Background Chemistry

protons
neutrons
electrons
nucleus
orbit
ionic
covalent
salts
share
transfer

Atoms of elements have various numbers of protons (+), neutrons (neutral) and electrons (-).

Protons and neutrons are found in the nucleus of the atom. Electrons are found in orbit around the outside of the nucleus.

In an ionic bond, the oppositely charged ions are attracted to each other.

The compounds formed from this type of reaction are generally called ionic/salts.

When two or more non-metal elements share electrons so that each atom can have access to a full outer shell of electrons then a covalent bond is formed.

Water:

In water, each hydrogen atom is bonded with a single covalent bond. Oxygen is a larger atom than hydrogen, the shared pair of electrons end up spending more time around the oxygen atom than the hydrogen. (unequal sharing)

polar
covalent
negative
positive
hydrogen bond
Proteins
DNA

The oxygen in water has a slight negative charge, and the hydrogens have a slight + charge. A water molecule is a polar molecule.

When two water molecules are near each other, they form a hydrogen bond

In DNA, it is hydrogen bonds that holds the two sides of the twisted ladder together in its helical shape.

Proteins are folded chains of amino acids, and hydrogen bonds are responsible for maintaining certain folds of proteins. Without a very specific fold, a protein (enzyme) may become inactive.

Properties of water that benefit life.

Ions
thermoregulator
cohesive
solvent
lubricants

1. Water is the universal solvent for polar (charged) molecules and helps chemical reactions within our bodies. Ions would not form like Na^+ or Cl^- ions if not dissolved in water.
2. Water molecules are cohesive or 'sticky', and therefore liquids fill vessels, such as blood vessels. Water is an excellent transport medium. Water's cohesiveness also makes it a suitable component of lubricant for epithelial tissues (gut lining) as well as inbetween joints.
3. It has a very high specific heat capacity, and therefore prevents drastic temperature changes. It is an ideal thermoregulator.
4. Water has a high heat of vaporization due to the energy needed to break all of the hydrogen bonds. When one sweats (sweat is mostly water) a large amount of body heat is required to evaporate that sweat. Heat loss = keeping cool.

The major categories of Biological molecules are:

- Carbs
- Proteins
- Nucleic Acids
- Lipids

Complete the following chart.

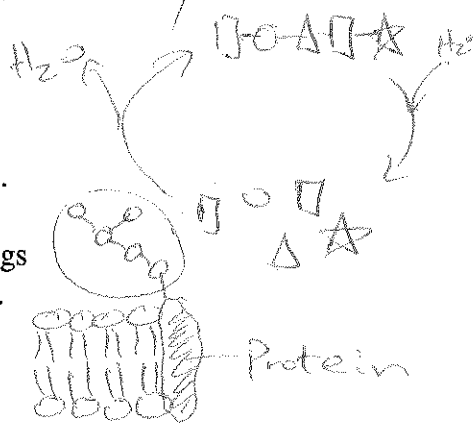
Nucleotide
Carbohydrates
Nucleic Acids
Monosaccharide
Proteins
Lipids
hydrolysis
condensation
synthesis

Polymer	*Monomer*
Carbohydrate	monosaccharide
Proteins	Amino acid
Nucleic Acid	nucleotides

Monomers join together to make polymers through a condensation synthesis reaction.

aka: dehydration synthesis

Polymers can break down into their monomers through a hydrolysis reaction.



Carbohydrates

adhere
structural
storage
recognition
CH_2O
$C_6H_{12}O_6$
polysaccharides
monosaccharides
disaccharides
lactose
maltose
sucrose
glycogen
starch
cellulose
glycosidic
liver
muscle

Functions

- for quick and short-term energy storage in all organisms.
- have structural function in plants, bacteria and insects.
- have cell recognition roles as in the A, B, O blood groupings
- The glycocalyx also help cells adhere to each other.

Structure

- CH_2O is the empirical formula for a carbohydrate
- $C_6H_{12}O_6$ is the structural or molecular formula for glucose.

- Simple carbohydrates include the monosacc and the disaccharides.
- Complete the following table

Monosaccharides	**Disaccharides**
glucose	maltose (glucose + glucose)
fructose	sucrose (glucose + fructose)
galactose	lactose (glucose + galactose)

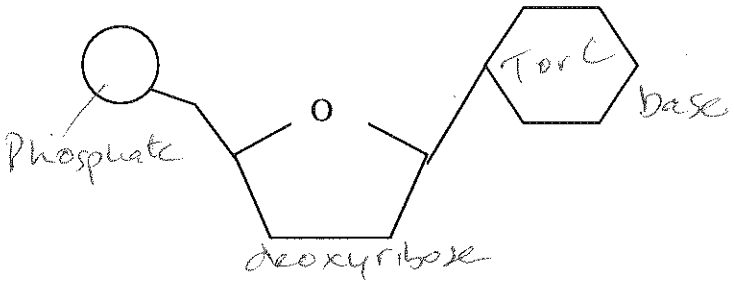
- Complex carbohydrates (aka: polysaccharides) are polymers and are made up of many monoasaccharides joined together.
- Starch is a storage form of glucose in plants. There is some side branching so.
- Glycogen is a storage form of glucose in animals. It has considerably more side branching than starch molecules.
- Cellulose is a structural polysaccharide found in plant cell walls. Cellulose is also long chains of glucose monomers, but every second glycosidic bond is invertedjoining monomers is upside down.

Nucleic Acids

Structure

pentose sugar
double helix
phosphate group
nitrogenous
pyrimidines
purines
deoxyribose
complimentary
rungs
single
C
U
A
Thymine
Uracil
ribose

- DNA (Deoxyribonucleic Acid) has a double helix shape
- A nucleotide has three parts:
  - A pentose sugar ring: deoxyribose
  - A phosphate gr: PO_4
  - 1 of 4 nitrogenous bases (ie. they raise pH):
    - The purines, guanine (G) and adenine (A), are double ring bases
    - The pyrimidines thymine(T) and cytosine (C), are single ring bases
- Label the following diagram with the three parts listed above



- The deoxyribose and the P group make up the sides of the ladder while the bases point inwards to make up the rungs of the ladder.

- The bases on opposite strands always pair accordingly:
  - G always pairs with C with three hydrogen bonds
  - A always pairs with T with two hydrogen bonds

  This is complimentary **base pairing**.

DNA replication - must cover

- RNA (Ribonucleic Acid) is also a sequence of nucleotides with the following differences from DNA (see table 2.3 pg. 41)
  - it is usually single stranded
  - it is not helical
  - it uses ribose sugar instead of deoxyribose
  - there is no T in RNA. Uracil is used instead

Functions

code
transferRNA
ribosomal RNA
messenger RNA
RNA
adenosine triphosphate
glucose
three
phosphate groups
adenosine diphosphate

- The sequence of the bases in a DNA molecule provide the code for the amino acid sequences of all proteins made in cells.
- RNA is a copy of one strand of an unzipped DNA molecule and can have 1 of 3 different functions in eukaryotic cells.
  - rRNA becomes a ribosome subunit out in the cytoplasm
  - mRNA delivers the genetic code from nucleus to the ribosome
  - tRNA picks up amino acids in the cytoplasm and brings them to ribosomes. transfers

(ATP) aka: Adenosine triphosphate $5

- referred to as the "energy currency of cells".
- a nucleotide with deoxyribose, adenine and 3 phosphate groups
- mitochondria makes ATP from glucose

- energy is stored between the 2nd and the 3rd phosphates; when hydrolyzed to make ADP and inorganic phosphate the energy released is used for many cell processes such as:
  - macromolecule synthesis
  - muscle contraction
  - conduction of nerve impulses
  - membrane channel operation

PO_4