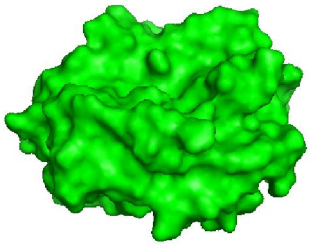
TB2 - Enzyme Specificity

ENZYMES AS GLOBULAR PROTEINS

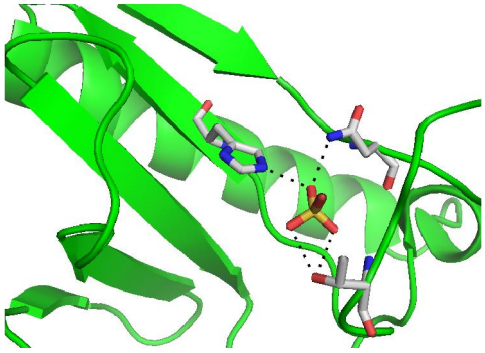


Proteins can exist in two general forms, **fibrous** or **globular**. **Enzymes** are a specific type of globular protein, ones which are roughly spherical. This structure allows the protein to fold into a ball-like shape, and helps create an active site on the protein surface. Such as in the protein shown, 5dj7_Globular_Protein.

THE CATALYTIC TRIAD

The **active site** of an enzyme is made from the polypeptide chain arranged in a **specific** way, which is **complementary** to the **substrate**. This polypeptide is itself a series of amino acids, and it is these amino acids which interact with the substrate in the **catalysis** reaction. One of the benefits of having a range of **20** different amino acids, is that the active site can be **tailored** to specific substrates. Each amino acid has slightly different properties and chemical functions. Not only can we classify amino acids on their properties, such as acidity, basicity, nucleophilicity, polarity, hydrophobicity etc., but we can also further differentiate them by size and structure.

One common feature in active sites is the **catalytic triad**. This is a set of three amino acids which work together in the active site to catalyse the reaction. A common set contains one **acidic**, one **basic**, and one **nucleophilic** amino acid. By utilising the different types of amino acids, the enzyme can initiate a series of chemical reactions with the substrate molecule. If we were to perform a similar reaction in the lab, then we would have to do it in very discrete stages, or else the acid and the base would react with each other, and then this would affect the nucleophile, creating a messy reaction. Because the catalytic triad has the three different types of residues which are needed in the chosen reaction, it can perform a clean reaction, very fast, and much easier than otherwise. This is how an enzyme can catalyse a reaction – it provides an **alternative reaction pathway**, which has a **lower activation energy**.



3oj7_Catalytic_Triad. The three amino acids in the triad are clearly visible. They hold the sulfate ion in place.

SPECIFICITY VS. SELECTIVITY

It is worth considering the difference between a reaction which shows specificity, against one which is selective. **Specificity** refers to a reaction where **only one reaction** can happen. So, if an enzyme is specific, then it will only catalyse one specific reaction. This is often important as enzymes tend to have a high degree of specificity, due to the structure of their active sites, which only allow specifically complementary substrates to react.

Selectivity is a different concept, where a **reaction is favoured over another one**. This can happen with some enzymes which are **promiscuous**, i.e. enzymes which can **catalyse multiple reactions**. Some enzymes can catalyse slightly different reactions, but will selective favour the catalysis of one of those over the others.

Produced by Adam Stubbs at Newcastle University as part of a summer outreach project.