

Summary of week 2

The nature of Biological molecules

The chemistry of living organisms –

Based overwhelmingly on the element carbon called organic chemistry.

Depends on chemical reactions that take place in aqueous (water) solutions within the narrow range of temperatures that exist on earth.

It is very complex – but don't panic!

It is controlled/coordinated by large molecules – macromolecules – made up of long chains of subunits

Types of atoms

Matter is made of **elements** and the smallest particle of an element is an **atom**.

Atoms can be grouped in **molecules**

Cells are made of a few types of atoms.

Neutrons, protons and electrons

Atoms are made of a nucleus of positively charged **protons** and neutral **neutrons**.

This nucleus is surrounded by a "cloud" of negatively charged **electrons**.

Atoms are electrically neutral so the number of electrons is the same as the number of protons.

Neutrons contribute to the stability of an atom and if there are "too many" or "too few" (different isotopes) the atom may change by radioactive decay.

Atomic or molecular mass is the mass of that structure compared with that of hydrogen (1) e.g. carbon ¹²C.

One proton has a mass of $1/6 \times 10^{23}$ g so 1g of hydrogen has 6×10^{23} (Avagadro's number) atoms in it.

Ionic bonds and Covalent bonds

Electrons are often considered being contained in specific shells or orbits – those of you who did the astronomy course and understand quantum mechanics will know more about this.

There is a specific maximum number of electrons that can exist in each shell.

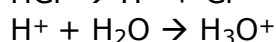
Electrons are most stable when they are in the most innermost shells possible.

However it is the case that many elements have outer shells that are not completely full.

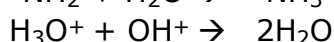
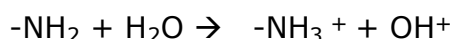
Since unfilled shells are less stable than filled ones, atoms with incomplete shells react with others to achieve completed outer shells either by transferring electrons or by sharing them. This is **chemical bonding**.

Acids and bases

Some polar substances form acids or bases in water. Acids release protons (Hydrogen ions) in water.



Bases remove protons in solution

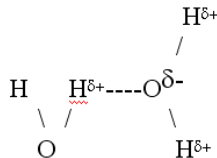


So the acid is neutralised. Look out for the -NH_2 or amine group.

Water

When atoms joined by a single covalent bond but the electrons are shared to a different extent a difference in charge results.

So in the water molecule there is a small negative charge at one end (around the oxygen atom) and a small positive charge at the other (around the hydrogen atoms). The dotted line represents a hydrogen bond between two molecules



Water is the most abundant compound >60% of organisms.

Small charges enable water molecules to adhere to one another and adhere to other molecules leading to surface tension.

Solvent and transport of soil minerals, products of photosynthesis, CO_2 in blood, O_2 and CO_2 at respiratory surfaces and chemicals inside the cell.

High Specific Heat capacity = 4 200 Joules/kg. $^\circ\text{C}$ i.e. large increases in heat energy vary the temperature of water rather little. So don't swim down at Sandbanks, go to the Maldives.

High heat of vaporisation used to provide cooling effect in sweating.

Highest density at 4 $^\circ\text{C}$. Ice destroys cells.

Source of hydrogen for photosynthesis.