** Indicates the presence of additional acids in the blood, suggesting underlying conditions like kidney failure or ingestion of toxic substances.
- **Normal Anion Gap:** Typically indicates a loss of bicarbonate without the accumulation of unmeasured acids.

The anion gap is a key diagnostic tool in assessing the cause and type of metabolic acidosis, guiding further treatment and investigation.