

Elements in the Human Body

For Pre-Health Students!

Carbon, hydrogen, oxygen, and nitrogen (CHON) are the most common elements in life forms.

Carbon in particular is amazing in that it loves to form four bonds with other atoms. It and hydrogen are found as the backbone structure of essentially all biomolecules.

PHOSPHORUS, usually in the form of the large ion PHOSPHATE:

- is part of the bones and teeth (in the form called hydroxyapatite crystals) - along with phosphates
- Forms the “phosphate backbone” of DNA and RNA
- Is found in adenosine “di” phosphate (so 2 of them) and adenosine “tri” phosphate (3 of them)
- Is found in all biological membranes (phospholipid bilayer). Phosphates are hydrophilic (like water)

CALCIUM

- is part of the bones and teeth (in the form called hydroxyapatite crystals) - along with phosphates
- Enters axon terminals and causes neurotransmitters to be released
- Causes muscle contraction inside of muscle cells
- Is an important component in blood-clotting

NITROGEN

- Nitrogenous bases form the “rungs” of DNA and RNA
- Is found in the adenosine part of ADP and ATP
- Is found in all amino acids, which link together to form proteins
- Is found in the nitrogenous wastes urea and creatinine, which are both excreted by the kidneys

ELECTROLYTES - charged elements (also usually classified as minerals)

- Na^+ , K^+ , Cl^- , Mg^{++} , Ca^{++}
- Extracellular Ions:
 - Na^+ : 135 - 145 mEq/L
 - Hyponatremia: too much Na^+ in the blood
 - Hyponatremia: not enough Na^+ in the blood
 - K^+ : 3 - 5 mEq/L
 - Hyperkalemia: too much K^+ in the blood
 - Hypokalemia: not enough K^+ in the blood
- Intracellular Ions:
 - Na^+ : 12mEq/L
 - K^+ : 140-150 mEq/L

ION MOVEMENT IN and OUT of CELLS

- Na^+ moves INTO cells down its concentration gradient
 - This depolarizes, excites, makes the cell more positive and likely to “act”
- K^+ moves OUT of cells down its concentration gradient
 - This repolarizes, deactivates, makes the cell less positive and less likely to “act”
- The Na^+/K^+ ATPase pump restores the concentration gradients and returns the Na^+ outside of the cell and the K^+ inside the cell
 - This requires a LOT of ATP!

- 3 Na⁺ pumped out and 2 K⁺ pumped in. So the inside of the cell is relatively negative to the outside of the cell.

ACIDOSIS/ALKALOSIS

- Acidosis: blood pH < 7.35
- Alkalosis: blood pH > 7.45
- When there is more carbon dioxide in the blood, it is more ACIDIC. When there is LESS carbon dioxide in the blood, it is more ALKALINE. We can adjust our breathing to adjust our blood pH!
- Respiratory acidosis is caused by lung dysfunction,
 - such as pneumonia. The lungs don't get rid of enough carbon dioxide.
- Respiratory alkalosis is caused by
 - hyperventilation, when the lungs blow off too much carbon dioxide.
- Metabolic acidosis is caused by cells or tissues in the body (other than the lungs) that generate too much acid, or can't rid of enough acid.
 - Excessive diarrhea can cause too much HCO₃⁻ loss from the body and lead to acidosis
- Metabolic alkalosis is caused by loss of acids from the body, as may occur in
 - Excessive vomiting, when too much HCl is lost from the body and can lead to alkalosis