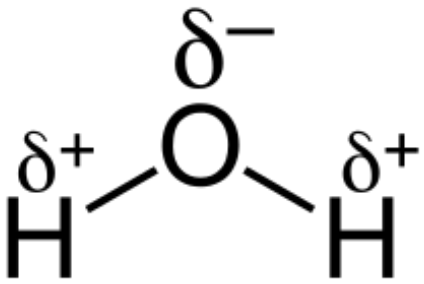
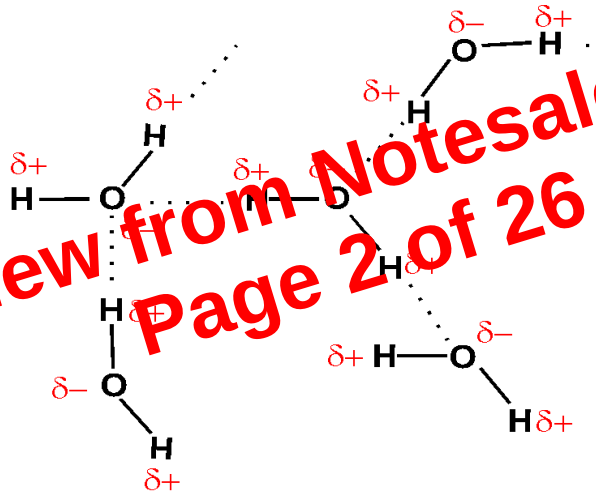
- Because the shared negative hydrogen electrons are pulled towards the oxygen atom, the other side of each hydrogen atom is left with a slight positive.
- The unshared negative electrons on the oxygen atom give it a slight negative charge.
- This makes water a polar molecule - it has a partial negative charge (δ-) on one side and a partial positive charge (δ+) on the other.



Hydrogen Bonding:

The slightly negative-charged oxygen atoms attract the slightly positively-charged hydrogen atoms of other water molecules. This attraction is called hydrogen bonding and it gives water some of its useful properties.



Properties of water:

High specific heat capacity:

- Hydrogen bonds give water a high specific heat capacity - this is the energy needed to raise 1g of a substance by $1^{O}C$
- The hydrogen bonds between water molecules can absorb a lot of energy.
- So water has a high specific heat capacity - it takes a lot of energy to heat it up
- This means water doesn't experience rapid temperature changes, which is one of the properties that makes it a good habitat - the temperature under water is likely to be more stable that it is on land.

(b) the concept of monomers and polymers and the importance of condensation and hydrolysis reactions in a range of biological molecules

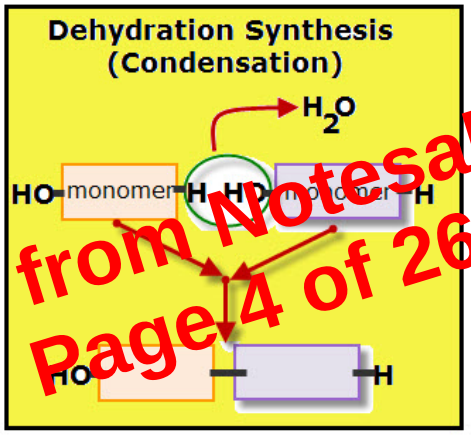
Macromolecules are polymers

Macromolecules:
- Macromolecules are complex molecules with a relatively large molecular mass. Examples of biological macromolecules include proteins, some carbohydrates and lipids.
- Polymers are a group of macromolecules.

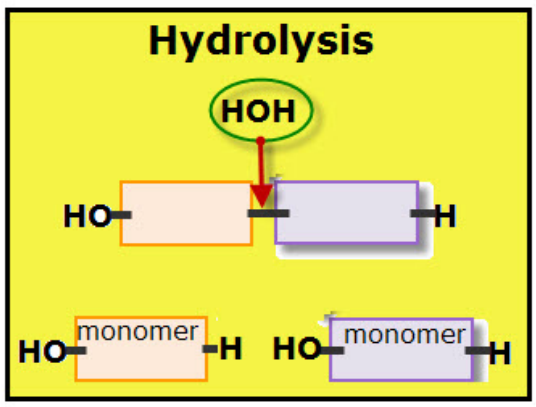
Polymers:
- Most carbohydrates and all proteins are polymers.
- Polymers are large, complex molecules composed of long chains of monomers joined together.
- Monomers are small, basic molecular units
- Examples of monomers include monosaccharides and amino acids

MONOMER + MONOMER + ... —> POLYMER

Making Polymers:
- Condensation Reactions occur between two monomers
- A condensation reaction forms a chemical bond, releasing a molecule of water



Breaking Polymers:
Hydrolysis reactions occur by adding a molecule of water in-between monomers.
There is a break in the chemical bonds between monomers and it uses a molecule of water



(g) how the structures and properties of glucose, starch, glycogen and cellulose molecules relate to their functions in living organisms

Functions of polysaccharides related to living organisms:

Starch:
- Consists of amylose and amylopectin
- Starch is insoluble in water which results in it not making water enter the cell via osmosis when it is present.

Amylose:
- Has its glycosidic bonds angled to give it a coiled shape, this is great for storage molecules as it means a lot of glucose can fit into a smaller space

Amylopectin:
- Has branches on it which means that enzymes can get down to the glycosidic bonds easily and break the polysaccharide apart to release glucose rapidly.
- This rapid release of glucose means that it is good for use in plants when energy is needed

Glycogen:
- It is very compact as well meaning that it can fit a lot of glucose into a compact area
- Has branded chains of which means again that the enzymes can get to the glycosidic bonds easily and can break down the polysaccharide to release glucose rapidly
- The rapid release of glucose is useful for if the organism requires energy fast.

Cellulose:
- Cellulose consists of chains of cellulose joined together by strong hydrogen bonds.
- These hydrogen bonds make cellulose very strong and stop enzymes from being able to get to the glycosidic bonds
- The strength of these bonds made this polysaccharide very strong and so useful for cell walls giving strength and rigidity.

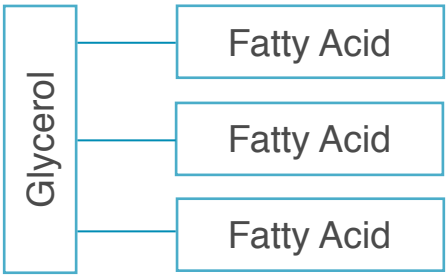
(h) the structure of a triglyceride and a phospholipid as examples of macromolecules. To include an outline of saturated and unsaturated fatty acids.

Lipids:
- Lipids are macromolecules (complex molecule with a large molecular mass)
- They all contain the chemical elements, Hydrogen, Carbon and Oxygen
- There are three types of lipid you need to know about - triglycerides, phospholipids and cholesterol

Triglycerides: (FATTY ACID ATTACHED TO GLYCEROL VIA ESTER BOND)
- Have one molecule of glycerol and three molecules of fatty acids attached on to it
- They're synthesised by the formation of an ester bond between each fatty acid and the glycerol molecule

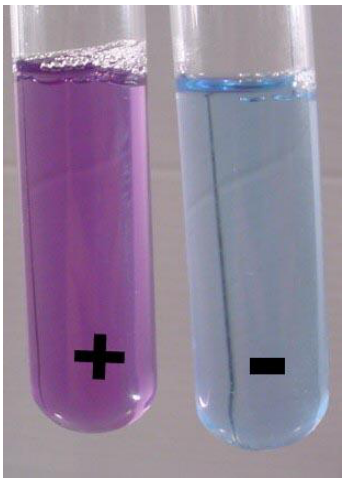
(i) the synthesis and breakdown of triglycerides by the forma on (esterification) and breakage of ester bonds between fatty acids and glycerol

Ester bond:
- One triglyceride has three ester bonds.
- Each ester bond is formed by a condensation reaction (where 1 molecule of water is related)
- The process in which triglycerides are synthesised is called ESTERIFICATION
- Triglycerides break down when the ester bonds are broken



(q) How to carry out and interpret the results of the following chemical tests:

- biuret test for proteins
- Benedict's test for reducing and non-reducing sugars
- reagent test strips for reducing sugars
- iodine test for starch
- emulsion test for lipids



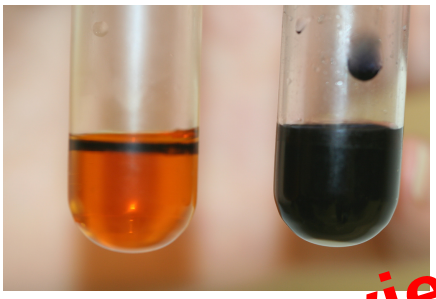
Biochemical Tests

The biuret test for proteins

Method:

1) The test solution needs to be alkaline, so first you add a few drops of sodium hydroxide solution
2) Then you add some copper(II) sulphate solution

- If protein is present then a colour change to Purple will occur
- If no protein is present then no colour change will occur, remaining in the blue colour.



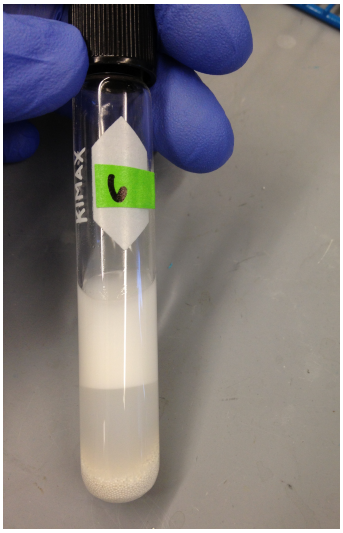
The iodine test for starch:

If you want to test for the presence of starch in a sample, you do the iodine test.

Method:

1) Add iodide dissolved in potassium iodide solution to the sample

•If starch is present then the sample will change colour from Browny-orange -> dark, blue-black colour



The emulsion test for lipids:

Method:

1) Shake the test sample with ethanol for about a minute
2) Then pour solution into water

- If lipid is present then the solution will turn milky (the more lipid the more precipitate)
- If no lipid then the solution will stay clear

The Benedict's test for sugars

Sugar is the general term for monosaccharides and disaccharides.
All sugars can be classed as either reducing or non-reducing.
To test the sugars present you use the Benedict's test.
the test differs depending on the type of sugar you are testing to.

Reducing sugars:

Include all monosaccharides (e.g. glucose) and some disaccharides (maltose and lactose)
Method:

1) Add Benedict's reagent to a sample and heat it in a water bath that has been brought to the boil