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# BABS1201- Lecture Notes

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## Lecture 2- Life

Most abundant elements in the universe:

- Hydrogen, Helium (scarce on earth, used in helium balloons, medical imaging, coolant), oxygen, carbon

Elements of life

- Carbon, hydrogen, oxygen, nitrogen (DNA), phosphorus (sugar phosphate backbone of DNA), sulfur (amino acids)

### Water

Why do we need it?

- Most biological molecules assume their shapes and functions in response to the physical and chemical properties of water
- Medium for most biochemical reactions is water
- Reactions involving water comprise many of those that support life (metabolism)
- Living organisms are found anywhere water is found
- Proteins are mostly in water
  - Can look at their behaviour and function, e.g. movement of proteins to pores before cell division
  - Some are located within cell membranes so water is not there

Structure of water

- Two hydrogen atoms covalently bonded to an oxygen
  - Oxygen has more protons in the center, more electronegative than the hydrogen hence charge across the molecule is uneven
  - Polar molecule

Water cohesion and adhesion

- Capillary action is due to water molecules being attracted to each other (cohesion) as well as the walls of a vessel (adhesion).
- E.g. trees where evaporation leads to water loss to atmosphere where the water is pulled up from the roots due to adhesion and cohesion, defying gravity

Water tension

- Water molecules near the surface interact more with those below and adjacent to them
- Water at the surface cannot bond above hence more bonds are formed at the sides and below
- This means the surface forms a stronger network than water molecules distributed elsewhere
  - This can impact on the breathing of premature babies' due to surface tension in lungs

Solvent

- Dissolves more substances than any other liquid
- Hydrophobic
  - Fats and oils, (non-polar and are not attracted to water)
- Hydrophilic
  - Water loving
- Soaps have both ends allowing them to break up fat and oil

#### Density

- Needs a lot of thermal energy to heat as it has a high specificity (specific heat of water = 4.18)
  - Useful to dissipate heat as we sweat
- Water expands and floats as it freezes. Normally, solid forms are heavier than liquids

#### Amphoteric, (base and acid)

- Can be ionized
  - $H_2O \leftrightarrow H^+ + OH^-$
  - $2H_2O \leftrightarrow H_3O^+ + OH^-$

#### pH and the body

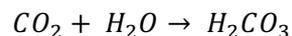
- Skeletal muscle can stop functioning correctly during extremely strenuous exercise due to a build-up of lactic acid which lowers the pH
- Coma can occur in untreated diabetic patients due to acidification of the blood by ketone bodies. Produced in starvation mode

#### Anaerobic metabolism: glucose → lactate → lactic acid

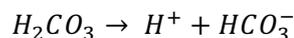
- The conversion of muscle glycogen to lactate generates ATP
  - Blood lactate rises
  - Release of  $H^+$  leading to a decrease in pH
  - Cannot be sustained in long runs as acidosis occurs

#### Water acidification

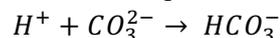
- $CO_2$  in atmosphere dissolves in the ocean, which reacts with water to form carbonic acid



- $H_2CO_3$  dissociates into  $H^+$  and bicarbonate ions



- The added  $H^+$  combines with  $CO_3^{2-}$  to form  $HCO_3^-$



- Less  $HCO_3^-$  is available for calcification → formation of calcium carbonate by marine organisms (i.e. corals)

