**Glycolipids**

They are associations of lipids with carbohydrates. Carbohydrates form a polar head to the molecule (found in membranes)

**Steroids**

4 rings of C fused together. With functional groups.

Cholesterol is used to synthesise:
- Male and female sex hormones
- Aldosterone
- Cortisol
- Bile salts

**Vitamins**

(Fat soluble vitamins)

- Vitamin A: formed from β-carotene (found in green and yellow vegetables). Involved in reception of light in the eyes.
- Vitamin D: (found in fish liver oil, dairy products) produced by the action of sunlight on cholesterol-like compound in the skin. Regulates absorption of Ca\(^{2+}\) in intestine and deposition of Ca in the bones.
- Vitamin E: (found in brown flour, liver, green vegetables) protects the cell membranes
- Vitamin K: (found in green leafy plants) synthesised by bacteria present in the gut – essential for blood clotting.
Carbohydrates

Monosaccharides

Consists of one sugar molecule \((\text{CH}_2\text{O})_n\), it is soluble in water and they are all reducing sugars (give brick red precipitate with Benedict’s Test)

They have a backbone of 3-7 Carbons: trioses (3), tetroses (4), pentoses (5), hexoses (6), heptoses (7).

All C, expect one, have an OH group. The remaining C is an aldehyde (aldose) or a keto group (ketose).

- Glucose: \(\text{C}_6\text{H}_{12}\text{O}_6\)
  - Forms fructose and galactose (isomers)

  ![Glucose](image1)
  ![Fructose](image2)

  Ring structures are more stable, used to make disaccharides and polysaccharides. Glucose can exist in two forms: alpha (makes starch) and beta (makes cellulose).

Optical isomers: 4 different groups are attached to a C (asymmetric C). They are classified dextro and levo referring to the directions in which solutions of these compounds rotate the plane of polarising light.

D-isomer is what occurs in living things.

Functions:
- Broken down to release energy for cellular activity
- Linked to form disaccharides and polysaccharides
- Ribose and deoxyribose imp for DNA and RNA synthesis
- Ribulose biphosphate made from ribulose and \(\text{CO}_2\) acceptor in photosynthesis
- Triose sugars such as glyceraldehydes and dihydroxyacetone are intermediates in respiration and photosynthesis
2. Phosphate group (from phosphoric acid) which gives acidic character.

\[
\begin{align*}
\text{O} & \\
\text{HO-P-OH} & \\
\text{OH} & \\
\end{align*}
\]

3. A N-containing base

There are 5 different bases:
- 2 purines: adenine and guanine
- 3 pyrimidines: cytosine, thymine, and uracil

Sugar + base -> nucleoside + phosphoric acid -> nucleotide

condensation

condensation

2 nucleotides form a dinucleotide by condensation by a phosphodiester bond.