

## Summary of Week 4

Protein structure – again  
Some history  
Binding and Antibodies  
Separation of proteins  
Protein functions  
Protein machines and protein synthesis

**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**.

So because of the particular amino acid sequence proteins fold into a particular shape.

There are many thousands of different proteins in cells – though they aren't all made in all cells all the time (how come?)

Their shape enables them to carry out complex functions when they bind/join to other molecules in the cell.

These shapes are stable i.e. in the conditions in the cell they only form one particular shape though crucially this shape may change slightly when the protein reacts with another molecule. Before we can understand how genes work, how muscles contract, how embryos develop or how whole bodies function we must understand proteins

Side chains may also generate weak bonds that cause the folding of the protein molecule.

Sizes are from 30 to 10,000 **amino acids**, most are 50 – 2000.

A bacterial cell may produce 1000 different proteins, a human cell 10,000.

Because of their specific shape each protein only binds with a one (or very few) **ligands**

Binding is by **weak non-covalent bonds**

Where a protein and ligand join is called the binding site of the protein.

Antibodies or immunoglobulins are produced by the **immune system** in response to specific foreign molecules like those on the surface of **pathogenic bacteria**.

Antibodies bind to specific **antigens**.

Antibody proteins have many loops which are ideal for “grasping” molecules as they allow lots of chemical groups to surround the ligand with the potential for many weak bonds to form.

Gel electrophoresis allows proteins to be separated by size.

pH can also separate them.

Combine the techniques and you have 2D techniques

Lysozyme kills bacteria in tears and by breaking down polysaccharides in the cell wall of bacteria (remember the reaction?) causing them to burst (why? Hint osmosis).

Lysozyme reduces the **activation energy** required to break the sugar (glycosidic) bond. So it acts as a **catalyst** to speed up a reaction.

Lysozyme can bind to 6 linked sugars at the same time.

The polysaccharide is the **substrate** and an **enzyme-substrate complex** is formed on binding.

The enzyme releases the changed substrate - **product** - after hydrolysis.

So then the enzyme molecule is free to work again.

**Proteins often form large complexes called protein machines.** e.g. ribosomes which control protein synthesis which is the next topic – except that we need to understand DNA and RNA first!