

Basic Chemistry

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Basic Chemistry

- We need to understand some general chemical principles because our body is made of different chemicals.
- The food we eat, water we drink, digestion of food are all chemical reactions.

Basic Chemistry

- Matter: anything that occupies space and has weight.
- Three states:
 - Solid: has definite shape and volume
Ex. Bones
 - Liquid: takes the shape of or conforms to whatever container it is in.
Ex. Blood, Saliva
 - Gas: no shape or volume
Ex. Air

Basic Chemistry

- Matter can undergo physical and chemical change.

Example: Eating a meal

Chewing breaks the food into smaller pieces
(Physical Change)

Digestive enzymes change food into simpler
substances (Chemical Change)

Basic Chemistry

- All matter is composed of elements
- An element is a fundamental substance that can not be broken into a simpler form by ordinary chemical reactions.
- Elements are made up of atoms

Basic Chemistry

- There are four elements that make up 96% of the body weight:
 - O- Oxygen
 - C- Carbon
 - H- Hydrogen
 - N- Nitrogen

Basic Chemistry

- Trace Elements are present in small amounts but are essential for life.

Ca- Calcium

P- Phosphorus

K- Potassium

S- Sulfur

Na- Sodium

Cl- Chloride

Mg- Magnesium

Fe- Iron

I- Iodine

Cr- Chromium

Co- Cobalt

Cu- Copper

F- Fluorine

Se- Selenium

Zn- Zinc

Basic Chemistry

- Elements are made of atoms.
- An ion is an atom that is electrically charged.
 - Cations: positive charge
 - Anion: negative charge

Basic Chemistry

- Common Cations:

Na^+ - Sodium - fluid balance & muscle and nerve function

Ca^{2+} - Calcium - Component of bones & teeth, blood clotting, muscle contraction

Fe^{2+} - Iron – component of hemoglobin

Basic Chemistry

- Common Cations:

H^+ - Hydrogen – acid base balance

K^+ - Pottassuim – nerve & muscle function

NH_4^+ - Ammonuim – acid base balance

Basic Chemistry

- Common Anions:

Cl^- - Chloride- part of digestive secretions

HCO_3^- - Bicarbonate – acid base balance

PO_4^{3-} Phosphate - component of bones and teeth:
component of ATP (adenosine triphosphate)
energy

Basic Chemistry

- Molecules: are formed when two or more of the same atoms combine
 - Two atoms of oxygen combine to form O_2
- Compounds contain molecules formed by two or more different atoms
 - Two hydrogen atoms combined with one oxygen atom form H_2O or water

Basic Chemistry

- Important Compounds and Molecules
 - Water:
 - Most abundant compound
 - 2/3 of adult body weight
 - Essential for life, we can only survive a few days without water

Basic Chemistry

- Water:
 - Universal Solvent: most substances dissolve in water allowing substance to move faster and easier
 - Temperature regulator: water can absorb large amounts of heat (produced by muscles) without the temperature of the water itself increasing

Basic Chemistry

- Lubricant: most bodily fluids contain water i.e. mucus, synovial fluid
- Chemical reactions: water plays crucial role. H₂O necessary for break down of carbohydrates and building of proteins
- Protective Device: CSF surrounds and protects brain & spinal cord, amniotic fluid surrounds fetus

Basic Chemistry

- Oxygen
 - 21% of the air we breath
 - Essential for life
 - Utilized by every cell
 - Energy that powers body
- Carbon Dioxide
 - Form of waste product of the body
 - Must be eliminated from the body

Basic Chemistry

- Chemical reactions: atoms of molecules interact to form new chemical combinations
 - Example: $C_6H_{12}O_6$ (glucose) + H_2O (water) \rightarrow CO_2 carbon dioxide + H_2O (water) + energy
- Most chemical reactions are slow process

Basic Chemistry

- Catalyst are chemical substances that help speed up the rate of chemical reactions
- When a catalyst is a protein substance it is called an enzyme

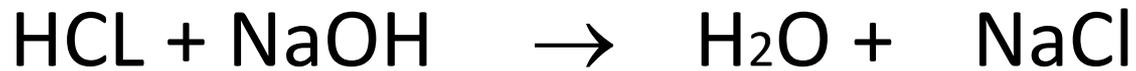
Basic Chemistry

- Acid and Base
 - Many substances in the body are classified as acids and bases (many as a result of chemical reactions)
 - A balance between acid and base is required for normal body function
 - Acid: sour taste, can be strong enough to burn
 - Base: bitter taste, slippery like soap

Basic Chemistry

- H^+ - Hydrogen ion—is an acid—determines the acidity of a solution
- OH^- - hydroxyl—is a base—is a hydrogen ion eliminator so it makes a solution less acidic
- When an acid & base mix neutralization occurs

Basic Chemistry



hydrogen + sodium → water + sodium
chloride hydroxide chloride



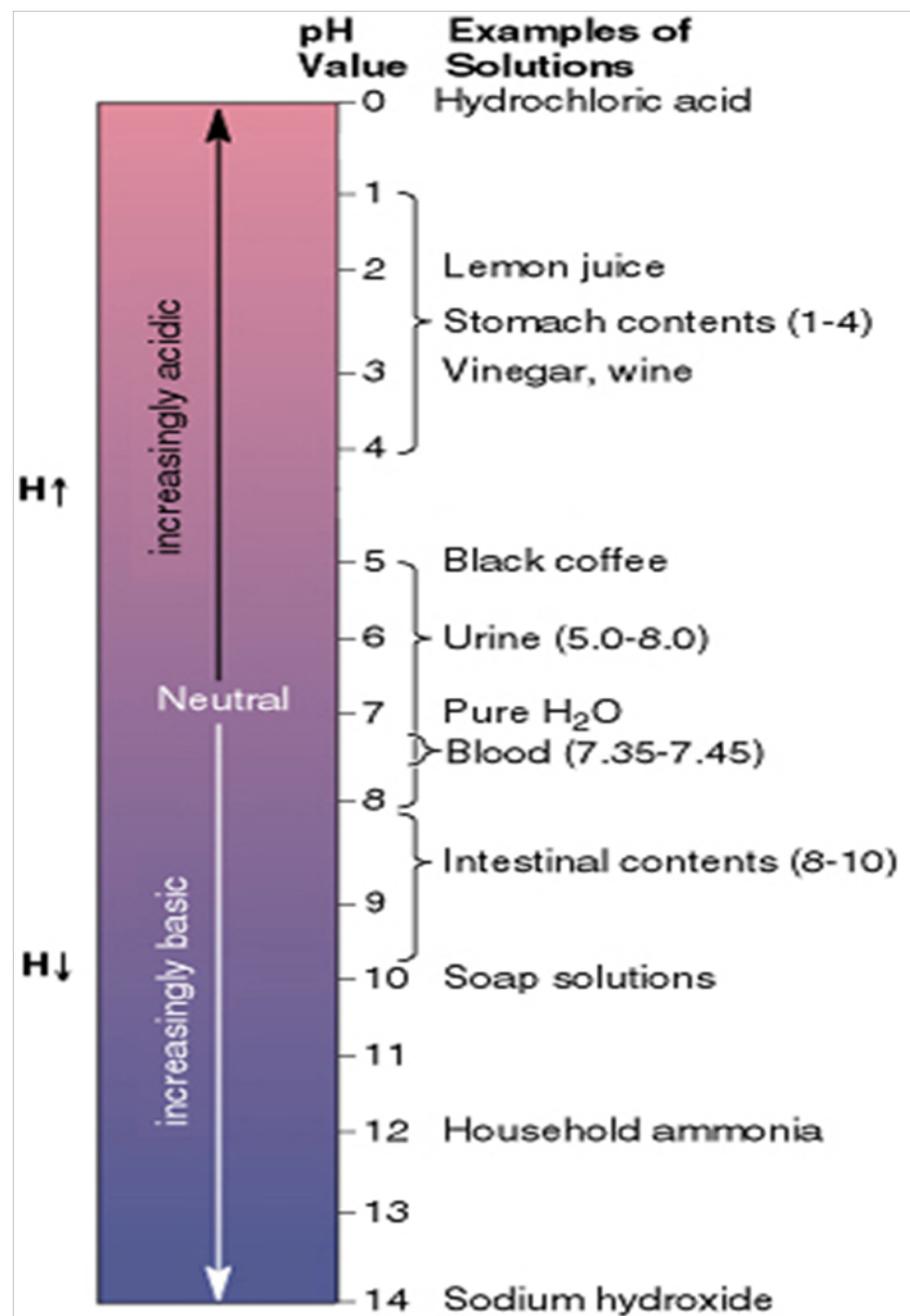
water + salt

Basic Chemistry

- Acid and base is measured by the pH scale.

0←7→14

- 7 – neutral; pure H₂O
- less than 7 – acid; stomach content, vaginal secretions, urine
- greater than 7- alkaline; intestinal contents, blood



Basic Chemistry

- Body functions best when blood remains at normal pH 7.35 – 7.45
 - Too acidic → Acidosis
 - Too basic → Alkalosis
- Serious clinical problems occur with acid base imbalance & must be corrected immediately
- pH is regulated on a minute to minute basis by a buffer system: the lungs & kidneys

Basic Chemistry

- Energy: the ability to do work
 - Body requires constant supply of energy
i.e. nerve impulses to travel, heart to beat
- Six forms:
 1. Mechanical- energy that causes movement
i.e. running, walking → energy to muscles
 2. Chemical- stored energy in chemical bonds
i.e. Fuel to do work such as walking
 3. Electrical: energy released from the movement of charged particles
i.e. Nerve transmission

Basic Chemistry

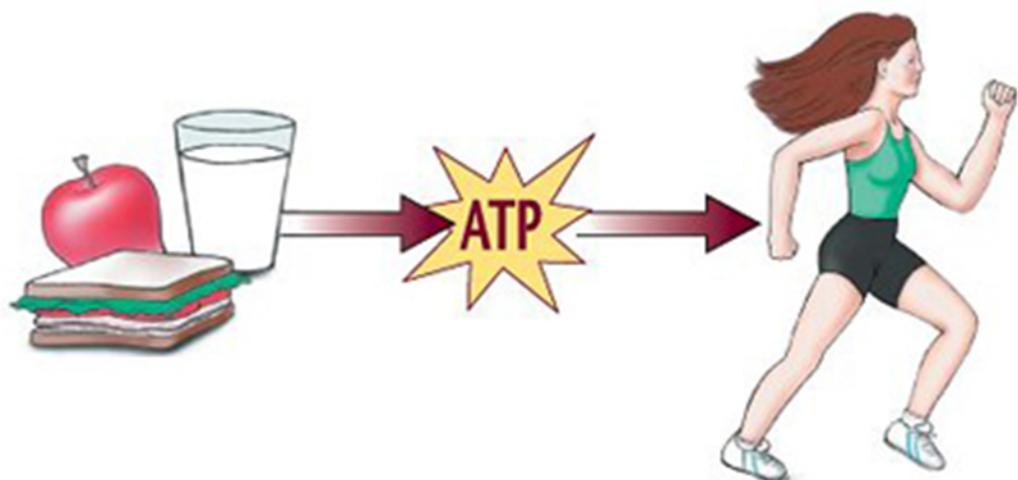
- Six Forms:
 4. Radiant: energy that travels in waves
 - i.e. Light stimulates vision or UV light causes tanning
 5. Thermal: energy transferred due to temperature difference
 - responsible for body temp
 6. Nuclear: energy released during decay of radioactive substances
 - i.e. Not in body but seen in diagnostic studies

Basic Chemistry

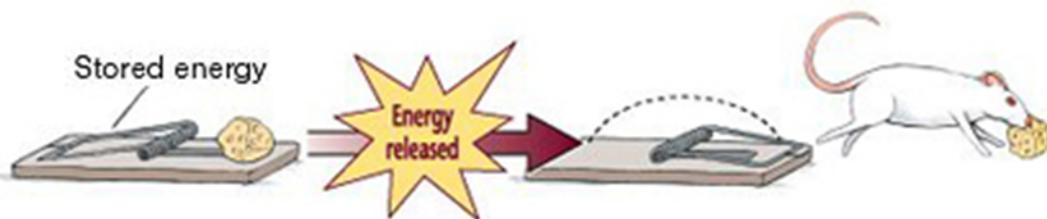
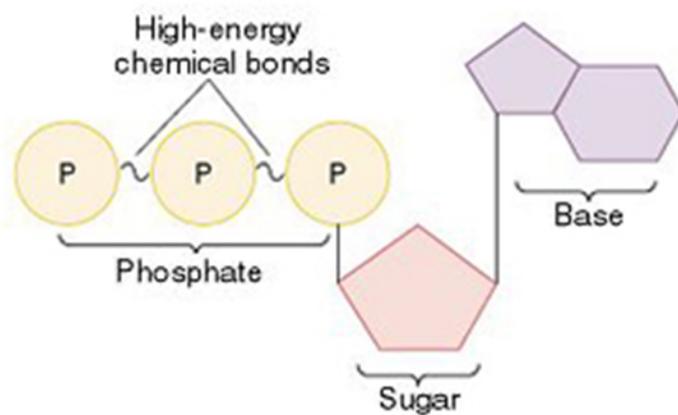
- Energy can be transferred from one form to another in the body.
i.e. Glucose → used by muscles during exercise (chemical energy stored in the muscle is converted to mechanical energy) → heat is released (thermal energy) → body temperature regulation

Basic Chemistry

- Energy comes from food we eat
- As the food breaks down, energy is released
- This energy needs to be converted ATP
- ATP (adenosine triphosphate) has three parts: a base, a sugar, and three triphosphate
- Energy released from ATP can be used directly by the cell.



Structure of ATP:



Basic Chemistry

- Mixtures, Solutions, & Suspension
 - Mixture: Combination of two or more substances that can be separated by ordinary physical means and retain their original properties
 - Solution are mixtures. Particles remain evenly distributed.
Two parts:
 - Solute: substance in smaller amount being dissolved
 - Solvent: larger part of solution that does the dissolving
 - Solutions are always clear and solute does not settle

Basic Chemistry

- Solutions:
 - Aqueous: water is solvent
 - Tincture: alcohol is solvent
- Suspensions are mixtures.
 - Particles are large and settle at the bottom
 - Mix but do not dissolve but mix
 - Colloidal suspension: such small particles they remain suspended
 - Colloid: gel like substance, ie. Blood plasma