Summary of Week 3

Carbohydrates – diffusion and osmosis.
Lipids – fats and oils
Amino acids are the subunits of proteins.

General formula $Cx(H_20)y$. All are aldehydes (HC=O) or ketones (C=O) and all contain several hydroxyl groups (OH).

Monosaccharides = single sugar units. Triose = 3Cs, pentose = 5Cs and hexoses = 6Cs.

```
 H-C=O          1
     |
  H-C-OH        2
     |
HO-C-H          3
     |
 H-C-OH         4
     |
 H-C-OH         5
     |
 H-C-OH         6
   |
   H
```

Ring structure formed by **Oxygen bridge** between carbon 1 and 5 results in α and β isomers about carbon 1. In monomers these positions can change but when a bond forms they are fixed.
Some sugars only vary in the arrangement of their atoms

Condensation reactions join monosaccharides to make disaccharides. **Hydrolysis** breaks down disaccharides.
Sucrose is glucose and fructose joined.

Glucose
Transport in animals: source of energy in respiration: forms sucrose, maltose and lactose
Ribose
In RNA forms part of backbone of molecule, and in NAD, ATP
Deoxiribose
In DNA, as above
Fructose
Often found in fruit; component of sucrose
Galactose
Component of lactose
Sucrose
Transported in plants: stored in onion bulbs
Maltose
Breakdown product of starch by amylase
Lactose
Milk sugar, food for young mammals.

Where many monosaccharides are joined, a polysaccharide is formed –

Not soluble in water so have no **osmotic effect** and are therefore suitable for storage. Examples -
Starch is a alpha glucose polymer, major energy **store** in plants. It occurs in two forms with 1-4 glycosydic bonds (in amylose) with, in addition, 1-6 side chains (in amylopectin). Starch grains can be stored inside chloroplasts and the cells of storage organs like potatoes. Reversible reaction occurs with I/KI orange turns black.
Glycogen is a alpha glucose polymer found in animals and fungi. It is like amylopectin but more highly branched.

Cellulose is a polymer of beta glucose. Most abundant organic chemical 50% of all organic carbon in the biosphere. Forms 20-40% of cell wall. Chains of molecules linked by H-bonds

form microfibrils arranged in layers in a matrix. High tensile strength, permeable, **cellulase** for its digestion not present in mammals but is in bacteria in the gut of ruminants. Economically important in paper and cotton.
Chitin is structurally similar to cellulose and is an important component of the exoskeleton of Arthropods.

Mostly C and H, a little O, and P in Phospholipids. Chemically a mixed group. Made of fatty acids with carboxyl group (COOH) and the alcohol glycerol –

CH_2OH
|
CHOH
|
CH_2OH

The glycerol and fatty acids are combined by a condensation reaction called esterification. If three fatty acid chains combine with glycerol a triglyceride is formed.

Adipose tissue stores fats.

Lipids generate 300 **kJ/g**. (cf. sugar 170kJ/g) therefore is a good energy store. Fat is a good heat **insulator** and so is stored under the skin. Good store of **"metabolic" water**.
Phospholipids have a phosphate group instead of one fatty acid and are a component in cell surface membranes. Scan p. 60

Steroids

Ring structures that do not contain fatty acids, include vitamin D, sex hormones, cortisone. Cholesterol (a steroid alcohol) and is an important intermediate in the synthesis of other steroids.

The first double-bond kink in an omega-3 fatty acid occurs between the third and fourth carbon atoms away from the omega end (the end away from the acid group).

For an omega-6, between the sixth and seventh. And for omega-9, between the ninth and tenth.
The following simplified diagrams show the structure that is typical of omega-3s and omega-6s. These two fatty acids—alpha-linolenic acid (ALA, an omega-3) and linoleic acid (an omega-6)—are the two **essential fatty acids** that the human body needs and cannot manufacture.

27/170 **amino acids** occur in proteins, 20 commonly so. 9 are not able to be synthesised by animals and are therefore essential in the diet. Like sugars all amino acids (except which one?) exist as optical isomers (2 mirror images) only L forms are found in proteins, why? It's a mystery.**Dipeptides** form when a bond forms between NH_2 and COOH by condensation. Polypeptides are longer chains. Very long chains with a special cell function are proteins. The amino acid sequence is determined by the genes (base sequence) in DNA. The amino acid sequence determines the shape of the molecule and how it functions.

Primary structure of a protein is its amino acid sequence.
Many proteins then form a helix or a pleated structure, this represents the **secondary structure**
As well as this, some proteins are further folded into a globular shape, this represents the **tertiary structure**.
These "folds" are held in place by weak bonds e.g. hydrogen bonds
Finally some very complex proteins contain more than one folded chain, this represents the **quaternary structure**.

Denaturation of a protein is the loss of its 3D structure which will disrupt its function.
Heat energy disrupts H bonds, changes in pH disrupt ionic bonds, both cause coagulation i.e. what happens when you boil an egg. Changes caused by pH changes may be reversible.