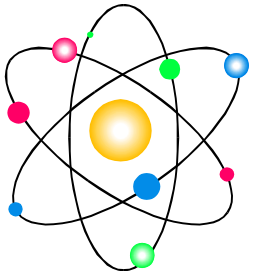
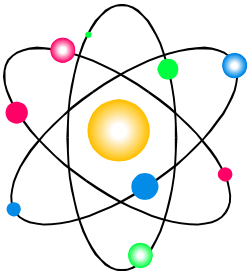




BRIEF REVISION OF CHEMISTRY TERMS

Atom

- The building block of matter
- There are more than 100 different types of atoms known, as shown in the Periodic Table. Only 92 are naturally-occurring with hydrogen as the lightest and uranium as the heaviest of these.
- The most common atoms on earth are are carbon (C), hydrogen (H), oxygen (O), nitrogen (N), phosphorus (P) and sulphur (S).

Ion

- A charged atom
- If an atom loses an electron/s, it becomes a positively-charged ion (e.g. hydrogen ions are H^{+}).
- If an atom gains an electron/s, it becomes a negatively-charged ion (e.g. oxygen ions are O^{2+}).

Element

- A substance composed of only one type of atom (e.g. gold Au)

Compound

- A substance composed of more than one type of atom (e.g. water H_2O)

Molecule

- The smallest particle of an element or a compound

Acid

- A compound containing hydrogen ions
- Has a pH less than 7 (7 is neutral e.g. water)
- Sour taste
- Changes blue litmus paper to a red colour
- Examples of acids in living organisms are: vinegar (acetic acid), lactic acid (from sour milk), sweat, urine

Base or Alkali

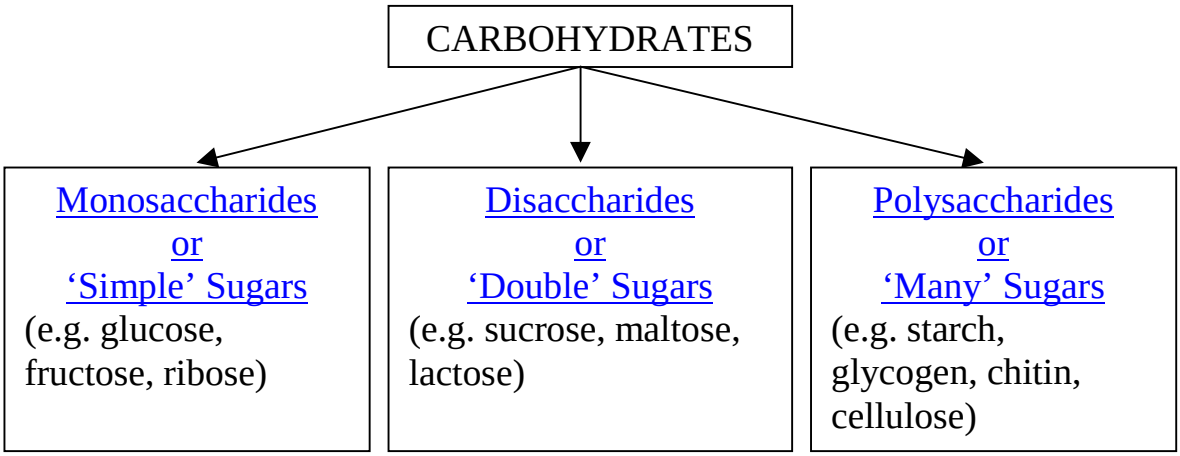
- A compound that neutralises an acid
- Has a pH more than 7
- Soapy feel
- Changes red litmus paper to a blue colour
- Example of a base in a living organism is blood

ORGANIC MACROMOLECULES

- Organic compounds are those that contain carbon (e.g. carbohydrates, lipids, proteins, nucleic acids).
- For example, a piece of human liver contains 80% water, 12% protein, 5% fats, 2% nucleic acids, 1% carbohydrate and less than 1% of other substances.

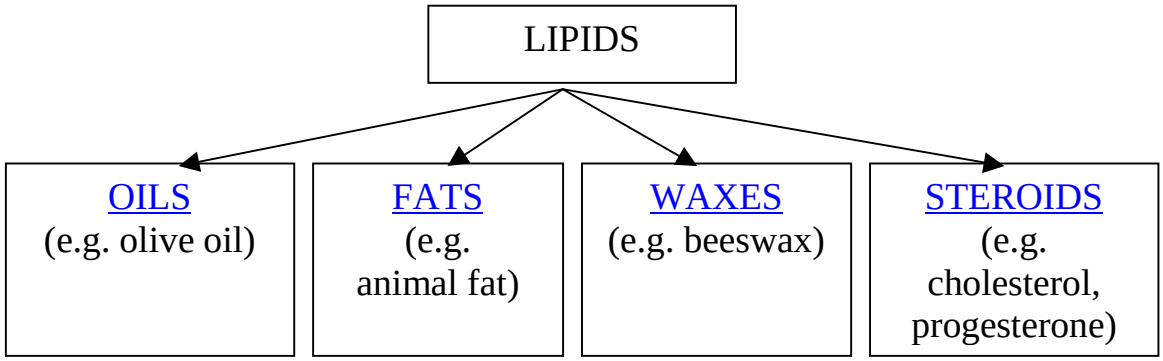
- Many organic molecules are assembled from small repeated units. Proteins are macromolecules made from amino acids, nucleic acids are made from nucleotides, carbohydrates are made from monosaccharides or simple sugars, and lipids are made from fatty acids and glycerol.
- Carbohydrates, proteins and nucleic acids are generally large macromolecules, whereas lipids are smaller.
- The formation of macromolecules usually involves a reaction where water is lost.

CARBOHYDRATES

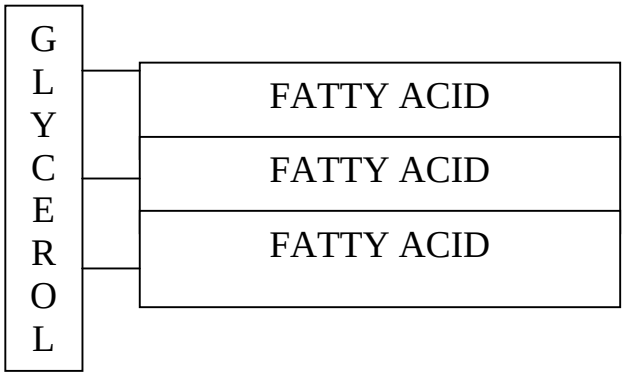


- Carbohydrates contain carbon, hydrogen and oxygen atoms with the ratio of hydrogen atoms to oxygen atoms in the ratio of 2 hydrogen atoms to 1 oxygen atoms (2H:1O) such as in sucrose or table sugar $C_{12}H_{22}O_{11}$.
- Carbohydrates are a ready source of energy.
- All carbohydrates are built up from monosaccharides or simple sugars, which can be formed in photosynthesis. During digestion, carbohydrates are mostly broken down to monosaccharides. Sugar in animals is transported in the form of the monosaccharide, glucose.
- An example of the formation of a disaccharide or 'double sugar' is:
  Glucose + Glucose $\longrightarrow$ Sucrose + Water
  $C_6H_{12}O_6 + C_6H_{12}O_6 \longrightarrow C_{12}H_{22}O_{11} + H_2O$
- Polysaccharides or 'many sugars' differ in their chemical structure. Animals cannot digest cellulose, and store their carbohydrates as glycogen. Plants use cellulose as a major component in cell walls. Chitin is a major component of the exoskeleton of insects and crabs.

LIPIDS (FATS AND OILS)



- Lipids contain carbon, hydrogen and oxygen atoms, but contain much less oxygen than carbohydrates.
- Lipids are hydrophobic ('water-hating' or insoluble in water).
- Functions of lipids are:
  1. Long-term energy storage, providing 6 times as much energy as carbohydrates
  2. Lipids and proteins are the major structural components of cell membranes
  3. Insulation e.g. whale blubber



- Lipids are made of 1 glycerol molecule (an alcohol) and 3 different fatty acid molecules, and are often called triglycerides. Human digestive enzymes break down lipids to fatty acids and glycerol in digestion.

PROTEINS (POLYPEPTIDES)

- Proteins contain carbon, hydrogen, oxygen, nitrogen, and usually sulphur or phosphorus atoms.
- Proteins are macromolecules that consist of long, unbranched chains of amino acids. These chains may contain about 20 up to hundreds of amino acids. An example of the size of proteins is the red pigment in red blood cells called haemoglobin with the chemical formula –
  $C_{3032}\ H_{4816}\ O_{872}\ N_{780}\ S_8\ Fe_4$
- Each cell contains hundreds of different proteins, and each kind of cell has some proteins that are unique to it. Plant or animal species that are closely related by evolution have proteins that are very similar. Their proteins will differ considerably from those of a distantly related species.
- There are about 20 different amino acids, that can be arranged in billions of ways to make long-chain proteins.
- Not all proteins contain all of the possible amino acids.
- Proteins are broken down by digestive enzymes to amino acids, and then these amino acids are reassembled to form different proteins (e.g. muscle, hormones).
- About 12 of the amino acids can be synthesised by the human body (in ribosomes), but 8 amino acids cannot be made by the body. These 8 must be included in the diet, and are called essential amino acids.
- 5 Functions of Proteins:
  1. Supporting structure (e.g. cell membranes)
  2. Metabolism (e.g. enzymes)
  3. Immune defence (e.g. antibodies)
  4. Body regulation (e.g. hormones)
  5. Last resort energy source after carbohydrates and lipids

- Proteins may also be completely broken down to form the nitrogenous wastes of urea and uric acid (in human urine and sweat) or ammonia (in other animals).
- 3 Main types of proteins:
  1. Fibrous Proteins – structural proteins that resemble coiled springs (e.g. keratin in hair, collagen in skin, myosin in muscle)
  2. Globular Proteins – functional proteins that have irregular shapes (e.g. enzymes, hormones, antibodies)
  3. Conjugated Proteins – composed of both protein and non-protein parts (e.g. lipoproteins in cell membranes, nucleoproteins in the cell nucleus)

NUCLEIC ACIDS (DNA and RNA)

2 Types of Nucleic Acids

1. DNA or Deoxyribonucleic Acid forms the genes, and is found only in the nucleus of cells
2. RNA or Ribonucleic Acid is found in the nucleus, ribosomes, and some other parts of the cell such as mitochondria and chloroplasts

Nucleotides

- Nucleic acids consist of a large number of nucleotides joined to form long, unbranched chains.
- Each nucleotide is made of 3 parts:
  1. a nitrogen-containing base (adenine, guanine, cytosine, thymine or uracil)
  2. a phosphate group
  3. a sugar (ribose or deoxyribose)

Complementary Nitrogen Bases

- The nitrogen bases are of 2 types:
  1. Purines (adenine and guanine)
  2. Pyrimidines (cytosine, and thymine or uracil)

Structure of DNA

- DNA is composed of 2 long strands of nucleotides that are twisted around each other into a double spiral helix shape.
- The nitrogen bases of DNA are adenine and guanine, and cytosine and thymine.
- The sugar of DNA is deoxyribose (ribose with one less oxygen atom).
- The order of nitrogen bases is the complement of each other on the 2 strands.

Structure of RNA

- RNA is composed of one strand of nucleotides in different shapes.
- The nitrogen bases of RNA are adenine and guanine, and cytosine and uracil.
- The sugar of RNA is ribose.
- There are 3 types of RNA:
- 1.Messenger RNA (mRNA)
- 2. Transfer RNA (tRNA)
- 3.Ribosomal RNA (rRNA)

Refer to the diagrams of DNA and RNA structures in your textbook.